AN EPIDEMIOLOGICAL INVESTIGATION OF FOOD-BORNE DISEASE SURVEILLANCE IN THE NCERA VILLAGES, EASTERN CAPE, SOUTH AFRICA

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Dissertation submitted in fulfilment of the requirements for the Masters for Health Science Degree in Environmental Health in the Faculty of Health Sciences at the Durban University of Technology.

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DECLARATION

This is to certify that this work is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Durban University of Technology or to any other institution for assessment or for any other purpose.

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ABSTRACT

An increase in food-borne disease burden in the world's population has raised concerns over the reliability of surveillance systems. Research has shown the importance of food-borne surveillance systems used in the detection and management of food-borne illness. Government fiscals are increasingly burdened by the rapid spread of food-borne illness, although the exact economic impact is unclear in many countries. In recent years, food security has been the main agenda overshadowing food safety. A reactional approach to outbreaks is the trend instead of proactive systems. Food-borne disease is associated with low and high socio-economic status populations. More than 30 pathogens were identified as the major causes of food-borne outbreaks globally, and some food-borne pathogens have long term health consequences.

Aim: The aim of the study was to investigate food-borne diseases surveillance in Ncera, Mpongo and Needscamp villages and local clinics, in the Eastern Cape, South Africa.

Methodology: A retrospective, observational, quantitative study was conducted in two phases. The first phase included the screening of tick registers at Ncera, Mpongo and Needscamp clinics. The screening was to determine the number of food-borne cases that were reported at these clinics. In the second phase, a stratified random sampling method was used to interview 90 households from the above-mentioned villages to determine the number of villagers who suffered from food-borne diseases, symptoms experienced and food safety practices. Results from both phases were compared to determine whether the number of reported cases at the clinics reflected the same number of cases in the villages from 2012 to 2014. The total size of the study population was 5007 people. Respondents were invited to participate having signed informed consent. Data was summarised and described using descriptive statistics such as frequencies, means and standard deviations. Data was analysed using SPSS version 23; cross tabulations and Chi-square tests at a probability of $p< 0.05$ were done. Graphs and tables were used to graphically represent the data.

Results: It was found that the majority of household heads were female (*n* = 51; 58.6%) and 33 (37.9%) of them were married. Most of the residents (*n* = 84; 96.5%) use the public health clinics for their medical condition treatment. Fifty-six (64.4%) household heads were HIV negative. The majority of households had a monthly income of R1 500 – R 3 500 (*n* = 45; 51.7). Less than a tenth (*n* = 6; 6.9%) of household heads were very concerned about the safety of food prepared at home. The relationship between food safety concern levels about food prepared at home and away from home was statistically significant (*p* = 0.000), reporting a significant difference in the way people perceive the preparation of food at home and away from home. More than a tenth of the villagers (*n* = 79; 19.7%) reported through the questionnaire, that they fell ill or thought that they fell ill from something they ate in the past 3 months. More than half (*n* = 56; 51.3%) of the participants who fell ill with food-borne diseases in these villages did not seek medical treatment for their illness whilst 6 (54.6%) did not see the need to seek medical treatment and reported that they got ill during weekends. Of those who sought medical treatment, 16 (39%) received prescribed medication while 3 (7%) reported that they were not provided with medication by healthcare providers when they suffered from food-borne illness. More than a quarter (*n* = 109; 27.3%) of household members fell ill from food-borne diseases in Ncera, Mpongo and Needscamp villages during the period 2012 to 2014. Whereas there were four food-borne cases reported to the clinics in the same period.

Conclusion: This research gathered information regarding food-borne disease prevalence in Ncera, Mpongo and Needscamp villages. It was observed that there is a gap in the surveillance of food-borne illness in these villages. In some of the tick registers used by healthcare providers at clinics to collect data, vital surveillance information such as gender, age and diagnosis was missing. This study deepens the understanding of food-borne illness and food safety in a village setting.

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Finally, this work is intended to contribute to the betterment of humanity, and that is where I will derive my satisfaction.

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GLOSSARY OF TERMS

Communicable Disease: An infectious disease (spread from person to person) either by direct contact with an affected individual or indirect by a vector.

Notifiable Disease: Any disease that is required by law to be reported to government authorities. The collation of information allows the authorities to monitor the disease and provide early warning of possible outbreaks.

Public Health: The science of protecting the safety and improving the health of communities through education, policy making research for disease and injury prevention.

Food safety: A science discipline describing handling, preparation, and storage of food in ways that prevent food-borne illness.

Food handler: A person who, in the course of his or her normal routine work, comes into contact with food not intended for his or her personal use.

Food premises: A building, structure, stall or other similar structure; it may include a caravan, vehicle, stand or place used for / or in connection with the handling of food.

Epidemiological surveillance: The continuous, systematic collection, analysis and interpretation of health related data needed for the planning, implementation and evaluation of public health practice.

Foodstuff:	Any article or substance (except a drug as defined in the Drugs Control Act No. 101 of 1965) ordinarily consumed by humans.
Food-borne disease:	An illness caused by the consumption of food or water contaminated with bacteria and / or their toxins, with parasites, viruses or chemicals.
Index case:	The initial patient in the population of an epidemiological investigation.
Head of Household:	A status held by the person in a household who is running the household and looking after qualified dependent/s.
Tick register:	Is a special book that contains information about people diagnosed with a specific type of disease, used by healthcare providers during consultation with patients.

ACRONYMS

BCMHD:	Buffalo City Metro Health District
BCMM:	Buffalo City Metropolitan Municipality
CDC:	Centers of Disease Control and Prevention
CIDTs:	Culture Independent Diagnostic Tests
CIFOR:	Council to Improve Food-borne Outbreak Response
CPA:	Consumer protection Act 68 of 2008
CSPI:	Center of Science in the public Interest
DAFF	Department of Agriculture, Forestry and Fisheries
DHIS:	District Health Information System
DOH:	Department of Health
DTI:	Department of Trade and Industry
EFSA:	European Food Safety Authority
EHNNS:	Environmental Health National Norms and Standards
EHP:	Environmental Health Practitioner
FACS:	Food Advisory Consumer Service
FAO:	Food and Agriculture Organisation
FCD:	Foodstuff, Cosmetics and Disinfectants Act 54 of 1972
FDA:	Food and Drug Administration
FSANZ:	Food Standards Australia New Zealand
FSN:	Food Safety Newsletter
FSSC:	Food Safety System Certification 22000
HACCP:	Hazardous Analysis Critical Control Point
HPA:	Health Professions Act 56 of 1974
IHR:	International Health Regulation
ISO:	International Standard Organization
MSA:	Meat Safety Act 40 of 2000
NEHP:	National Environmental Health policy 2013
NFSAPR:	The National Food Safety Alert Policy and official food product recall
NHA:	National Health Act 61 of 2003
NHLS:	National health laboratory Services
NICD:	National Institute for Communicable Disease
NSNP:	National School Nutrition Program

SFI:	Safe Food International
UK:	United Kingdom
UN:	United Nations
USA:	United States of America
WHA:	World Health Assembly
WHO:	World Health Organisation

CHAPTER 1: INTRODUCTION

1.1 Background

The World Health Organization (WHO) (2016) stated that food-borne diseases remain a major public health concern. In the United States of America (USA), it is estimated that 48 million people get ill from food-borne diseases (Centers of Disease Control and Prevention, 2016). In Africa, it is estimated that 92 million fall ill and 137 000 die each year (WHO, 2015). The WHO (2015) latest findings revealed that millions of people worldwide are suffering from food-borne disease, and 420 000 die as a result. The figures include 582 million cases of 22 different diseases experienced in 2010 (WHO, 2016). Food-borne disease can be caused by bacteria, parasites, toxins and viruses. Amongst the common pathogens are *Salmonella* and *Escherichia coli* which account for 52 000 and 37 000 deaths, respectively (WHO, 2016). Efforts have been done to investigate food-borne disease; however, below 50% of all causes of outbreaks are identified (Taege, 2010). Research indicates that most food-borne cases are not reported to health facilities (Department of Health, 2009).

Furthermore, literature suggests that some of the leading contributors to the emergence of food-borne diseases in Africa are poor sanitation and non-reporting of suspected food-borne cases worldwide. Lack of infrastructure, poor knowledge of hygiene and practices in food establishments are contributors to outbreaks of food-borne illnesses (Kibret & Abera, 2012).

1.2 Food safety challenges in Africa

Food safety is not synonymous with food quality, although there might be an overlap. Quality includes a product's natural attributes that satisfy consumption standards and influence its value to consumers, whereas safety includes all measures intended to protect human health (Nelson, 2005). Food safety impacts on food security, political instability and food-borne disease in Africa (Food and Agriculture Organization, 2005). Practises directed at improving food safety also reduce food losses and increase

availability (FAO, 2005). While persons suffering from communicable diseases such as tuberculosis, malaria and other ailments are vulnerable to unsafe food (WHO, 2007). Most food-borne diseases in low and middle income countries are assumed to be caused by fresh, perishable foods sold in informal markets (Grace, 2015). Food-borne disease is likely to increase in low and middle income countries due to huge consumption of risky food such as uninspected meat of livestock and fish products as well as fresh produce (Uyttendaele, Franz & Schluter, 2016). A survey that was conducted in Belgium indicated that the lack of food safety knowledge, agricultural policies, appropriate legislation and enforcement by African governments are factors that impact on food safety (Uyttendaele, De Boeck & Jacxsens, 2016).

The technical limitations of the food safety systems in Africa are a continuous challenge in meeting food safety requirements. Lamuka (2015) stated that the change from end product testing to process based quality management, which shifts the primary responsibility of food safety management from government to the industry is a problem. The focus is to ensure that the end product complies with regulation and fair business practice, while food safety may be compromised in the process flow (Mensah *et al.*, 2012). It reduces governments only to act as auditors of the industry's food safety programs. Literature suggests that consumers in African countries face a higher level of exposure to unsafe foods (Lamuka, 2015).

A food safety situational analysis in nine countries was conducted by different authorities (Figure 1.1). In Ghana, the food supply chain was generally not regulated and there was no traceability. There is a need to improve inspection by health officials and laboratory services (Dedeh, 2009). Mali is regarded as an emerging food producing country. However, there is a need for social innovation based on the empowerment of primary food producers for sustainability and safe food (Cheng, Mantovani & Frazzoli, 2016). Kenya experienced major problems of non-compliance with basic food safety and agricultural health practices in local markets since the level of awareness of these practices among small producers is negligible (Jeo, 2010). Barungi (2010) argues that in Uganda, the food safety system is disorganised. Uganda has a multi-agency system where food safety, quality and infrastructure are

fragmented. The battle in Cote d ‘Ivoire, which ended in 2007 has greatly affected the regular maintenance of water supply infrastructure, resulting in poor sanitation and lack of potable water. This had a direct adverse impact on food safety especially in the Northern parts of the country (UNICEF, 2008). Mozambique, like most sub-Saharan African countries, depends largely on sustainable agriculture. An intergovernmental project aimed at strengthening controls of food safety threats, as well as plant and animal pests and diseases to improve agricultural productivity and trade in Southern Africa, was launched in Mozambique (FAO, 2015). It is reported that Tanzania experienced an acute shortage of food safety and consumer protection inspectors. There are approximately 17 food laws and 250 food standards while there was no national food safety policy which guides and synchronize the implementation of all food legislation in Tanzania (Mirondo, 2015).

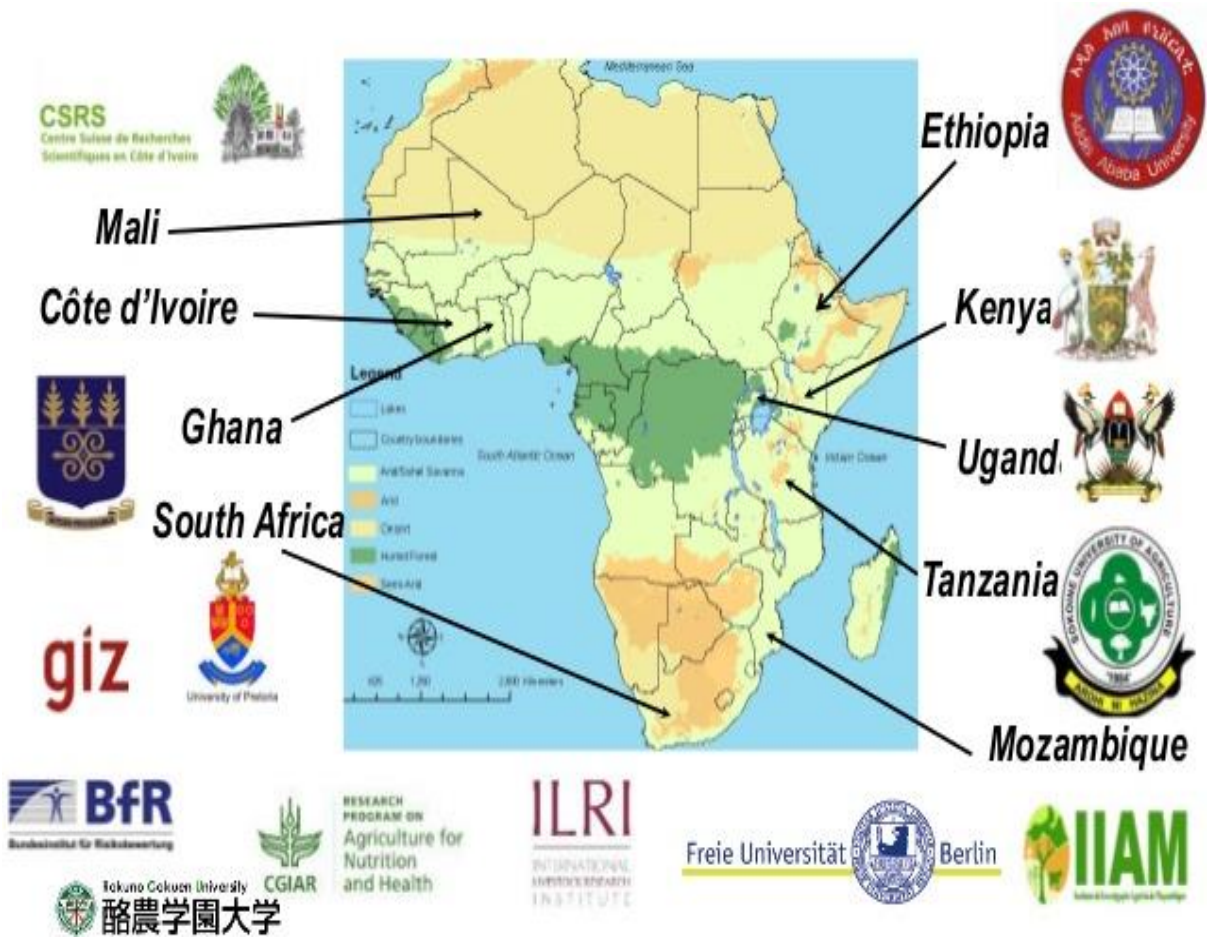

Figure 1.1: Food safety analyses in Africa (Grace *et al.*, 2014).

Food safety implies the absence of harmful agents in food or acceptable and safe levels of contaminants, adulterants or any substance that causes food to pose a health threat on an acute and chronic basis (Lamuka, 2015). Food security is achieved when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food (FAO, 2005). It is rather paradoxical to discuss food safety and security (Figure 1.2) in Africa, especially in Ethiopia where millions lacked food. Both shortage and lack of appropriate food safety assurance systems are problems that have become obstacles to the Ethiopian economic development (Ayalew, Birhanu & Asrade, 2013). In Tanzania, it was found that food standards can lead to an increase in food security and safety.

Reports indicate that supermarkets introduced private quality standards which resulted in higher food prices that were assumed to exclude poor households from benefiting from the high quality food (Fabe, Oelze & Grote, 2015). Belluco *et al.,* (2013) stated that the increasing world population worsens serious problems related to food security in developing countries. On the other hand, in industrialized countries, where the problem of food security is of minor concern, health problems related to food refer to two main factors: food safety; and environmental sustainability of food production. For these reasons, new ways must be found to increase yields while preserving food quality. Belluco *et al.,* (2013) further suggested that insects could be of great interest as a possible solution due to their capability to satisfy two different requirements: (i) they are an important source of protein and other nutrients; (ii) their use as food has ecological advantages over conventional meat and, in the long run, economic benefits. However, little is known on the food safety side, and this can be of critical importance to meet society's approval, especially if people are not accustomed to eating insects.

In South Africa, all the rural provinces are beneficiaries of the National School Nutrition Programme that feeds children at schools in order to alleviate hunger and improve the capacity to learn, but schools in these provinces have high food-borne disease outbreaks, including boarding schools (Nhlapo, Lues & Groenewald, 2014).

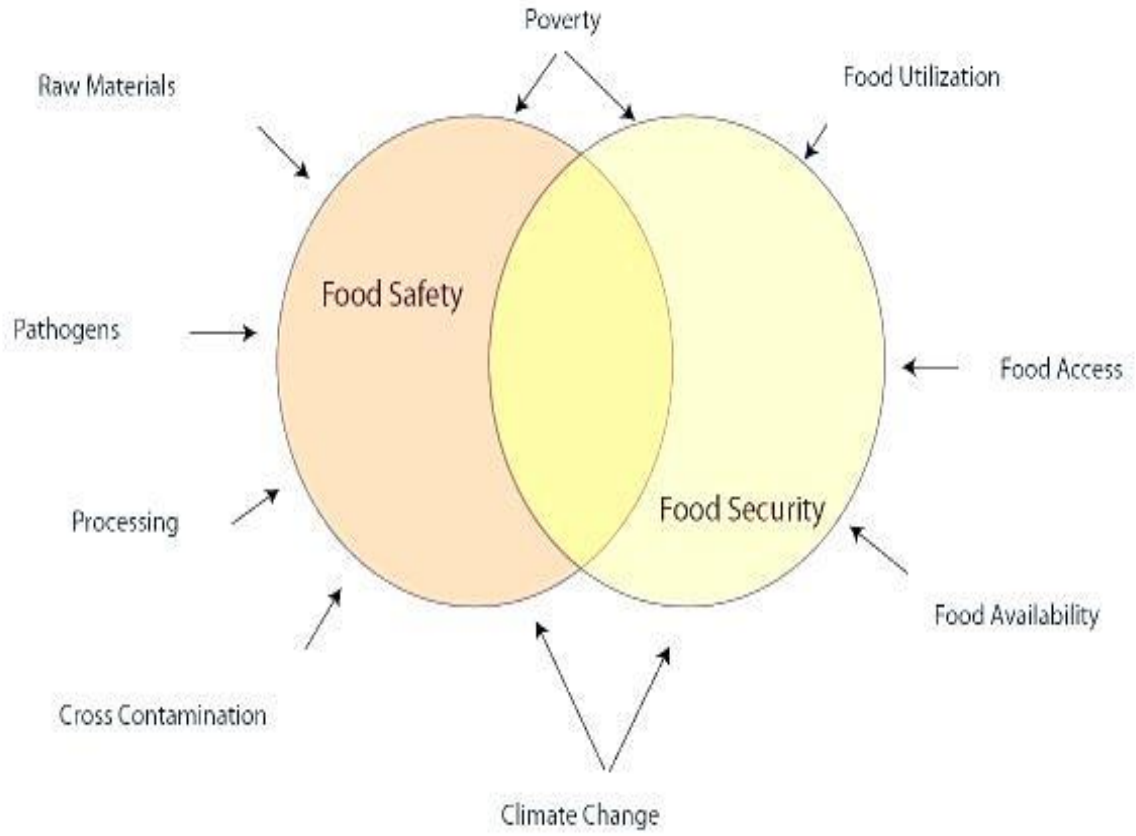

Figure 1.2: Interrelationships of food safety and food security (Nature Education, 2012).

Smith *et al.,* (2007) reported that outbreaks of food-borne disease in humans are common in South Africa but rarely reported. Korsten (2016) stated that South Africa does not have adequate capacity to forecast and track a food-borne disease case. The expert further reported that the provision of quality produce to poor communities remains the biggest challenge to food safety, and lack of an independent regulatory body to ensure food safety further compounds concern around the level of toxins in some food. According to the DoH, DTI and DAFF report (2013), challenges of food safety in South Africa include lack of political and technical structures in the coordination of functions, as well as duplication and unclear or conflicting jurisdiction of functions within involved government departments. Lack of an integrated strategy on National food audits and food laboratory networks with a mandate for food safety remains a challenge.

Routine health surveillance indicates that sanitation poses a major health problem in Ncera, Mpongo and Needscamp villages. There are four categories of food-borne disease surveillance, namely: no formal system; syndromic surveillance; laboratory-based surveillance and integrated food chain surveillance (Mensah *et al.,* 2012). This study seeks to explore the food-borne disease surveillance system that is used in South Africa.

South Africa is experiencing an urban influx due to large scale rural – urban migration (Van der Merwe, 2011). This global demographic trend results in complex food supply systems, including a distribution chain which involves wholesalers, intermediaries, distributors and street vendors. Such a distribution chain has the potential of increasing the price of food and contamination which has a negative consequence to the urban poor communities (Van der Merwe, 2011). The global average price of food was 25% higher in December 2010 than in December 2009 (National Agricultural Marketing Council, 2012).

In terms of the National Policy on Food and Nutrition Security (2013), the current food safety and quality control systems in South Africa are fragmented, with different

agencies administering the implementation of various regulations determined by different pieces of legislation. Custodians include:

- The Department of Health (Food Inspection Services);
- The Department of Agriculture, Forestry and Fisheries (Perishable Products Export Control Board); and
- The Department of Trade and Industry (South African Bureau of Standards).

The policy, therefore, proposes the formation of a centralised food safety and quality controlling system for South Africa, including the creation of a body that will amalgamate different entities responsible for implementing food safety regulations.

Subsequent to the horse meat scandal in 2013, the joint sitting of Parliament instructed the DoH, Department of Trade and Industry (DTI) and Department of Agriculture, Forestry and Fisheries (DAFF) to draft an action plan to strengthen food control in South Africa. The DoH is required to audit and provide support to local authorities (Municipal Health Services) in order to ensure food control and food safety (National Health Act 61 of 2003) (NHA).

Local Government is regarded as the first line of service in many countries; this is where the implementation of intervention strategies takes place for various community needs, including food safety audits by Health officials (FAO, 2005). The WHO norm for staffing stipulated a ratio of one Environmental Health Practitioner per 10 000 population (Agenbag, 2008). However, the National Environmental Health Policy (2013) adopted one Environmental Health Practitioner (EHP) per 15 000 population. Although the government provides an equitable share to local authorities, in many municipalities, this ratio is not achieved causing poor coverage in terms of environmental health services which include food safety monitoring in communities, particularly those in rural settings (Agenbag & Balfour-Kaipa, 2012). Haynes (2004) showed that in the 2002/3 fiscal year, R393 million was spent in the whole country on Municipal Health Services.

1.3 Research problem

The surveillance of food-borne disease is a critical component of food safety at community level. The food-borne disease outbreaks that have been reported by the media, prior being detected by the epidemiological surveillance system which is in place in the Buffalo City Metro Health District (BCMHD), have raised alarm on the accuracy of the surveillance system.

The BCMHD health information system (2015) which captures data from clinics and hospitals in the district indicated that there were no reported food-borne cases in Ncera, Mpongo and Needscamp villages from the period 2012 to 2014. There were, however, sporadic cases of food-borne illnesses reported by private medical practitioners in the same region, thus suggesting a possible non-reporting of food-borne cases in these villages. This phenomenon necessitated the epidemiological investigation of food-borne diseases in these villages from the 2012 to 2014.

1.4 Aim and Objectives of the study

The aim of the study was to investigate the surveillance of food-borne diseases in Ncera, Mpongo and Needscamp villages and local clinics, in the Eastern Cape, South Africa.

The objectives of the study are:

- To determine the prevalence of food-borne disease from clinic records during the period 2012 to 2014;
- To determine the prevalence of food-borne disease from village residents;
- To determine the community's level of understanding of food-borne illness through a self-administered questionnaire; and
- To identify the reasons for not seeking medical help and for not reporting food-borne illnesses in these communities via a self-administered questionnaire.

1.5 Hypothesis of the study

There is prevalence of food-borne disease in Ncera, Mpongo and Needscamp villages but villagers do not report food-borne ilnesses.

1.6 Significance of the study

This is a first epidemiological investigation of food-borne diseases conducted in Ncera, Mpongo and Needs camp villages. It comes after WHO had declared Food Safety as the theme of the World Health Day in 2015 in order to increase awareness on food-borne diseases (WHO, 2015). Furthermore, food-borne outbreaks are common in the African region, especially among village consumers. Food-borne disease remains a public health concern (Grace, 2015; WHO, 2017).

The findings of this study will thus contribute in the identification of deficiencies of the current food-borne surveillance system that is used in the BCMHD and the empowerment of health professionals and communities with best practices in terms of food-borne surveillance and food safety matters. This study will deduce recommendations that would improve food-borne disease surveillance when implemented at provincial and district level.

1.7 Methods

A retrospective, observational and quantitative study design was followed. It sought to investigate the prevalence of food-borne disease in Ncera, Mpongo and Needscamp villages in Buffalo City Metropolitan Municipality (BCMM) in the Eastern Cape Province. The self-administered questionnaire and the data analysis methods were subjected to a focus group of experts in the field of study. This exercise culminated in numerous adjustments and changes.

The first phase included the screening of available data at the clinics. The tick registers in these clinics, Mpongo (119), Ncera (124) and Needscamp (135) were sourced for

the periods 2012 to 2014. The second phase was to randomly survey the residents of these villages through a self-administered questionnaire which consisted of demographical and food safety questions. The questionnaires comprised of 39 questions in total. The data was analysed using SPSS version 23, cross-tabulations and the Chi-square tests were conducted.

1.8 The area of study

The study was conducted in BCMM in the Eastern Cape Province of South Africa. Buffalo City Metropolitan Municipality has a relatively small economy; it contributes 1.7% to the South African economy and 21.2% to the Eastern Cape economy. The illiteracy rate in BCMM is high, with over 12% of the population being functionally illiterate (BCMM Annual Report, 2016).

The target villages were IsiXhosa speaking households that are situated approximately 50 kilometres away from East London with a population size of 5007 consisting of 2115 households (Statistics South Africa, 2011). The community stakeholders, upon consultation, indicated that people do not go to clinics if they suspect food related ailments. According to Frean (2010), it is mandatory to report food-borne cases to the health facility in South Africa; however, many cases go unreported and unrecorded.

1.9 Structure of the Dissertation

Chapter 1: This chapter covers the background of the study, which includes the introduction, the background information about the research problem, statement of the research problem, aim of the study, significance of the study and the structure of the dissertation.

Chapter 2: This chapter focuses on the literature review addressing the food-borne disease burden. The critical analysis and synthesis of literature related to food safety and food-borne disease surveillance in different countries are addressed.

Chapter 3: This chapter presents the research design, methods, sampling, population of the study, data collection process, method, data analysis, validity reliability, accuracy and ethical consideration of the study.

Chapter 4: This chapter presents the data, together with a description of the research findings which include steps taken in analysing the information and its categorisation.

Chapter 5: Discussion of the research findings on the themes that emerged during the analysis and the limitations thereafter is done.

Chapter 6: Conclusions and recommendations are presented in this final chapter.

1.10 Conclusion

This study examined the existing epidemiological surveillance system in the BCMHD in order to improve and strengthen the surveillance of food-borne disease in the district, using the quantitative research approach. There are limited studies that are similar to this one which have been conducted in South Africa to determine different variables from those that are explored in this research. The resultant outcomes of this study will benefit the villagers and government through updated information. Recommendations will be made to the provincial Department of Health to improve and manage food-borne surveillance in the BCMHD. This study is in line with the Sustainable Development Goal three and the South African Government National Developmental Plan 2030, which seeks to realise a good health and healthy environment for all citizens through research and improve the lives of all South Africans despite their economic background.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The search engines google and google scholar were used in this study. The key words that were used include: food-borne disease; food-borne pathogen surveillance; food-borne outbreaks burden; and food safety internationally in Africa, South Africa and the Eastern Cape Province.

2.1.1 Contextual framework of food poisoning

Food poisoning is an illness caused by the consumption of food or water contaminated with bacteria or their toxins, or with parasites, viruses or chemicals (Fasoro *et al.,* 2016). It is diagnosed when there is an acute intestinal disease acquired by consuming contaminated food or water, inclusive of juice and wine (Malangu, 2016). Food spoilage and *food poisoning* are two different food conditions. Food spoilage is a metabolic process that causes food to be undesirable for human consumption due to changes in observable characteristics. Such food may not cause illness because there are no pathogens or toxins present, but changes in texture, smell, taste, or appearance causes it to be rejected. Some ecologists have suggested these noxious smells are produced by microbes to repulse large animals, thereby keeping the food resource for themselves (Rawat, 2015). According to Jarvie (2015), food spoilage is caused by yeasts, moulds, fungi or bacteria. Furthermore, spoiled food will not cause illness, since food spoilage organisms do not cause life-threating infections. However, food poisoning pathogens will cause illness and possible death. The inability to smell or see or detect the pathogenic bacterium in spoiled food makes it risky to consume (Magoulas, 2016).

Food allergy is an abnormal response to a particular food, triggered by the body's immune system. Allergic reaction to food can cause serious illness and death (Foodsafety.gov, 2015). In view of the above food safety conditions and other

related factors, health researchers are arguing that the ambiguity of the term *food poisoning* will hamper surveillance, as it may confuse citizens. The North Carolina Public Health (2017) refers to the term *food poisoning* as misleading, since it groups all food-related illnesses by symptoms, rather than by the pathogen that causes the illness such as a toxin, bacteria or virus. The Food and Drug Administration (2012) stated that the terms *food-borne illness* and *food poisoning* are often used interchangeably by consumers. However, both have different meanings. *Food-borne illness* is an infection that results from eating food contaminated with viable (live) microorganisms or their toxins and also includes allergic reactions and other conditions, where foods act as a carrier of the allergen. *Food poisoning* is a form of food-borne illness caused by the ingestion of toxins.

Food borne illnesses are classified into two broad groups, namely, intoxication and infection. Intoxication is caused by ingestion of toxin produced by pathogens, while infection is caused by ingestion of food containing viable pathogens. Toxins can be present even where the bacteria or other causative agents are not, and it is possible to develop food intoxication by eating animals that have consumed toxin-producing organisms (Addis & Sisay, 2015).

2.1.2 Global overview of the impact of food-borne diseases and surveillance

One in ten people in the world fall ill after consumption of contaminated food, with the highest burden in Africa, followed by South – East Asia, and Europe has the lowest burden of food-borne diseases, globally (WHO, 2015). According to the WHO's report (2016), 420 000 people die as a result of ingestion of contaminated food. Of these deaths, 30% represents children under the age of 5 years, despite them making up only 9% of the world's population. Although the burden of food-borne disease is worldwide, but particularly high in low-income regions of the world (WHO, 2015), although Newman *et al.,* (2015) argues that people from low socioeconomic status are associated with safer food handling and preparation. This is possibly due to individuals from lower socioeconomic status groups who are likely to work or have worked in food-preparation or other related industries in which they received specific hygiene instruction.

Nutrition, food safety and food security are intertwined (WHO, 2015). Private dwellings were reported to be the most common places of food contamination (Baumann & Sadkowska, 2007). The Food Safety News (2013) reported that poor nutrition and less access to healthcare leads to a greater likelihood of bacterial and viral infections, including food-borne illness among low-income children. Whereas literature suggests that high socio-economic status groups are associated with increased incidence of *Campylobacter* (Figure 2.1) and *Salmonella* (Newman *et al.*, 2015).

In New Zealand, *Campylobacter* (Figure 2.1), is an important priority food-borne pathogen of concern, and their target is to reduce the number of human cases of food-borne campylobacteriosis to 10% by 2020 (Lopez *et al.,* 2016). In Israel, during 2013, the *Campylobacter* bacterium was reported to be responsible for 8 000 cases of food-borne illness. The report estimated that for every reported case of food-borne diseases, there are between five and 10 unreported ones (Times of Israel, 2016). In Australia, a study found that most food-borne illness occurred as gastroenteritis, but the effect of non-gastrointestinal illnesses and sequelae were substantial. Kirk *et al*., (2014) stated that salmonellosis and campylobacteriosis increased from 2000 to 2010 this was associated with hospitalization. According to WHO (2000), Iceland reported a total of 687 cases while 674 laboratory-confirmed food-borne disease cases were notified in 1999 and 2000 respectively.

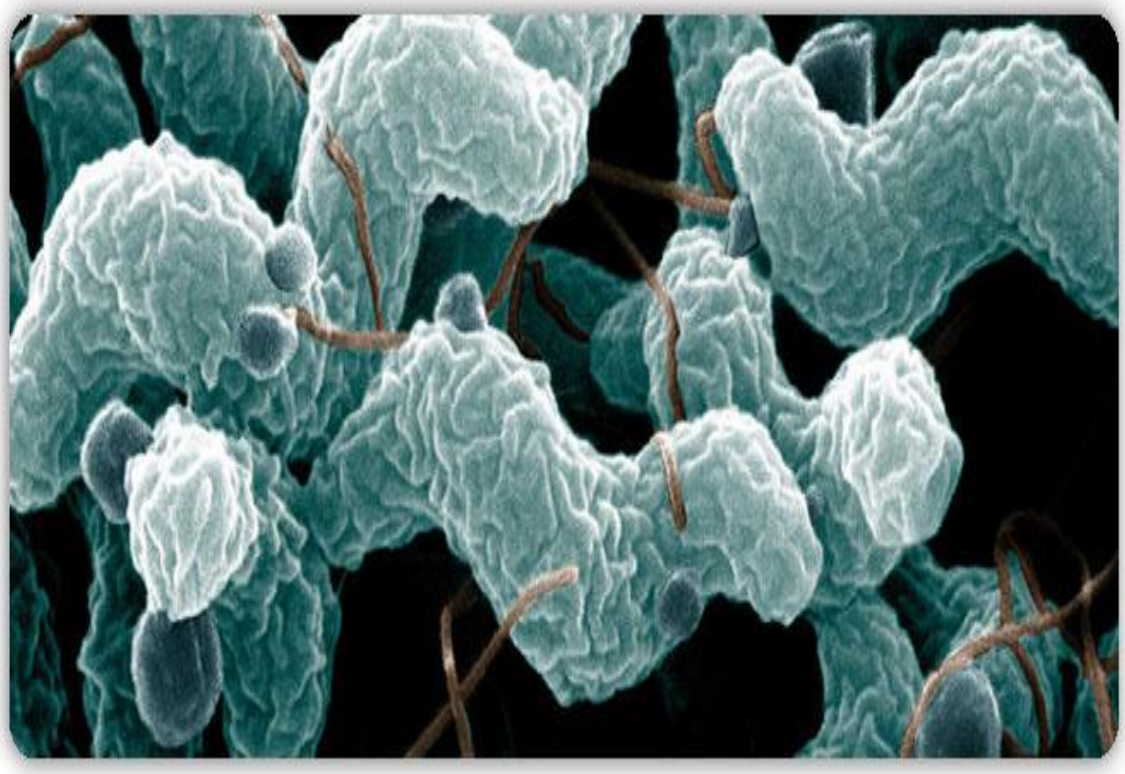

Figure 2.1: The *Campylobacter jejuni* (University of Leicester, 2017).

In 1999, 63% of the laboratory-confirmed notified cases were that of *Campylobacter*, followed by *Salmonella*, which was responsible for 25% for the laboratory confirmed notified cases. In 2000, salmonellosis accounted for 54% of the laboratory confirmed notified cases and campylobacteriosis for 36% of cases. Food-borne illness in South Korea was estimated at 336 138 cases, with hospitalized patients, outpatient visits (foodborne disease infections), and patients' experiences (without visiting physicians) accounting for 2.3%, 14.4% and 83.3%, respectively (Park *et al.,* 2015). Contaminated food was estimated to be responsible for 30 840 gastroenteritis-associated hospitalisations. Food-borne diseases affect an estimated 4.1 million Australians each year (Kirk, 2014). As reported by Hajar (2013), in the USA, there are annually about 76 million food-borne cases with 3 000 deaths, due to food-borne diseases. In Malaysia, this number appears to be lower than the United Kingdom (UK), USA and Australia, but this may be due to a large number of cases being unreported (Soon, Singh & Baines, 2011). A study by Soon *et al.,* (2011) revealed that in Malaysia, the main contributing factor to foodborne diseases was identified as insanitary food handling procedures which accounted for more than 50% of the poisoning episodes.

Bezirtzoglou and Stavropoulou (2011) suggest that Malaysia is one of the countries that could have high cases of food-borne diseases due to the high ambient temperatures which make the conditions ideal for bacterial growth. Food-borne diseases are under-reported in Morocco and in many other countries; these diseases are reported in extreme cases only (Food Advisory Consumer Service, 2009). China reported 31.1% of food-borne cases caused by *Vibrio parahaemolyticus* and 17.9% caused by *Salmonella and* the most dangerous foods are meat and seafood products. Cooked meat and seafood obtained from farmers' markets are more susceptible to contamination compared to those from supermarkets in China (Zhang *et al.,* 2016).

A study that was conducted in Greece used the available food-borne surveillance data from a hospital and found that food-borne disease was responsible for 70% of disability-adjusted life years. These findings indicated the value of accurate data for

future studies and interventions (Gkogka *et al.,* 2011). According to Iwamoto *et al.,* (2010), the prevention of seafood-associated infections requires an understanding not only of the etiologic agents and seafood commodities associated with illness but also of the mechanisms of contamination that are amenable to control. Ritter and Tondo (2014) stated that in Brazil, most food-borne illnesses are caused *by Salmonella*, *Staphylococcus aureus* and *Escherichia coli.* This led to the development of a risk-based evaluation tool able to asses and grade Brazilian food services in cities that were going to host the FIFA World Cup. The tool was used by the Brazilian sanitary surveillance officers during the inspection of food premises.

The use of good practices in the production and conservation of food is essential to ensure that food is fit for consumption. A study that was conducted in France revealed that retiring workers in the food industry were linked to the dramatic increase of food-borne illnesses, from 624 in 2004 to 1 320 in 2013 (Rothman, 2015).

In 2011, Dubai undertook the first food-borne disease investigation and surveillance system and it revealed 1 663 cases reported in the first nine months but in 2013, there were only 518 confirmed cases of food-borne diseases in Dubai (Khaleej Times, 2014). A study in Catalonia, Spain, reported that there were 181 reported food-borne outbreaks from October 2004 to October 2005. The report further revealed that Norovirus are under-reported compared to bacterial outbreaks (Martinez *et al.,* 2008). In Italy, a protracted outbreak of listeriosis due to serotype was experienced from January 2015 to February 2016. Further findings suggested that this outbreak was associated with a contaminated pork product (Marini *et* al., 2016). It is estimated that 1.6 million people acquire food-borne illness each year in Canada (Thomas *et al.,* 2013).

Botulism is a major public health problem in Argentina and has been recognized since 1922, when the first outbreak was reported in Mendoza. Between 1992 and 2004, forty-one food-borne botulism cases were reported and the cause in each was related to improper storage of food (Rebagliati *et al.,* 2009). Food handlers play

a major role in the prevention of food-borne illnesses. Fifty-nine percent of the 27 food-borne outbreaks studied by Delegado de Saúde Concelhio (local health authority) in Portugal during 2002 were reported within 72 hours after the date of onset. Five hundred and seventy-seven people became ill, 9.6% of the patients were admitted to hospital and no deaths were reported (Correia, Gonçalves & Saraiva, 2004). A total of 394 food-borne infections and intoxications involving 5 838 cases were reported in Poland. The main vehicle of these cases was food prepared from various raw materials of animal sources and meals prepared from milk and eggs.

There are less known long-term consequences of contracting food-borne disease, including reactive arthritis, urinary tract problems and damage to the eyes. This follows *Salmonella* and *Shigella* infections, kidney failure and diabetes after infection with *Escherichia coli* (McKenna, 2012). A research study by Walkerton Health found that that between 5% and 30% of patients who suffer an acute episode of infectious gastroenteritis develop chronic gastrointestinal symptoms despite clearance of the inciting pathogens (Clark, Macnab & Sontrop, 2008). Many consumers have instituted lawsuits against food companies after contracting food-borne disease from food, and in the near future, National Health Departments may suffer the same for failing to ensure food safety (Winters, 2012).

The potential impact of food-borne outbreaks on a food business can be devastating (Hussain & Dawson, 2013). According to Roberts (2000), a number of economists estimate the costs of the intervention in a food-borne outbreak, while others trace out the costs beyond the health sector and few project the costs to encompass the long-term consequence of the illness. In the USA, it was estimated that cases of food-borne illnesses resulted in $5–17 billion in economic and productivity losses annually (Scharff, 2012). Nevertheless, the importance of food-borne diseases as a public health problem is often overlooked because the true incidence is difficult to evaluate while the severity of the health and economic impact is often not fully understood (Hussain & Dawson, 2013).

In Africa, more than 91 million people are estimated to contract food-borne diseases, resulting in 137 000 deaths each year (WHO, 2015). Some food safety experts allege that in Africa, approximately 2 000 people die from food-borne diseases each day (Taege, 2010). Malangu (2016) argues that food-borne diseases can be measured in terms of morbidity and mortality; nevertheless, due to lack of population based data, it is impossible to estimate the mortality rate resulting from food-borne diseases in Africa. Although literature indicates that a large number of African rural communities have no epidemiological data on food-borne disease outbreaks, some African states are beginning to embark on longitudinal solutions for food safety, in conjunction with food security (Fasoro *et al.,* 2016). Sokheng (2014) reported that two Cambodian soldiers who were on peacekeeping mission in Mali died after they consumed contaminated food. Furthermore, more than 2 200 students experienced similar symptoms after consuming school lunches in the Southern province of Soha in Mali.

Infants, young children, pregnant women and those with other underlying illnesses are particularly vulnerable to food-borne diseases (Food Safety Newsletter, 2015). *Vibrio cholerae*, the microbe that causes cholera, caused 709 deaths in 13 African countries from January to May 2015. *Staphylococcus typhi* has reportedly caused 19 824 illnesses and nine deaths in four African countries in the same time period (Food Safety Newsletter (2015). In 2011, 19 people died of food-borne diseases and 7 died of suspected food-diseases in Nigeria and Ghana, respectively (Safe Food International, 2011). A study that was conducted in Nigeria identified practices that contribute to food-borne outbreaks; these include improper refrigeration, prolonged handling and inadequate reheating of cooked food and contamination of food by commercial or household food handlers who prepare meals while sick or practiced poor personal hygiene. Ten students were immediately ill and then hospitalized after consuming cooked cassava in Nigeria (Promed, 2015; Fasoro *et al.,* 2016).

The lack of data as a result of poor reporting of food-borne diseases is affecting the epidemiological surveillance of food-borne illnesses worldwide (Miyagishima, Abela-Ridder & Savelli, 2013). Data limitation and availability on food-borne illness in countries was highlighted in the first WHO estimate of the burden of food-borne

disease report (WHO, 2015), which led the researchers to present the estimates in regions instead of each member country. An effective epidemiological surveillance for food-borne illness led to better management and control of food-borne incidence. According to the Food Advisory Consumer Service (2009), effective epidemiological surveillance and reporting systems in developed countries have made people aware of the dangers of food-borne diseases and also of preventative measures. Therefore, reporting a suspected food-borne case by the infected person is paramount in any country. Among other things, it will inform the countries' planning and budgeting in line with the international food security agenda (Crush & Frayne, 2011).

The WHO developed a working document called 'five keys to safer food manual' that is aimed at preventing the rise in food-borne diseases through health and hygiene education in the world. The manual summarizes the core message of food safety; which is to keep clean, separate raw and cooked food, cook thoroughly, keep food at safe temperatures and use safe water and raw materials (WHO, 2006).

In a study by Pelzer (2011), it is reported that while rural communities become larger and transport more accessible, food that was grown or processed at one point and shipped to another increases risks of contamination. Urbanisation of rural areas, although vital for the economic growth of any city, may also pose health problems. In many African states, such as Kenya, Nigeria and Morocco, street and school food vendors form an integral part of the food supply chain.

In South Africa, this sector is confronted with many challenges. There is inadequate supervision and proper monitoring by EHPs, lack of training on food safety principles, storage at improper temperature and preparation of meals in unhygienic surroundings. These factors increase the risk of food contamination (Okojie & Isah, 2014). Furthermore, some food premises neglect the importance of hygiene and sanitation, thus increasing the risk of food-borne illness among consumers (Campos *et al.,* 2009). In terms of the Environmental Health National Norms and Standards (EHNNS) (2013), all high risk food handling premises should be inspected once in three months in order to identify, control and prevent food contamination. Prevention should be at the centre

of all environmental health actions. Prevention also needs to address both adverse environmental health practices as well as adverse behaviour for an improved environment and healthier lifestyles.

2.1.3 Food-borne disease surveillance systems

Food-borne surveillance is the systematic collection, analysis and interpretation of data essential to planning, implementation and evaluation of public health practice and the timely dissemination of this information for public health action (WHO, 2017). However, Mensah *et al.,* (2012) suggest that most food safety programmes and food safety systems remain fragmented, thus resulting in duplication of efforts. Unlike food-monitoring programs, which seek to identify problems in food production and corrective measures, surveillance seeks to determine the causative agents to increase knowledge about them. However, food-borne disease surveillance cannot prevent the index case, it increases the chances of identifying an index case or outbreak early (Council to Improve Food-borne Outbreak Response, 2014).

There is an epidemiological challenge when estimating the economic burden of food-borne disease, which will give a clear picture of the extent of the problem. The challenge is the estimation of the annual number of illnesses caused by a particular pathogen in a particular region or country. This is a challenge because unknown proportions of ill people do not consult with a doctor or visit a healthcare facility, many visits go undiagnosed because the specimen is not obtained, or the laboratory testing does not seek to report nor identify the causative agent as shown in Figure 2.2 (Buzby & Roberts 2009).

Improved food surveillance systems are associated with early detection of food-borne cases and result in a reduction of food-borne outbreaks. A study that was conducted in the USA reported that the number of food-borne disease outbreaks reported declined substantially in 2009 when the surveillance system was upgraded (Imanishi *at el.,* 2014). The Centers for Disease Control and Prevention (CDC) (CDC, 2016) stated that surveillance systems are used worldwide to provide information about the occurrence of the food-borne disease Moreover, surveillance systems are traditionally

passive, which means that under-reporting is a major drawback for data analysis and interpretation (Rocourt *at el.,* 2003). In another study in Brazil, Carneiro *et al.,* (2014) reported that there is an urgent need for a better reporting and monitoring system as well as better food safety procedures that are important for the control of food-borne infectious diseases. Diarrhoea is one of the symptoms of food-borne illness. Although most people regard diarrhoea as a temporary inconvenience rather than a symptom of disease, the vast majority of diarrhoeal episodes do not result in a visit to a physician, even though the person may be incapacitated for several days (WHO, 2016).

Literature indicates that surveillance statistics reflect a fraction of cases that occur in the community. Each surveillance system plays a vital role in detecting and preventing food-borne disease and outbreaks (CDC, 2011). Figure 2.2 illustrates the steps that must occur for a person who becomes ill to be identified as a laboratory-confirmed case that is reported to health surveillance in South Africa. In the USA, specialised and specific food-borne disease surveillance exists. These systems encourage sectoral collaboration for a common course, which is to protect public health (CDC, 2011). According to Adokiya *et al.,* (2015), the use of a centralized electronic disease surveillance system has improved food-borne disease surveillance and outbreak detection by data management, improving communication and data sharing with stakeholders in developed countries.

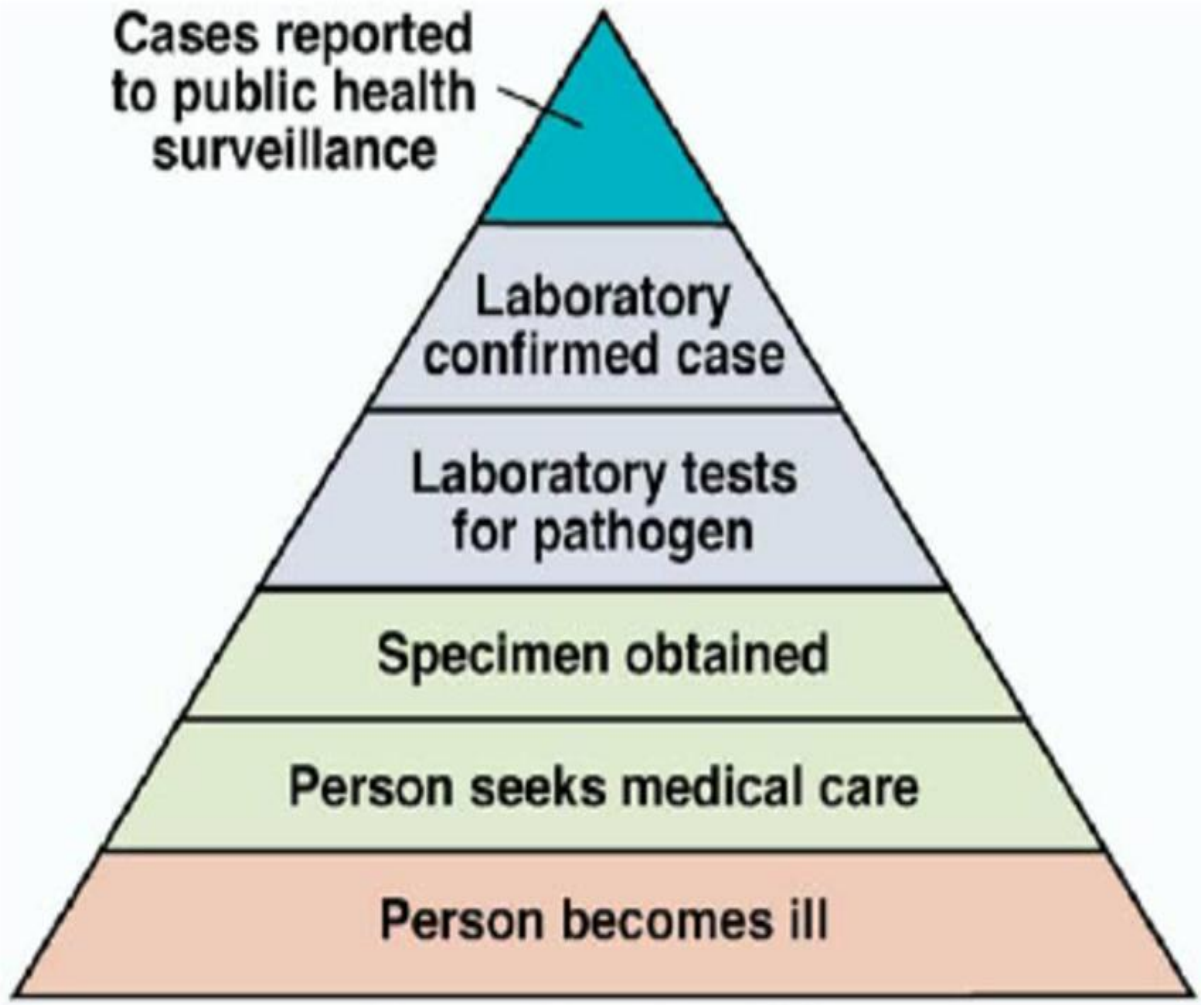

Figure 2.2: Food-disease surveillance pyramid (Buzby & Roberts, 2009).

2.1.3.1 International surveillance system overview

The National Notifiable Disease Surveillance System (NNDSS) is a multifaceted program from the USA. It includes surveillance systems for collection, analysis, and sharing health data. It is a nationwide collaboration that enables all levels of public health, local, state, territorial and international structures to share notifiable disease related health information; public health practitioners then use this data to monitor, control and prevent the occurrence of notifiable communicable and non-communicable disease (CDC, 2016). The NNDSS is a traditional food control system which is used for health surveillance in South African. Data is collected from the health facilities by health officials on the individual cases they suspect and laboratory confirmed cases as required by law. This information is then sent to the national health department office for record keeping and support. Health officials in municipal health are notified in order to conduct further investigation for confirmed cases. This system is regarded as passive and does not focus on preventive programs. It relies on the reports of primary health care officials and is susceptible to under-recognition and under-reporting (Ayalew *et al.,* 2013).

The National Antimicrobial Resistance Monitoring System (NARMS) is used in the USA and UK. It conducts surveillance to determine antimicrobial resistance among food-borne bacteria in humans from retail meat and animals. It enhances collaboration between the Agricultural sector and Public Health to detect, respond to and prevent antimicrobial resistance pathogens. The development of resistance to various medicines poses a serious public health threat (Food and Drug Administration, 2016). An antimicrobial resistance strategy framework to detect, manage and prevention emerging pathogens was formulated in South Africa, which includes improved patient outcomes and vaccination (Mendelson & Matsoso, 2015).

The National Electronic Norovirus Outbreak Network (CaliciNet) is used in the USA. The system participates in public health laboratories and uses standardized laboratory protocols to examine the genetic make-up of norovirus strains that are associated with gastroenteritis. These laboratories electronically submit laboratory data, including

genetic sequences of norovirus strains, and basic epidemiologic data from outbreaks to the CaliciNet database. Outbreak strains are compared with existing norovirus sequences in the database, thus helping CDC link outbreaks to a common source, such as contaminated food (CDC, 2015). However, this system is not used in South Africa.

National Molecular Subtyping Network for Food-borne Disease Surveillance (PulseNet) system is used in the USA. It involves Agriculture, federal laboratories and states who use standardized methods to perform pulse-field gel electrophoresis on food-borne bacterial pathogens. It has revolutionized the detection and investigation of food-borne disease outbreaks, especially those occurring in multiple sites in the USA (CDC, 2015). However, this system is not used in South Africa.

The National Outbreak Reporting System NORS is used in the USA. It collects reports of food-borne outbreaks due to enteric bacterial, viral, parasitic and chemical agents. A designated team conducts analyses of these reports to improve an understanding of the human health impact of food-borne outbreaks and the pathogens involved (CDC, 2015). However, this system is not used in South Africa.

Contributing factor Surveillance - Environmental Health Specialist Network (EHS-Net) system is used in the USA. The system gathers information from investigators in state and local public health agencies about contributing factors in food-borne outbreaks through environmental assessments. It requires a systemic description of what happened and how events most likely unfolded in an outbreak (CDC, 2000). However, this system is not used in South Africa.

The Laboratory-base Enteric Disease Surveillance (LEDS) system is used in the USA. This system collects reports of laboratory-confirmed human infections of *Salmonella*, *Shigella* and *Escherichia coli* isolates from state public health laboratories. In the USA, the number of laboratory-confirmed human *Salmonella* isolates reported to LEDS was less than 20% of the number of salmonellosis cases reported to the NNDSS (CDC,

2011). This system is used in South Africa where all confirmed cases in laboratories are collected and analysed to construct prevention modules and strategies.

Food-borne disease Notification and Complaints System is used in the USA. The system receives triages and responds to reports from the community about the possible food-borne disease events. In a study conducted by Li (2010), 70% of foodborne outbreaks detected solely through the complaint system were detected through a single complaint. Of outbreaks detected through a single complaint, 87% of complainants reported illness in multiple households, and 13% of complainants reported illness in a single household. However, this system is not used in South Africa.

The syndromic surveillance system is used in the USA. This is a fairly new surveillance method and has not been adapted for enteric disease surveillance. It is pre-clinical (i.e., not dependant on access to health care) and clinical pre-diagnostic (i.e., does not rely on laboratory confirmation and therefore takes less time) (CIFOR, 2014). The syndromic surveillance systems seek to use existing health data in real time to provide immediate analysis and feedback to those charged with investigation and follow-up of potential outbreaks (Henning, 2004). However, this system does not exist in South Africa.

The pathogen-specific surveillance system is used in the UK. It systemically collects analyses and disseminates information about the specific pathogen and laboratory-confirmed illnesses or well defined syndromes as part of prevention and control activities (CIFOR, 2009). A study on specific pathogen surveillance systems in seven European member states revealed that millions of illnesses occur annually in the European population, leading to thousands of hospitalizations; use of data on the healthcare system in these states in relation to pathogen characteristics that influences healthcare seeking is vital for prevention (Haagsma *et al.,* 2013). However, this system does not exist in South Africa.

2.2 Food-borne disease cases in South Africa

According to Statistics South Africa (2011), 5% of deaths in 2010 were caused by food-borne diseases. Many school children have suffered food-borne disease in different provinces in South Africa as reported by the media (News24, 2015). The Eastern Cape, KwaZulu-Natal and Limpopo provinces are amongst the beneficiaries of the National School Nutrition Programme that feeds children at schools in order to alleviate hunger and improve the capacity to learn, but schools in these provinces had high food-borne outbreaks (Nhlapo, Lues & Groenewald, 2014). Meanwhile, Smith (2013) argues that improper storage, food preparation methods, improper cleaning and poor sanitary practices that exist in schools may result in the deterioration of nutrients and subsequent illness.

In addition, Khanum and Pal (2013) suggest that it is widely accepted that many cases of food-borne illness occur as a result of improper handling and preparation of food by consumers in their own kitchens. A study by Painter *et al.,* (2013) estimated the percentage of outbreaks per selected food items, including dairy, eggs, beef, game, pork and poultry. The report indicated that fresh produce commodities (fruits and nuts) accounted for 46% of illnesses whilst plant commodities accounted for 42% of illness and meat-poultry commodities (beef, game, pork, and poultry) accounted for 22%. Land animal commodities were responsible for 6% of sicknesses. Among the commodities, more illnesses were associated with leafy vegetables. Leafy greens remain one of the most relevant crops in fresh produce, with an increasing production of bagged salads. The selection of water sources and use of water treatment, may improve the safety of fresh produce drastically (Uyttendaele *et al.,* 2016).

As a result of the rampant poverty in the country and in terms of the Agenda 21, the South African Government adopted a Reconstruction and Development Programme (RDP) as its national strategy to combat poverty and unemployment. Several policies have been developed which take poverty issues into consideration, such as the policy for Social Welfare, the Water Supply and Sanitation policy, and the National Water Policy. One of the RDP goals was to establishing a social security system and other

safety nets to protect the poor, disabled, elderly and other vulnerable groups. The NSNP is one program which seeks to enhance the social security of vulnerable groups, in this case, poor pupils (Koch, 2011).

Bundy *et al.,* (2009) concur that the school feeding scheme is now clearly evident as a major social programme in most countries, with a global turnover in excess of $US 100 billion. Furthermore, school feeding programmes increase school attendance, cognition and educational achievement. Ndebele (2009), from the National Department of Education, stated that volunteers in the NSNP will be trained on health and hygiene standards. It is not clear how this training has unfolded throughout the feeding schools in South Africa.

Figure 2.3 illustrates pupils vacating the school premises after a food-borne outbreak at St Mathews boarding School. It is unknown whether these outbreaks are due to the food received from the Nutrition Programme. Nhlapo (2013) found that the lack of proper kitchen facilities and ventilation and shortage of foodstuffs and utensils while administering the National School Nutrition Program (NSNP) were the main challenges observed during a study in Bloemfontein. This meant that these schools were not compliant with the South Africa health and hygiene regulations.

Figure 2.3: St Mathews School closed after 60 food-borne cases were reported (Kimberley, 2012).

In the Eastern Cape, in King Williams Town, there were 1 000 pupils admitted at the Bhisho hospital after consuming food from the nutrition program in October 2016, which led to a non-compliant dairy closure in the region (Dispatchlive, 2016). More than 70 pupils from Kei Road Primary School in Komga suffered from food-borne illness (Dayimani, 2016). In Mitchells Plain, Cape Town, it was reported that a child died and a man was in a critical condition while three other children were all in a serious condition after consuming contaminated food (News24, 2017). More than 70 people were treated after they suffered from food-borne illness at the Aldam resort in Ventersburg, Free State (News24, 2016). Peddie and Idutywa are both small towns in the Eastern Cape where 18 school children and 34 villagers were hospitalized due to food-borne diseases in February and March 2015 (Dispatchlive, 2015). A primary school in the same province had more than 100 pupils hospitalized in November 2014, due to food-borne diseases (NICD, 2014). In the North West, Bojanala district approximately 279 learners fell ill after consuming a meal prepared at the school in October 2014 (NICD, 2014).

An outbreak of food-borne Salmonellosis in KwaZulu-Natal resulted in 216 villagers admitted to a rural hospital in KwaZulu-Natal after consuming a meal at a school function (Niehaus *et al.,* 2011). In Pietermaritzburg, KwaZulu-Natal, there were 56 children hospitalized after presenting with food-borne disease symptoms (News24, 2015). In Gauteng, one of the 26 boarders at the Aurora Comprehensive School died due to a suspected food-borne outbreak in April 2013. Three children died due to suspected food-borne disease after eating at Ema Primary School in Johannesburg in September 2014 (eNCA, 2014). Meanwhile, a secondary school in Ekurhuleni had 82 pupils treated for food-borne illness at Pholosong Hospital in July 2016 (Gauteng Department of Health, 2016).

Timeslive (2017) reported that chicken and milk that was not stored properly were suspected to be the sources of food-borne illness that claimed the life of one elderly person and caused 58 others to fall ill at Port Elizabeth's frail home. In Limpopo, funeral attendees in Tshivhilwi village contracted food-borne diseases in June 2010

(NICD, 2010). A *Staphylococci* food-borne illness outbreak occurred after patients consumed a hotel meal in the same province in May 2015 (NICD, 2015).

A study by Lund & O'Brien (2011) reported that food-borne cases can be prevented, thereby protecting the vulnerable groups in society. The study further recommended that food handlers should have on-going training and instruction in the importance of personal hygiene and hand washing and there should be regular assessment of knowledge and practice. In terms of regulation 962 of 2012 promulgated under the Foodstuffs, Cosmetics and Disinfectant Act (FCD) (1972), the food control function is the competency of designated local authorities and it includes the promotion of safe transportation, handling, storage and preparation of foodstuffs used in the Primary and High School Nutrition programme, Prisons, Health establishments and airports.

2.2.1 Toxic Fungi in Food

It is widely reported that fungi are major plant pathogens that produce mycotoxins that are versatile and potent causes of disease (Bennett & Klich, 2003). Fungal contamination of food is rarely recognized as a cause of food-borne disease. The number of people affected by mycoses and mycotoxicosis is unknown. Fungal diseases are nevertheless a serious international health problem (Bennett & Klich, 2003). Mycotoxins can cause acute and chronic illnesses i.e. induce cancer and damage vital organs (Schardl, Panaccione & Tudzynski, 2006). However, Young (2016) argued that fungi are not the cause of the cancerous condition but are the evidence of cells and tissues biologically transforming from a healthy state into an unhealthy state. Mycotoxins thrive in acidic conditions. Therefore, over-acidification of the body leads to the development of chronic fungal infections and ultimately a cancerous condition of the cells and tissues.

A study by Bouakline *et al.,* (2000) showed that food is a potential source of fungal exposure in patients with blood conditions like anaemia, which made them more susceptible to infection. The report further proposed that the catering process in haematology wards should include the sterilization of foods and dishes, listing of banned foods as patients in these wards have compromised immune systems, and

compliance with procedures for disinfection of individual packaging. High-quality and varied meals are important for the patient's health. This should be balanced against the accompanying risk of fungal infection.

Lee *et al.,* (2014) recently conducted a study which revealed that commercial yogurts contaminated with *Mucor circinelloides* (fungal pathogen) were sold in the USA, and approximately 200 consumers became ill with nausea, vomiting and diarrhoea. The study further alluded that fungal infections have increased and fungal pathogens, as food-borne pathogens, have been neglected compared to other well-known food-borne pathogens.

Figure 2.4 shows a common toxic fungus, (*Rhizopus stolonifer*) found in most households. There are approximately 300 different mycotoxins, with a dozen known to be threats to human and animal health (Zain, 2011). Human exposure to mycotoxins may result from consumption of plant-derived foods that are contaminated with toxins as well as the carry-over of mycotoxins in animal products such as meat and eggs. Mycotoxin contamination of agricultural products still occurs in the developed world, however, Milićević, Škrinjar and Baltić (2010) reported that the application of modern agricultural practices and the presence of a legislatively regulated food processing and marketing system have greatly reduced mycotoxin exposure in developed countries. According to Zain (2011), it is difficult to prove that a disease is a mycotoxicosis, and moulds may also be present without producing any toxin.

Figure 2.4: Common *Rhizopus stolonifer* on bread (Parkins, 2017).

Figure 2.5 shows the chemical structure of mycotoxins in food. Mycotoxins are secondary metabolites produced by micro-fungi that are capable of causing disease and death in humans and other animals (Vasatkova *et al.,* 2009). However, Theodora (2016) argued that these mycotoxins are usually ingested with food or inhaled and can be absorbed through the skin. Furthermore, Theodora (2016) stated that mycotoxins are the most hazardous of all food contaminants and can have long-term cumulative effects on human health.

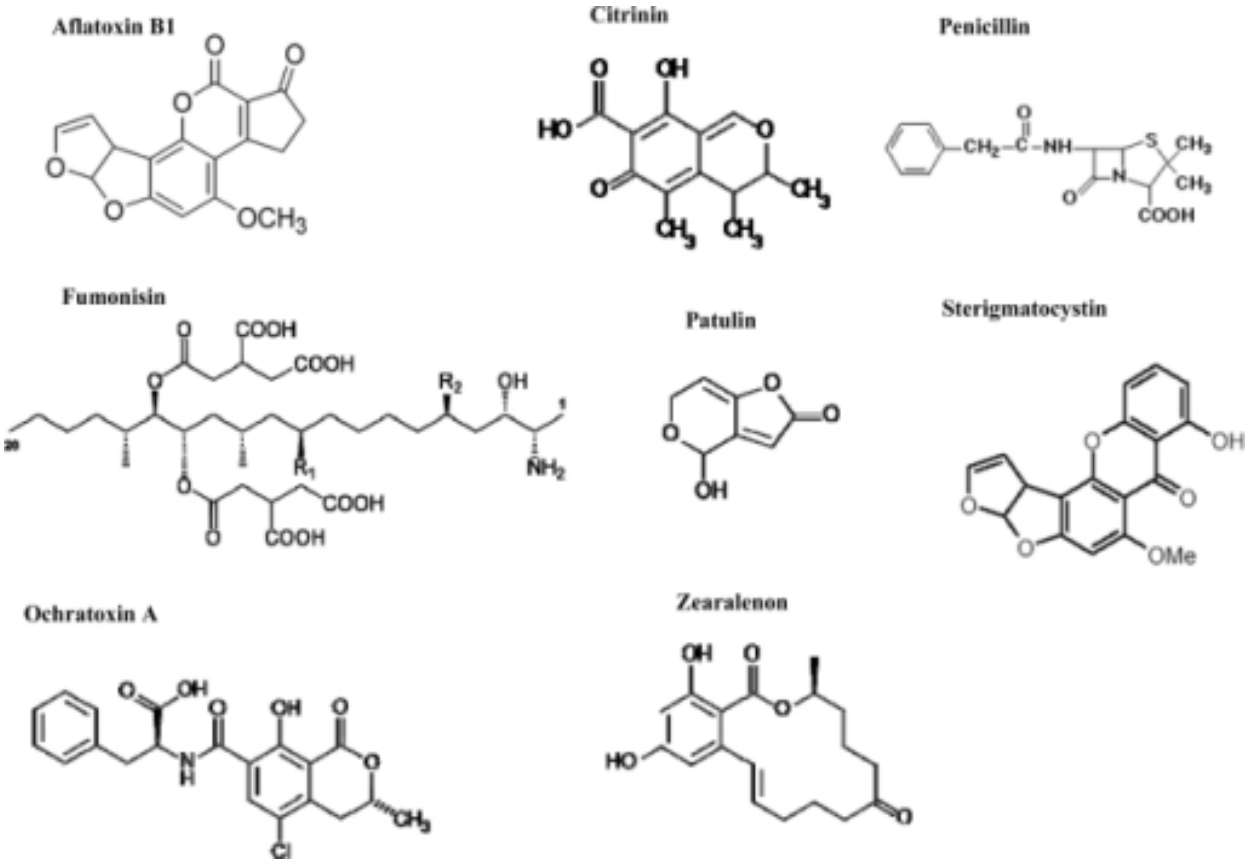

Figure 2.5: Chemical structures of mycotoxins found in food (Vasatkova *et al.*, 2009).

2.2.2 Food-borne disease community-based surveillance in South Africa

The importation and exportation of food in Africa has increased the likelihood of international incidents involving contaminated food through transportation and distribution of food. It has become necessary to strengthen surveillance which will allow early detection, management and prevention of spread of foodborne disease outbreaks (Mensah *et al.,* 2012). Figure 2.6 displays some of the questions that should be used in an active surveillance in order to gather a more accurate data for analysis.

According to the International Health Regulation (IHR) (2005), South Africa is required to appoint EHPs in the ports of entry. Their role is to enforce international and local health regulations, thereby protecting public health. South Africa uses the National notifiable disease surveillance system which receives data from health officials such as doctors or nurses who provide information from their health care facilities (IHR, 2005). In terms of the clinical guidelines on management and control of infectious food-borne disease (2011), health professionals depend on laboratory results to confirm a case. The Center of Enteric Disease at the National Institute of Communicable Diseases (NICD) collects all human isolates from diagnostic microbiology laboratories in South Africa for surveillance, consolidation and reporting (NICD, 2012). However, there is minimal interaction between the NICD, which is the government expert body in communicable diseases playing a supporting role in government response to communicable disease threats, and local government spheres. This creates a surveillance gap as EHPs are situated at the local government sphere.

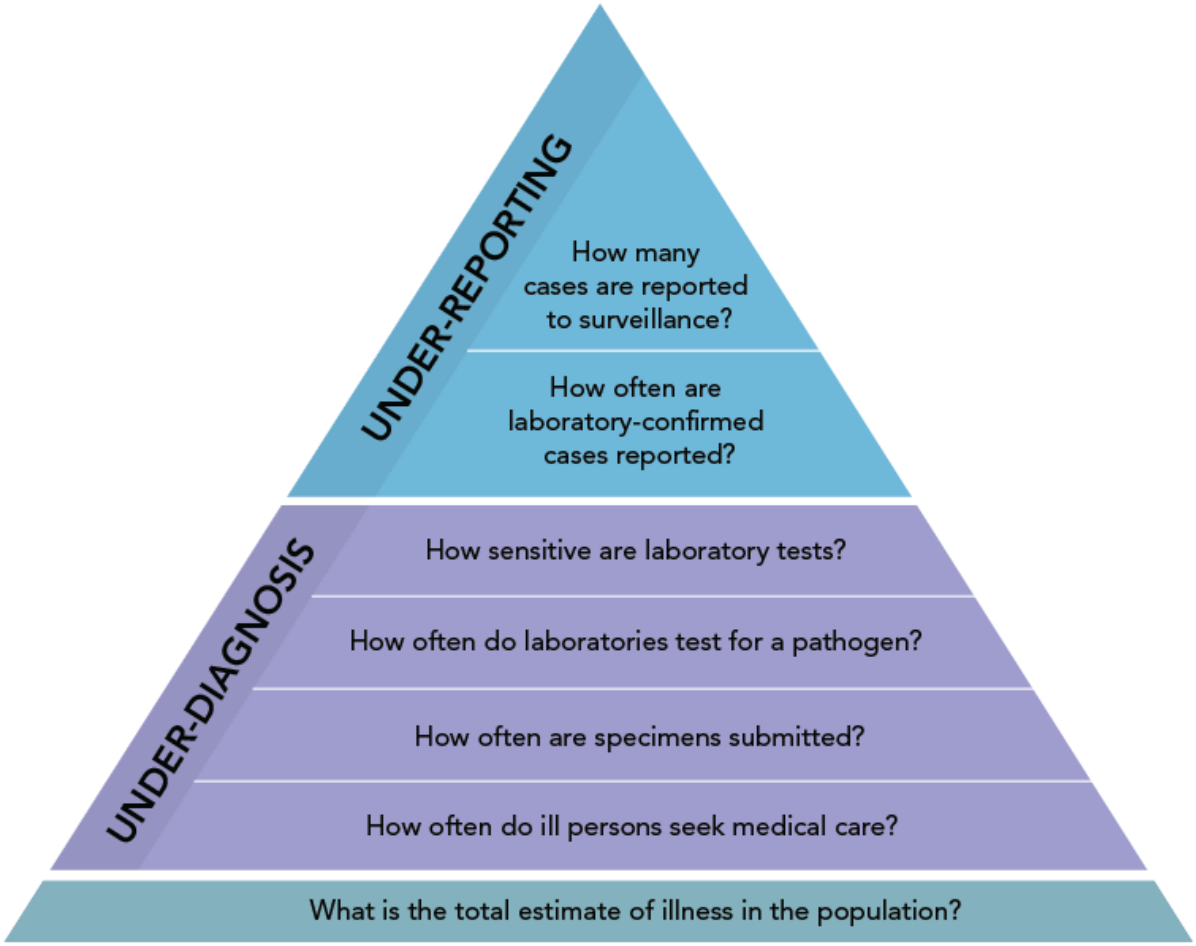

Figure 2.6: Components of active food-borne disease surveillance (Powell, 2014).

In terms of the Health Profession Act (1974), EHPs are required to conduct surveillance and prevention of communicable disease (excluding immunisations) and to undertake food control inspections in communities according to Regulation 962 of 2012. The surveillance and prevention of communicable disease includes health and hygiene promotion programs aimed at prevention of environmentally induced diseases, participatory hygiene and sanitation training approaches for effective control measures at community level and epidemiological surveillance of disease.

2.2.3 Food-borne disease outbreak investigation

The WHO (2008) produced guidelines for investigation and control of food-borne disease outbreaks which includes a multi-skill approach with seven steps indicated in a food-borne outbreak investigation. These steps are shown in figure 2.7. However, countries can make adaptation on the guidelines to suit their situation at field level. Furthermore, clinical diagnosis delays and a long incubation period can result in poor recall, thereby hampering an investigation (Shah *et al.,* 2009).

Many people with symptoms of food-borne illness do not seek medical attention, further contributing to under diagnosis. This behaviour contributes to the rapid distribution of food-borne illness on both national and global scales, thereby making it nearly impossible to detect even a large food-borne outbreak in time to limit its impact (National Academies Press, 2006). A study by Frenzen (2004) found that gastroenteritis is not always accurately diagnosed or reported. Physicians do not always recognize known causes of gastroenteritis and may not report the specific cause on hospital charts or death certificates.

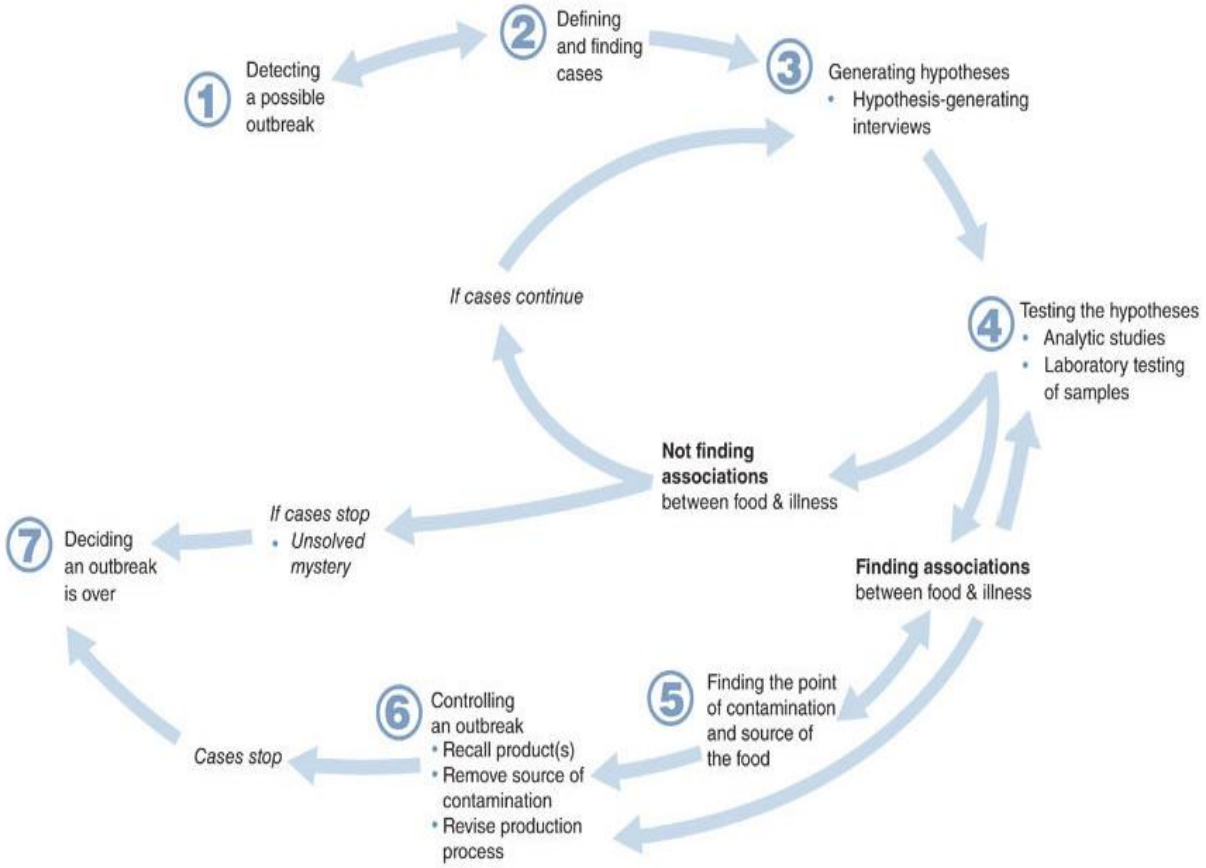

Figure 2.7: Steps in a food-borne outbreak investigation (CDC, 2013[a]).

Clinicians are vital players in the diagnosis of food-borne illnesses. However, it was advised that physicians should avoid attributing cases of food-borne illness to specific food sources without definitive testing and reporting. In cases of suspected food-borne disease or in the setting of an outbreak, stool and vomitus samples should be sent for testing (Switaj, Winter & Christensen, 2015). It is reported that most health professionals do not collect specimen for testing unless it is an outbreak. A study that was conducted in the USA revealed that the etiologic agent and vehicle are frequently undetermined in food-borne outbreaks. Therefore, a greater emphasis on collection of specimen of suspected cases by health professionals is required (Murphree *et al*., 2012). According to Kumar (2015), the lack of laboratories poses a challenge in the investigation of food-borne disease, generally, and delays in sampling analyses.

Humphries and Linscott (2015) highlighted the importance of laboratory-clinician communication for food-borne illness cases. Laboratories should ensure that physicians understand what organisms are screened for in the routine bacterial stool culture, as this is rarely apparent to a general practitioner or even to many specialists. However, most clinical laboratories in different countries have adopted culture-independent test (CIDT) methods such as antigen-based tests and nucleic acid–based assays to determine food-borne illness cases.

There is limited information regarding the involvement of communities in food-borne disease investigation. According to WHO (2012), communities must be integrated in food-borne diseases surveillance and investigation. This should be an opportunity to educate the communities on food safety in order to control and avoid the re-occurrence of the disease.

In South Africa, health workers use clinical guidelines on management and control of infectious food-borne disease (2011). The guidelines define a food-borne disease outbreak as two or more linked patients presenting with acute gastrointestinal, neurological, hepatic or haemorrhagic manifestation after having a shared a common meal or beverage during the past 72 hours. It also provides for reporting of suspected food-borne case to EHPs and use of a laboratory only for the confirmation of the

causative agents. The EHP is mandated to take samples of the food consumed by a patient. It is important to determine who was preparing the meal as well as how the meal was prepared and stored prior to service. If food from the event is not available for sampling, then food from the same batch at the preparation point may be sampled. Food sampling during a food-borne disease investigation is paramount. In terms of the guidelines for EHPs on food safety control at special events (2004), the EHP is tasked to collect the sample in a correct manner in the event of a food related disease outbreak.

2.3 The chemical, viral, bacterial and parasitic agents of food-borne diseases

A recent study showed that the main causative agents of food-borne diseases are bacteria (66%), chemicals (26%), viruses (4%) and parasites (4%) and that their symptoms vary in degree and combination (Addis & Sisay, 2015). Mead *et al.,* (1999) suggested that viruses are the most common pathogens transmitted via food, causing 66.6% of food-related illnesses in the USA compared to 9.7% and 14.2% for *Salmonella* and *Campylobacter*, respectively. Figure 2.8 shows the different temperatures at which viruses and bacteria may perish during food preparation.

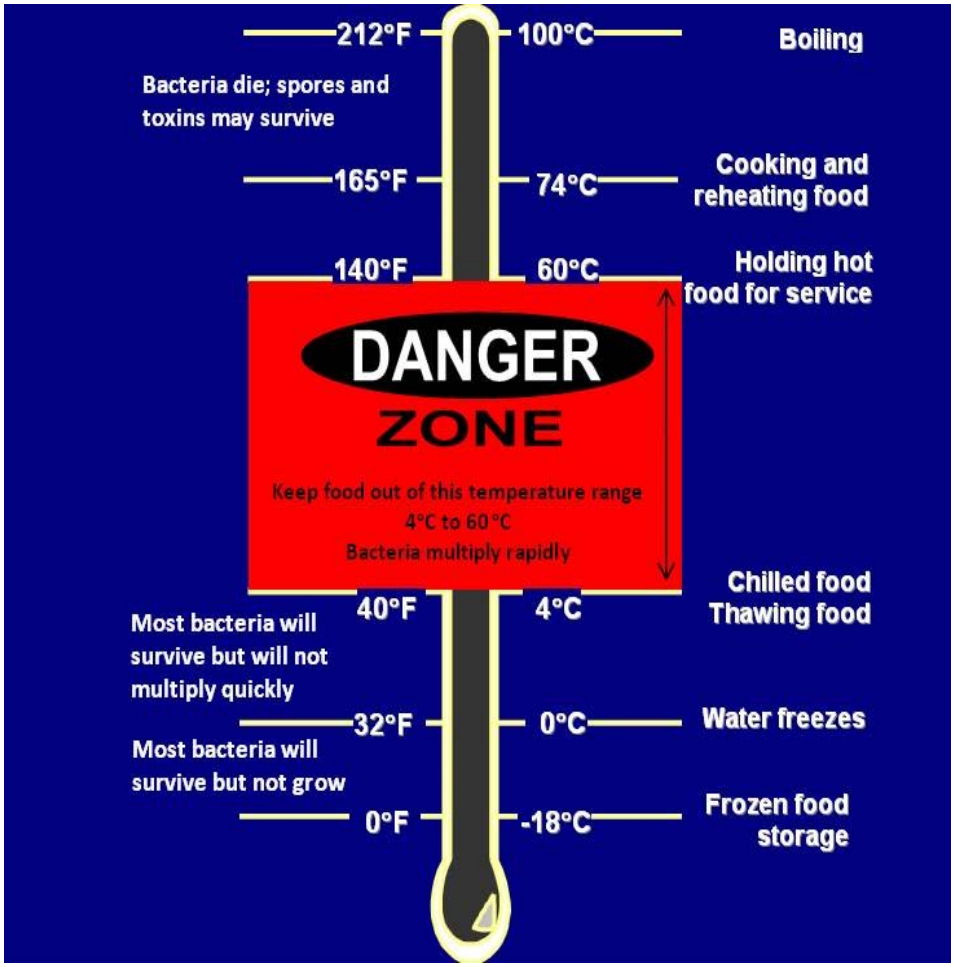

Figure 2.8: The important temperatures to remember during food preparation (BC Open textbooks, 2015).

The Food and Agriculture Organisation (2014) reported that there were ten food-borne parasites of greatest global concern as listed in table 2.1. These parasites affect the health of millions of people every year, infecting muscle tissues and organs, causing epilepsy, anaphylactic shock, amoebic dysentery and other problems. Despite their huge social costs and global impacts, information is generally lacking regarding the origins of these parasites and how they infect humans. This section elaborates on the etiology of major causative agents of food-borne diseases in order to provide an overview of their pathogenicity in relation to human health.

Table 2.1: Common causative agents for Food-borne Disease (Taege, 2010).

Bacteria	Parasites	Viruses
Salmonella spp.	*Taenia solium* (pork tapeworm): In pork	Norwalk
Campylobacter jejuni	*Echinococcus granulosus* (hydatid worm or dog tapeworm): In fresh produce	Hepatitis A
Escherichia coli	*Echinococcus multilocularis* (a type of tapeworm): In fresh produce	
Listeria monocytognes	*Toxoplasma gondii (protozoa)*: In meat from small ruminants, pork, beef, game meat (red meat and organs)	
Vibrio spp.	*Cryptosporidium spp.(protozoa):* In fresh produce, fruit juice, milk	
Yersinia spp.	*Entamoeba histolytica (protozoa)*: In fresh produce	
Clostriduim perfringens	*Trichinella spiralis* (pork worm): In pork	
Staphylococcus aureus	*Opisthorchiidae* (family of flatworms): In freshwater fish	
Mushrooms	Miscellaneous	
Amatoxin	Niacin	
Phallotoxin	Monosodium glutamate	

2.3.1 Chemical contamination

Some chemicals that cause food-borne illnesses are natural components of food although others may be accidentally added during production and handling (Hussain & Dawson, 2013). Chemical food-borne illness results from eating a plant or animal that contains a toxin. Poisoning occurs after ingestion of poisonous species of mushrooms or plants or contaminated fish or shellfish (Gerald, 2016). Konzo is a particular form of paralysis caused by cyanide in cassava root plant, as shown in figure 2.9, which is unique to Africa and results in deaths of approximately 20% of affected people, which is a high mortality rate (WHO, 2015).

Other researchers classify cassava amongst the top ten most dangerous foods due to its potent production of cyanide (Fletcher, 2010). However, other literature suggests that the most dangerous food for consumers is fugu (blowfish), which contains a poison called tetrodotoxin, which is 1 200 times deadlier than cyanide (Friedman, 2010). Common symptoms are diarrhoea, nausea and vomiting and sometimes seizures and paralysis. Prevention includes washing of food before consumption (Newell *et al.,* 2010).

Figure 2.9: Cassava root plant (Fletcher, 2010).

The WHO (2017) stated that naturally occurring toxins include mycotoxins, marine bio-toxins, cyanogenic glycosides and toxins occurring in poisonous mushrooms. Staple foods like corn or cereals can contain high levels of mycotoxins such as aflatoxin and ochratoxin. Long-term exposure can affect the immune system and normal development. The WHO (2017) further reported that dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and cause cancer. The contamination by heavy metal in food occurs mainly through pollution of air, water and soil, while lead cadmium and mercury cause neurological and kidney damage.

2.3.2 Viral infections

In the USA, viruses account for 67% of food related illness, compared to 9.7% and 14.2% for *Sallmonella* and *Campylobacter*, respectively (Vasickova *et al.,* 2007). Naroviruses (NoVs) are non-enveloped single stranded RNA viruses belonging to the family *Caliciviridae* and can infect humans through contaminated food (Koopmans, 2012). NoVs are regarded as the major causative agents of epidemic gastro-enteritis in all age groups, resulting in over 267 million annual infections globally (Barrabeig *et al.,* 2010).

Hepatitis A (HAV) is a small, non-enveloped, single stranded RNA virus and a member of the family *Picornaviridae*. Figure 2.10 shows the structure of HAV. A single HAV infected food handler can transmit HAV to hundreds of persons and cause a substantial economic burden to public health. Fiore (2004) reported that person to person is the most common method of transmission of HAV, which occurs via faecal-oral contamination. Infection may also result from exposure to common vehicles such as faecal contaminated water or food (NICD, 2012). WHO (2016) states that predictors of past or recent infection with HAV include low household socio-economic status, over-crowding and residence in rural areas. Almost everyone recovers fully from HAV with a lifelong immunity. Safe water supply, food safety, improved sanitation, hand washing and HAV vaccine are the most effective methods to prevent the disease (Ogholikhan & Schwarz, 2016).

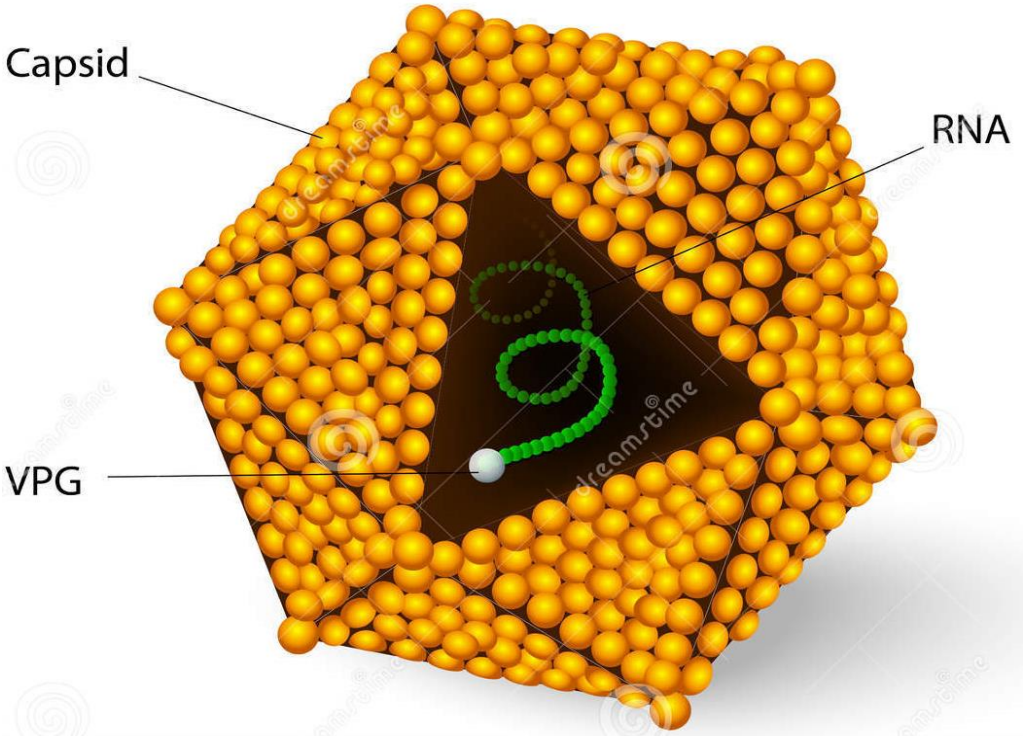

Figure 2.10: The Hepatitis A Virus (Crystal graphics, 2017).

2.3.3 Bacterial Infections

According to Shirai (2015) frequent sources of food-borne outbreaks are meat, dairy products, eggs and vegetables. The bacteria that mostly cause food-borne illness are *Salmonella typhi*, *Campylobacter, Escherichia coli, Listeria, Staphylococcus aureus and Clostridium perfringens* (Foodsafety.gov, 2015). A study by Painter *et al.,* (2013) found that almost any food can be a source of food-borne disease. Some foods are more commonly associated with particular organisms. *Salmonella* has traditionally been associated with poultry and eggs, *Campylobacter* with chicken and unpasteurized milk. Furthermore, the study showed that more deaths were attributed to poultry than to any other food product. These organisms have evolved and have greater cold, heat, and acid tolerance, as well as resistance to multiple antibiotics (Taege, 2010).

2.3.3.1 *Salmonella typhi*

Salmonellosis is a disease caused by the bacteria *Salmonella*. These bacteria are a major cause of food-borne diseases throughout the world (Park *et al.,* 2015). They are widely distributed in nature, with humans and animals being their primary reservoirs. Non-Typhoidal *Salmonella* kills 32 000 people a year in the African region (WHO, 2016). There are over 2 500 different strains called serotypes that have been identified to date. A few of serotypes are host-specific and can reside in only one or few animals, namely: *Salmonella dublin* in cattle and *Salmonella choleraesuis* in pigs. *Salmonella enteritidis* and *Salmonella typhimurium* are the two most important serotypes of salmonellosis transmitted from animals to humans (Gal-Mor, Boyle & Grassl, 2014).

The majority (80%) of all salmonellosis cases are misdiagnosed or classified as sporadic cases, which wanes surveillance and institutional response to outbreaks (WHO, 2015). Addis and Sisay (2015) suggest that there is a need to develop methods to control the contamination by *Salmonella* of farms by instituting bio-security and bio-containment practices, in addition to enhanced food production, handling and good storage practices. The need for the farm to employ stringent food safety systems is emphasized by the findings of a study conducted in the USA which revealed that the

prevalence of faecal *Salmonella* was lower in certified-organic bird farms than in conventionally raised bird farms (Alali *et al*., 2010). The bacteria are generally transmitted to humans through consumption of contaminated food of animal origin. The symptoms of salmonellosis include stomach cramps, vomiting, diarrhoea and fever (Humphries & Linscott, 2015). The onset of disease symptoms occurs 6 – 72 hours after ingestion of *Salmonella*. Treatment for severe cases is symptomatic, electrolyte replacement and rehydration. Routine antimicrobial therapy is not recommended for mild or moderate cases in healthy individuals, and prevention includes basic food hygiene practices such as cooking food thoroughly, maintaining the cold chain and practicing personal hygiene (WHO, 2015).

2.3.3.2 *Staphylococcus aureus*

Staphylococcus aureus is a type of bacterium commonly found in large numbers near an opening of the body surface such as the skin, hair, pharynx and nasal fossa of both people and animals (WHO, 2015). It belongs to the family Staphylococcaceae and at least 30 species have been recognised by biochemical analysis (Mandal, 2012). The Methicillin-resistant *Staphylococcus aureus* (MRSA) is a strain that has traditionally been considered a nosocomial pathogen. Many reports of MRSA have been increasing and were found in patients who were associated with pig farms (Van Loo *et al.,* 2007). The incidence of *Staphylococcus aureus* is also associated with ethnicity.

In the USA, the incidence of invasive MRSA in the black population (27.7% per year) was almost double that in the white population (66.5% per year) (Tong *et al.,* 2015). There were 365 episodes of *Staphylococcus aureus* bacteraemia identified in Cape Town, with an annual incidence of 3.28 cases per 1 000 hospital admissions (Naidoo *et al.,* 2013). This bacterium causes food-borne illnesses when a food handler contaminates food which is not properly stored. Unsanitary conditions and crowded community settings increase exposure to *Staphylococcus aureus*. The bacteria can be transmitted from person to person through contact with a carrier. It is characterized by a short incubation period of 1 to 6 hours. The onset is sudden and is characterized by vomiting and diarrhoea but no fever (Foodsafety.gov, 2015). Recommended treatments for these patients are rest, plenty of fluids and medicine to calm the

stomach. Prevention and control of the disease includes proper cooking of food, proper storage, education of food handlers about food-borne diseases, prohibiting food handlers with skin lesions from handling food and maintenance of the cold chain (Foodsafety.gov, 2015).

2.3.3.3 *Escherichia coli*

Escherichia coli are commonly found in the environment, as well as in the gut of both humans and warm blooded animals. *Escherichia coli* consist of a diverse group of bacteria. The pathogenic *Escherichia coli* strains are categorized into pathotypes. Pathotypes are a group of organisms of the same species and pathogenicity on a specific host (Croxen, 2013). Figure 2.11 depicts one of the common *Escherichia coli* strains. Six pathotypes are associated with diarrhoea and, collectively, are referred to as diarrheagenic *Escherichia coli.*

Figure 2.11: *Escherichia coli* (Siegrist, 2017).

It can grow in temperatures ranging from 7 to 50 ºC, with an optimum temperature of 37 ºC and is destroyed by thorough cooking of food at 70 ºC. In the North West of South Africa, three babies died, and over 500 people were treated after drinking *Escherichia coli* contaminated water in 2014 (NICD, 2014). Transmission occurs after consumption of contaminated food and water. The incubation period is 72 – 120 hours, and clinical symptoms include diarrhoea with abdominal cramps, which may turn into bloody diarrhoea after a few days (Food Safety Newsletter, 2015). Recommended treatment for patients is rest, plenty of fluids and medicine to calm the stomach (Clark, 2016).

2.3.3.4 *Clostridium perfringens*

Clostridium perfringens is an anaerobic spore-forming bacterium found in many environmental sources, as well as in the intestines of both humans and animals. The food-borne disease strains of *C. perfringens* exist in the soil, water, meat, poultry, dust and spice (Pelzer, 2011). *C. perfringens* is the most common causes of food-borne illness in the USA. It is estimated that nearly 1 million cases of food-borne illnesses per year are caused by this bacterium. This illness mostly occurs after consuming food from institutional cafeterias. It is transmitted when individuals consume food that is prepared in large quantities and subsequently kept warm for a long time prior to serving (Fafangel *at el.,* 2015).

The incubation period is 8 – 22 hours. The illness is characterized by acute abdominal pain, abdominal cramps, diarrhoea and vomiting. Recommended treatment is oral rehydration, and in severe cases, intravenous fluids and electrolyte replacement (Food and Drug Administration, 2012) (FDA).

2.3.3.5 Parasites

Parasites are organisms that derive nourishment and protection from other living organism known as hosts. They are of different types and range in size from tiny, single-celled organism to large ones. The size ranges from 1 of 2 micrometres to 25 meters in length. Parasites may be present in food or in water and have been identified

as causes of food-borne or water-borne illness worldwide (WHO, 2016). Most common parasites (Table 2.1) are transmitted from host to host through the consumption of contaminated water and food (Cabral, 2010). Prevention includes washing of hands with a detergent, drinking water from treated sources, not swallowing water while swimming and not using raw animal faeces to fertilize food crops. The incubation period varies with different parasites. Clinical symptoms include cramping, abdominal pain, and watery diarrhoea, fatigue, bloating and vomiting. Infected people do not always require treatment as the symptoms may heal on their own (FDA, 2012).

2.3.4 Food borne diseases and vulnerable groups

Food-borne pathogens are more likely to cause infection and result in more serious consequences in vulnerable people than in healthy adults (Uyttendaele *et al.,* 2015). In first world countries, such as the UK and USA, about 15% of the population may be affected (Lund & O'Brien, 2011). There are three important factors in the acquisition of food-borne disease which include the virulence of the pathogen, exposure to the agent in a meal and resistance of the person to infection (Scientific information Bulletin, 2015). Immune ability is negatively affected by age, pregnancy and other factors, such as poor nutrition and chronic illnesses. Young children are at more risk to food-borne illnesses because their immune system is still developing and the protection afforded by the gut flora is not as effective as in adult. In addition, the Health Systems Trust Report (2006) attributed 15% of mortality in children below age 5 to gastroenteritis. The elderly are also susceptible to food-borne illnesses due to the decrease in the immune system's ability to fight diseases (WHO, 2000). In the Western Europe, the elderly are encouraged to consume a healthy diet for improved health (Uyttendaele *et al.,* 2015).

Table 2.2 indicates factors that increase the risk of acquiring food-borne diseases. These factors make the host vulnerable to the infecting agents. It is reported that 125 000 children under the age of 5 die of the food-borne disease burden every year (WHO, 2015). Nevertheless, Quinlan (2013) alluded that safe food handling knowledge and behaviour among low income and minority consumers suggest that there may be a need to target food safety messages to these vulnerable populations. Another possibility is that these vulnerable groups are receiving food that is less safe at the level of the retail outlet or foodservice facilities.

Table 1.2: Factors that increase the risk of food-borne Infection (Lund & O'Brien, 2011).

Host factors	Reasons
Primary immunodeficiencies	Immune system inadequate to combat infection
Immunocompromised persons, including people treated with chemotherapy or radiation therapy, recipients of transplants taking immunosuppressive drugs, persons with leukaemia, persons with diseases of the immune system, AIDS patients	Immune system inadequate to combat infection
Excessive iron in blood	High levels of iron increase growth of certain pathogens
Cirrhosis and other liver disease, kidney function (alcoholism)	Iron overload, immune system dysfunction
Stress, e.g. as a result of surgery	Changes in metabolism reduce resistance to infection
Pregnancy	Altered immunity
Age <5 years	Lack of developed immune system, smaller infective dose required for infection
Age 60–65 years	Immune system deteriorating, also affected by chronic ailments
Nutritional deficiency, e.g., through poor absorption of food, poor nutrition, or starvation	Inadequate immune system
Consumption of antacids, particularly proton pump inhibitors	Increase pH in stomach, increasing survival of pathogens
Consumption of large volumes of liquids, including water	Dilution of acids in the stomach, rapid transit through stomach
Ingestion of fatty foods (e.g., chocolate, cheese, hamburger) containing pathogens	Fat protects pathogens from acid in stomach

2.4 Food-borne disease statutory framework

The food industry is one of the most legislated industries in many countries, including South Africa; however, the implementation of these laws remains inexplicit. It is widely reported that only some of the African countries require national reporting of food-borne disease incidents, and even fewer exercises the accurate reporting (FAO, 2015). Experts allege that the rate of implementation of food safety laws in South Africa is low (Brink, 2013). It was important to review the South African legal framework pertaining to food in order to understand the context of food-borne illness in this country.

2.4.1 International Food Standards organisations

The Codex Alimentarius Commission is a joint inter-governmental body of the FAO under the UN and WHO with 186 member states, consisting of 48 African member states. This organization sets standards, provides guidelines and practices that contributes to the safety, quality and fairness of international food trade (Codex Alimentarius, 2016). As a member of this commission since 1994, South Africa is obligated to promote and ensure food safety in the country, thereby reducing food-borne diseases. The WHO is responsible for directing and coordinating health standards across the world and influences international public policies and implements the IHR 2005 (UNDESA, 2015).

The IHR (2005) which was adopted by the 58th World Health Assembly in May 2005, came into effect on the 15 June 2007 and is a legally-binding international instrument on all imports or exports of foodstuff, cosmetics, disinfectants and hazardous substances. The Hazardous Critical Control Point is an internationally recognized system of food safety management which prevents hazards in food establishments. It focuses on the process control and the prevention of identified hazards in a particular establishment. The International Standard Organization 22000 and Food Safety Systems Certification 22000 provide a framework for the effective management of food safety in food premises (Marais *et al.*, 2007).

There are other governmental and non-governmental international organizations that are advocating for food safety such as the International Food Safety Authorities Network (INFOSAN), Food and Agricultural Organization (FAO), FDA, Food Standard Agency (FSA), European Food Safety Authority (EFSAU) and Food Standards Australia New Zealand (FSANZ). A WHO member country is legally required to identify and assess any eminent public health risk within 48 hours. However, according to FAO (2015), there is no obligation to report food-borne disease internationally, with the exception of cholera.

2.4.2 Applicable South African food legislations

The food control section within the DoH in South Africa (2017) is responsible for ensuring the safety of food in the country**.** The functions of the food control section are to:

- Administer food legislation. This includes developing and publicising regulations for food safety, food labelling and related matters as well as developing technical guidelines where necessary;
- Inform, educate and communicate to industry, consumers, the media, government departments and other stakeholders about food safety and related matters;
- Audit and support Port Health Services in the provinces related to the control of imported foodstuffs. Audit and support Municipal Health Services in metros and district municipalities related to law enforcement, monitoring, information, education and communication and other activities; and
- Evaluate risk assessments related to agricultural chemicals and food produced through biotechnology for the Departments of Agriculture, Forestry and Fisheries and co-ordinate routine and specific food monitoring programmes and attend to food safety alerts.

The Constitution of the Republic of South Africa (1996) states that everyone has the right to an environment that is not harmful to their health or well-being and the right to have access to sufficient food and water. The NHA (2003) and the National

Environmental Health Policy (NEHP, 2013) seek to provide a legal framework that will ensure an environment that will promote, improve and protect the health of all citizens, including the control of importation and exportation of foodstuffs and the facilitation of provision of safe available food and water, and nutrition for vulnerable groups. Regulation 287 (2010) promulgated under the NHA (2003) provides guidance for the management of communicable diseases and stipulates methods of reporting of a notifiable medical condition which includes food-borne diseases. All medical conditions in Table 2.3 must be reported within 24 hours after the diagnosis by a health provider. It further postulates a penalty and/ or imprisonment for failure to notify or report a notifiable medical condition.

Table 2.3: Priority communicable diseases that need immediate verbal report on clinical suspicion within 24 hours (National Health Act 61 of 2003).

Communicable Disease	ICD10 Code
Acute flaccid paralysis	AFP
Anthrax	A22
Cholera	ADO
Crimean-Congo-Haemorrhagic Fever & other viral haemorrhagic fevers	A98
Food poisoning, food-borne diseases	AD2 & AD5
Meningococcal infection	A39
Novel influenza subtype I	N/A
Plague	A2D
Rabies	A82
Smallpox	N/A
Yellow fever	A95
Poliomyelitis (Acute)	A8D.1; A8D.2
Severe acute respiratory syndrome (SARS)	N/A

Although it is mandatory to report any food-borne case to the nearest health facility in the country, many cases remain unreported and unrecorded (Frean, 2010). Four confirmed food-borne cases from the same source is regarded as a food-borne diseases outbreak in many countries, including South Africa, but if unreported, health officials will not realise that there is an outbreak of a food-borne disease, and many more people will be infected (NHA, 2003).

The Health Professional Act (HPA) (1974) stipulates the functions of the EHP, which include water quality monitoring and food control. Inspections of the food handling premises are conducted in line with Regulation 962 and 146 as proclaimed under the Foodstuff, Cosmetics and Disinfectants Act (FCDA) (1972). The FCDA states that any person shall be guilty of an offence if he or she sells, manufactures or imports for sale, any foodstuff which is contaminated, impure or decayed or deemed harmful in terms of any applicable regulation. Regulation 962 of 2012 deals with the structural conditions, personal hygiene and general hygiene of the food premises.

It further prescribes that no person shall handle or permit food to be handled on food premises which do not have a valid certificate of acceptability (Appendix VI). Regulation 146 states that all food labels must be written in English and, where possible, any of the other South African official languages. The label must be visible and legible, state the country of origin, name and address of the manufacturer, importer or distributor. Batch identification and date marking must be on the label as well and must include the typical nutritional information table for all products.

The National Food Safety Alert Policy and Official Product Recall (2004) stipulates essential three classes or types of food product recall. Class one recall happens when a health hazard situation exists or when there is reasonable probability that eating the food will cause health problems or death. Class two recall occurs when a health hazard situation involves a remote probability of adverse health consequences from consuming the food; class three recall transpires from a situation where eating the food will not cause adverse health consequences but is a precaution exercise. The Consumer Protection Act (2008) allows for a consumer to claim against a supplier for

damages arising from food-borne disease. Under Section 61, consumers are able to sue suppliers and manufacturers of goods, including foodstuffs. The Department of Health recently enacted the Environmental Health National Norms and Standards (EHNNS) (2013), which strives to standardize functions and activities in the delivery of environmental health services and establish a level against which environmental health service delivery can be assessed.

2.5 Aim and Objectives of the study

The aim of the study was to investigate the surveillance of food-borne diseases in Ncera villages and local clinics, in the Eastern Cape, South Africa.

The objectives of the study include:

- To determine the prevalence of food-borne disease from clinic records during the period 2012 to 2014.
- To determine the prevalence of food-borne disease from village residents.
- To determine the community's level of understanding of food-borne illness through a self-administered questionnaire.
- To identify the reasons for not seeking medical help and for not reporting food-borne illnesses in these communities.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter presents the research design and methods utilised in conducting this study. The chapter also presents the methods of data analysis, ethical considerations and steps taken by the researcher to ensure reliability and validity of the research. The study was conducted in two phases. The first phase screened the data in the tick registers from Ncera, Mpongo and Needscamp clinics from the period 2012 to 2014. The second phase included the interviews conducted with the heads of households from these villages. The data was examined in order to ascertain the number of reported food-borne cases.

3.2 Research Design

A retrospective, observational, quantitative design was used in this study. Observational studies investigate the relationship between exposures, such as risk factors and outcomes, which would be the disease state or complications (Song & Chung, 2010). Observational studies fall under the category of analytic study designs further sub-classified as observational or experimental study (Song & Chung 2010). According to Mann (2017), this type of research identifies gaps in the existing health system and obtains information from the community.

According to Wyse (2011) a quantitative research is used to quantify the problem by way of generating numerical data or data that can be transformed into statistics. It is used to quantify attitudes, opinions, behaviours and other defined variables (Wyse, 2011). It is often concerned with finding evidence to either support or contradict the hypothesis that was formulated (Bryman, 2006). Quantitative research's main purpose is the quantification of the data. It allows generalisations of the results by measuring views and responses of the sample population (Sudeshna & Datt, 2016). Quantitative data can help establish correlations between given variables and outcomes (Choy,

2014). The data should allow others to validate original findings by independently replicating the analysis (Madrigal & McClain, 2012).

3.4 Research Setting

Polit and Beck (2012) describe a setting as an environment where the data is collected for the study. The households' heads living in Ncera, Mpongo and Needscamp villages, which are situated in the BCMM, were accessed for participation in this study. The BCMM covers approximately 2 536 km^2 (Figure 3.1) and is situated relatively centrally in the Eastern Cape. The metro is bounded to the south-east by the Indian Ocean and has 68 kilometres of coastline. The metro also serves as the key urban centre in the eastern part of the province.

The Eastern Cape Development Corporation (ECDC, 2016) reported that households within the BCMM (90.7%) had the third highest access to piped water in the Eastern Cape. In 2015, BCMM had 70.9% residents who had access to sanitation. BCMM had the third lowest proportion of individuals living below the poverty line at 33.9%, or 263 576 people (BCMM Annual report, 2016).

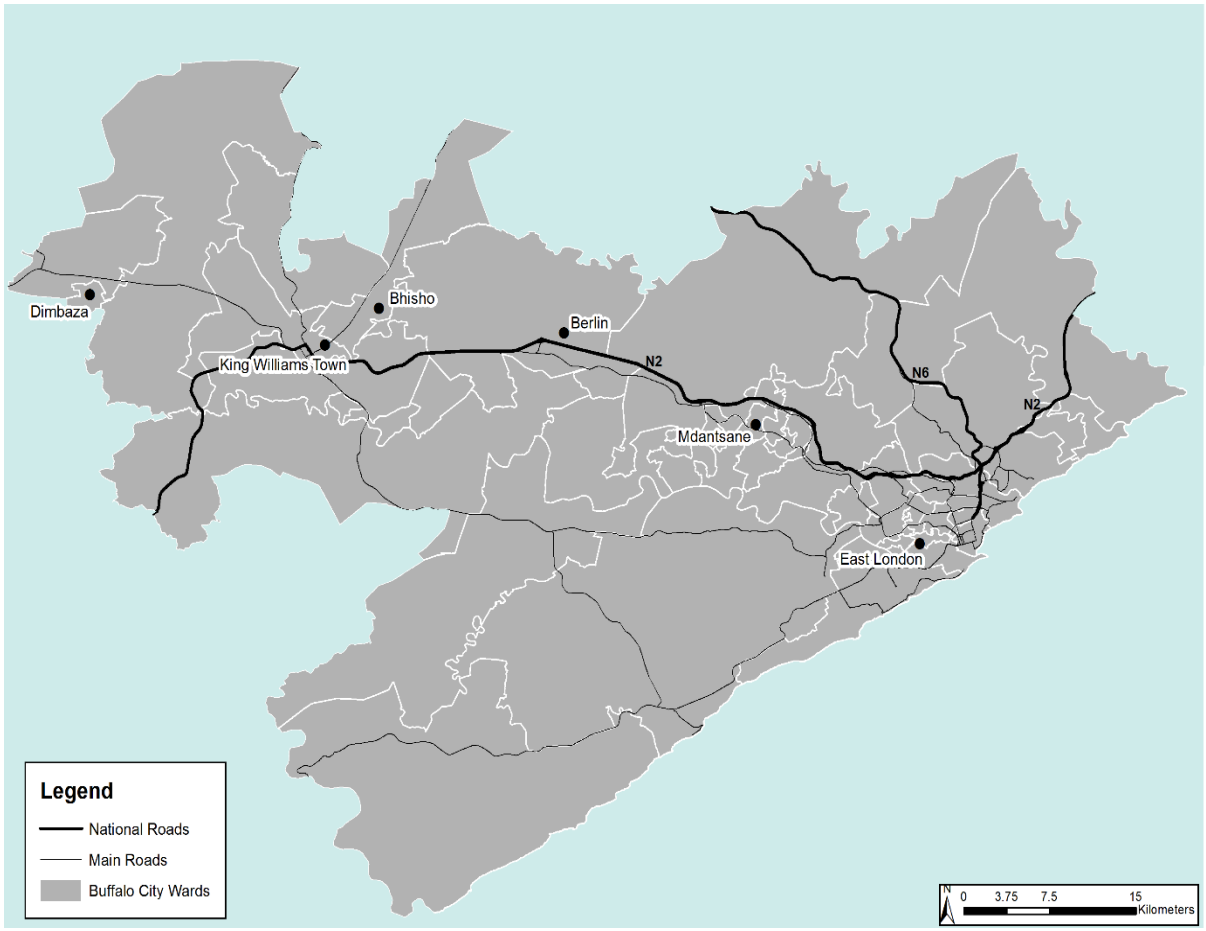

Figure 3.1: The Buffalo City Metropolitan Municipality's borders (ECDC, 2016).

3.5 Target population

In terms of Stats SA (2016), there were 339 males and 420 females in Ncera village, 54 males and 69 females in Mpongo village while Needscamp village had 1845 males and 2283 females. In addition, there were 1680 households in Needscamp village, 369 in Ncera village and 66 in Mpongo village. Figure 3.2 depicts the population pyramid of the BCMHD.

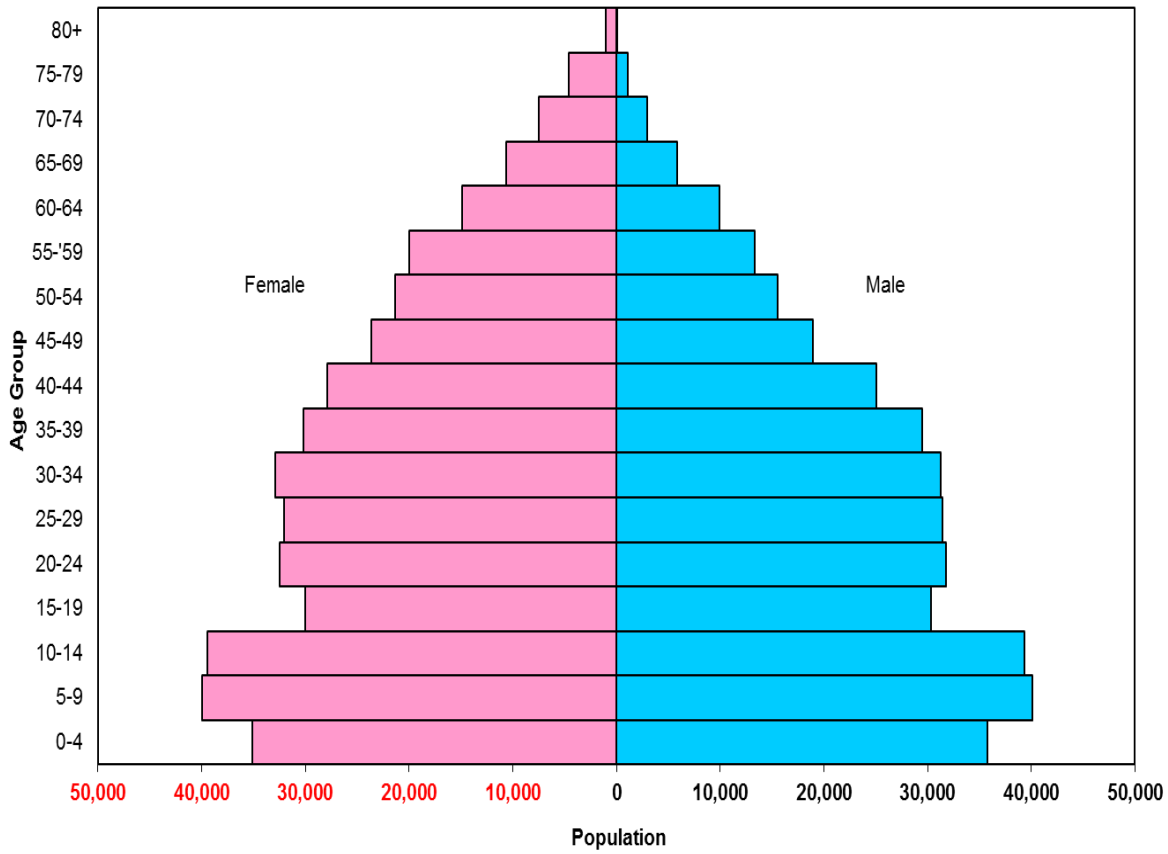

Figure 3.2 Population pyramid, Buffalo City (District Health Council, 2017).

The population that was targeted for the study comprised IsiXhosa speaking people situated approximately 50 kilometers away from East London city center, consisting of vast land and a mountainous landscape (Figure 3.3), and they were all from BCMM. Depoy and Gitlin (2011) define the target population as a group of individuals from which the researcher is able to select a sample. In this study, the target population was from households in Ncera, Mpongo and Needscamp villages.

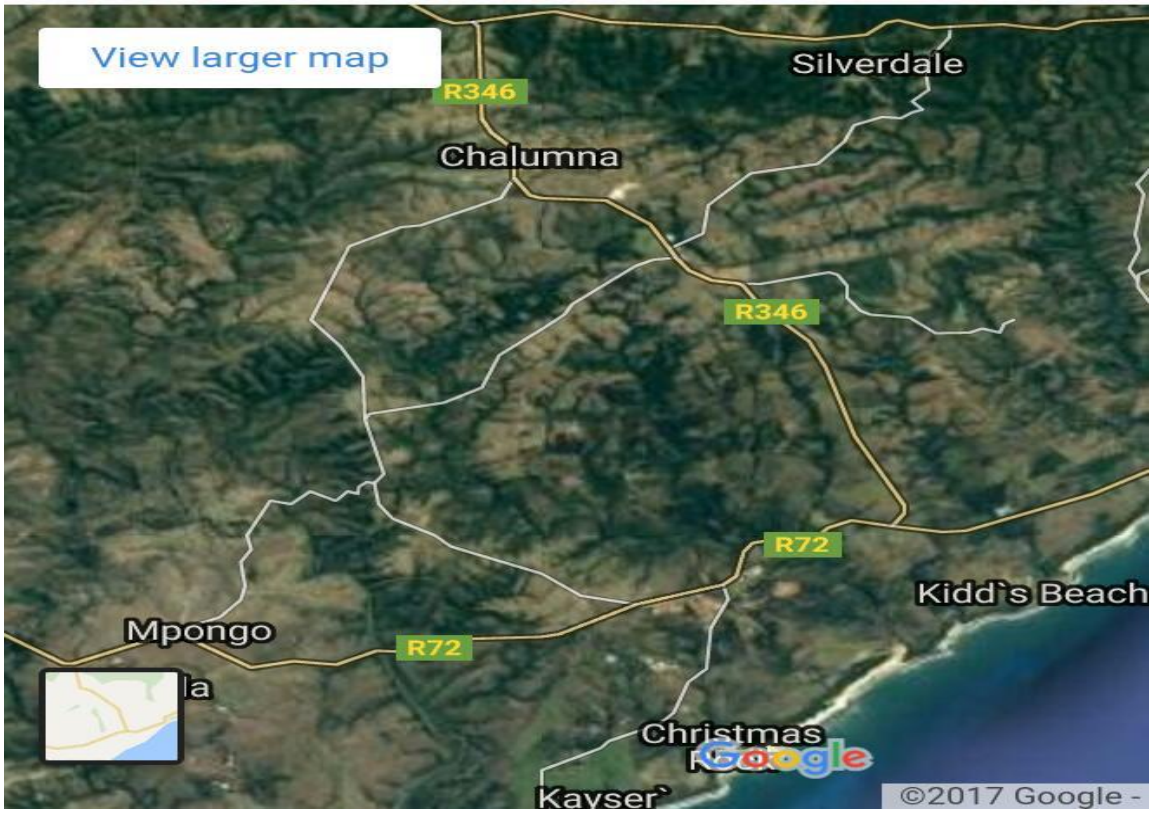

Figure 3.3: Landscape of the targeted area (Google maps, 2017).

3.6 Sampling Procedure

Martinez-Mesa (2016) defines sampling as the process through which individuals or sampling units are selected from the sample frame. The sampling methods unfolded in two phases. In the first phase, purposive sampling of clinic records was done. The clinic registers were examined to determine whether there were any food-borne diseases reported from the 2012 to 2014 period.

In the second phase, households in these villages were randomly sampled in order to interview household heads. The sample size was calculated by the statistician. A total of 90 households were sampled resulting in a total sample size of 337 participants in various households. Figure 3.2 shows the population pyramid where the sample was taken. This refers to the selection of a sample such that each member of a population has an equal probability of being included in the study (Polit & Beck, 2012). The house numbers were randomly chosen by a computer programme to minimise sampling bias. The sample included household heads that were required to complete the questionnaire.

3.7 Participants

All participants were adults, 18 years and older and residing in Ncera, Mpongo and Needscamp for at least six months prior to the start of the investigation.

3.8 Inclusion criteria

The inclusion criteria included respondents who:

- Were the head of the household;
- Resided in Ncera, Needscamp or Mpongo villages in the Eastern Cape;
- Were fluent in either English or IsiXhosa;
- Had resided in these villages at least six months prior to the start of investigation; and

- Were 18 years and above.

3.9 Exclusion criteria

The exclusion criteria included:

- Persons younger than 18 years old;
- Individuals that did not belong to a household; and
- Individuals who were related to the primary investigator.

3.10 Data collection

Data was collected in two phases, and the data collection process is summarized in Table 3.1.

- **Phase 1: Clinic records**

  In the first phase, data was collected from 378 tick registers, which were available and accessible at the time of investigation from the 2012 to 2014 period (Figure 3.5). Three Environmental Health Interns were hired to assist in data collection. During the examination of the clinic tick registers, it was realised that most records are done in codes, in some registers there were no diagnosis and age columns and in some instances, illegible writing was observed. The researcher examined the tick register to determine the number of food-borne illness cases that were reported, diagnosed or suspected and referral records were also examined. Figure 3.4 shows the distribution of 77 clinics in the Buffalo City Metro Health District. It also depicts the concentration of clinics in the urban corridor, while there are fewer clinics in peripheral areas of the city centre.

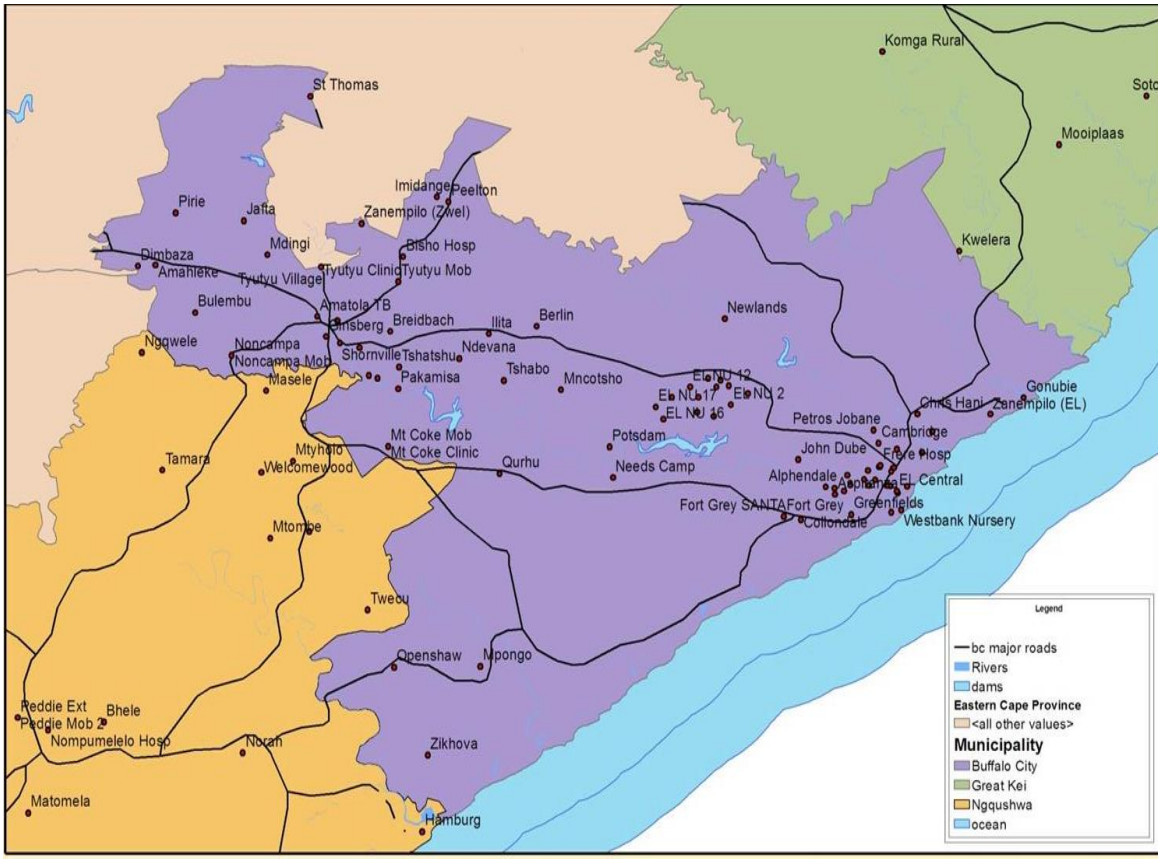

Figure 3.4: Distribution of clinics in Buffalo City Metro Health District (District Health Council, 2017).

Figure 3.5: Tick registers scrutinized at Needscamp clinic.

- **Phase 2: Village survey**

During this phase, all data was collected through a self-administered questionnaire (Table 3.1). No names or other personal identifying information was required on the questionnaire. The household heads were furnished with consent forms and upon completion of the consent form, they were requested to complete the questionnaire, using their language of preference (English or isiXhosa). The household heads completed the questionnaires. Those who could not write were assisted by the researcher; in such instances the researcher asked the questions and completed the questionnaire on behalf of the respondents. Each questionnaire had a unique serial number which allowed the village site to be identified.

Table 3.1: Summary of the data collection process.

Objectives	Activity	Tasks	Outcome
To determine the prevalence of food-poisoning from clinic records from the 2012 to 2014 period.	Screening of clinic tick registers from the 2012 to 2014 period.	Four visits per clinic (depending on the number of registers)	Number of reported food-borne cases. Their demographics Their villages
To determine the prevalence of food poisoning from village residents.	Gather data from the villagers via a structured research tool	Visit Ncera village in the first month, Mpongo village in the second and Needs camp in the third. Request household heads to complete the questionnaire and analyse	Number (%) of individuals in households who were infected by a food-borne disease Determine various factors
To determine the community's level of understanding of food-borne illness through a self-administered questionnaire	Gather data from the villagers via a structured research tool	Visit Ncera village in the first month, Mpongo village in the second and Needs camp in the third. Interview family members	% of household members and heads who have knowledge of food-borne illnesses
Objectives	**Activity**	**Tasks**	**Outcome**
To identify the reasons for not seeking medical help and for not reporting food-borne illnesses in these communities, using a questionnaire	Gather data from the villagers via a structured research tool	Visit Ncera village in the first month, Mpongo village in the second and Needs camp in the third. Statistical analysis	Reasons for not seeking medical help.

This phase included a stratified random sampling method of household numbers populated in an excel document. During this phase, it emerged that there were households with no numbers, unclear household numbers and in some instances, the household members were not sure of their house numbers. This resulted in excluding those households without numbers and only randomly including those with known numbers.

3.10.1 Measuring tool

According to Foster *et al.,* (2010), questionnaires have the advantage of obtaining confidential information from a large number of people about their knowledge, attitudes, opinions and perceptions. An added benefit of questionnaires is that bias is reduced because all respondents are given the same ordinal scale options to answer, and, therefore, the possibility of misinterpreting the results is reduced (Brink *et al.,* 2007).

The questionnaire (Appendix VIII) that was used for this study has been adapted from a similar study in the USA, permission was sought and granted (Arendt *et al.,* 2013). The questionnaire was available in English and Isixhosa, the primary languages understood and spoken by the study population. Questions were structured and included demographic data, medical history of family members and information on food-borne disease. The latter included questions on food-borne disease symptoms, use of alternate treatment and food safety related information.

3.10.1.1 Validity

Validity determines whether the research truly measures that which it was intended to measure or how truthful the results are. The content validity is concerned with how accurate the data questions are (Joppe, 2000). A study by Salant and Dillman (1994) stated that an expert group meeting is held to stimulate individuals' thinking about the research topic and to encourage them to develop ideas and suggestions for inclusion into the questionnaire. In this way, expert groups support the research process by increasing the relevance of the research, whilst also contextualising the questionnaire

in time, environment and people. The research tool was subjected to a strict interrogation by a group of five experts, comprising of the researcher, both supervisors and three other academics in the field. The issues of confounding factors and study limitations were extensively discussed, and proposed changes were effected on the research tool.

3.10.1.2 Reliability

The research questionnaire was tested for accuracy in a pilot study that consisted of six respondents from the study population. Respondents for the pilot study were required to meet the same inclusion and exclusion criteria as those applicable to the main study. The respondents were randomly selected from patients who attended the Needscamp clinic for medical consultation. They were given the information letter (Appendix IV) and voluntarily signed the consent (Appendix V) form voluntarily. These participants were subsequently excluded from the main study. Their responses were also excluded from the final analysis. The changes that were considered on the research tool were on the medical history (Appendix VII) and food safety questions resulting in additional question on the research tool. Some questions were rephrased for better understanding. Some questions were removed as they were duplicated.

3.11 Ethical consideration

The research was approved by the Durban University of Technology Institutional Ethics Committee (IREC Ref No 58/16) (Appendix A and B). A letter requesting permission to conduct the study in the Eastern Cape was submitted to the Eastern Cape Health Department (Appendix I). The Eastern Cape Department of Health granted the approval to conduct the study (Appendix II). The Buffalo City Metropolitan Health District was also consulted and endorsed the study (Appendix III). In all the households where data was collected, the researcher explained the aim and objectives of the study in their preferred language. All respondents were informed that participation was voluntary and that they were allowed to withdraw at any stage of the study.

No names or other identifiable information was collected on the questionnaire. The signed consent form was collected separately from the questionnaire, which was collected in a sealed ballot box. Data obtained during this study was kept in a safe, locked cupboard and will be stored for a period of five years. This information will be shredded and disposed of at the end of the five year period. All information provided was treated with confidentiality.

3.11.1 Protecting the rights of the participants

3.11.1.1 Non-discrimination

The researcher avoided discrimination against the participants on the basis of gender, race, ethnicity or other factors that may jeopardise the validity and reliability of the study results. Equal opportunity was afforded to all respondents in the study population through strict adherence to the random sampling methods used.

3.11.1.2 Benevolence

The researcher did no harm, refrained from exploitation of participants and promoted both individual and societal benefits that were directly related to the participation in the research. All study participants were assured that they would not be exposed to any physical harm during the study. Participants were given an opportunity to be part of the study or to refuse if they did not want to participate or felt uncomfortable.

3.11.1.3 Respect for persons

The researcher respected the rights of the participants, both self-determination and the right to full disclosure (full informed consent for research participants). The rights of all people to decide to participate in the study were respected based on the ethical principle of self-determination and the expected professional obligation to truthfully grant full disclosure of information relevant to the study. For participants to make an informed decision to participate in the study, a detailed explanation of the study, including but not limited to, the purpose of the study, consequences of participation or refusal to participate and any possible gains or risks associated with participating in the study, was provided. Participants were asked to voluntarily sign a written consent

form to participate in the study, which was witnessed and co-signed by the researcher. No financial incentives were promised or provided to respondents during the study. Thereafter, the household head signed the information consent letter on behalf of the household and other adults in the household were permitted to assist the household head to answer the questionnaire.

3.11.1.4 Justice

The researcher respected the rights of all the respondents and other categories of participants included in the study with regards to privacy and the right to fair treatment in the context of the research participation. The privacy of participants regarding any information relevant to them and their identity were maintained and safeguarded by the researcher. No section of the research report contained any information that could be used by any reader to determine the personal identity of the source of such information.

3.11.2 Scientific integrity of the research

3.11.2.1 Intellectual honesty

The researcher strived for honesty in all scientific communications by honestly reporting data, results, and methods and cited all authors whose information is contained in this thesis as far as possible. The researcher did not fabricate, falsify or misrepresent data. According to Befring (2015), dishonesty may sometimes manifest itself in plagiarism, fabrication or forgery of data, or in taking the credit for someone else's work. Plagiarism can include duplicating, copying or many other subtle forms of using the theories, interpretations, designs or results of others without reference to the sources.

3.12 Data analysis and estimation

Quantitative data obtained was captured and uploaded onto an excel coded document in a numerical form. The statistician services were used for data analysis, SPSS version 23, was used for the statistical analysis of data. Frequencies of all categorical data were calculated as numbers and percentages. A Chi-square test was used to determine the correlation between categorical variables. The outcomes of these statistical models were interpreted, estimated and presented in tables and graphs.

CHAPTER 4: RESULTS

4.1 Introduction

The findings of the study are presented in this chapter. Phase two of the data collection which included the interviews of household heads is presented first, followed by data collected from first phase which involved the examination of clinic tick registers. The data obtained from phase two is presented in the following sequence: demographic characteristics of household heads and total population, symptoms experienced, health facilities used, common food preparatory methods, households' food safety management, education of household heads, food safety concern levels and clinic records for food-borne disease.

4.2 Participant demographic characteristics

Data was obtained from three villages, namely: Ncera, Needscamp and Mpongo. Twenty-nine household heads were from Ncera, 28 from Needscamp and 30 from Mpongo. In total, 87 household heads were interviewed in the three villages. In these households, there were a total number of 399 people.

The demographic characteristics of household heads are presented in Table 4.1. Over half of household heads were female (*n* = 51; 58.6%), and 33 (37.9%) of them were married, while 11(12.6%) were living together with their partners, and twenty five (28.7%) were single. Twenty six (29.9%) household heads were between 50 and 64 years of age. The majority of household heads were Black (*n* = 86; 98.8%). More than half of the household heads were HIV negative (*n* = 56; 64.4%). More than half of household heads reported that they do not have any other food-borne illness (*n* = 62; 71.3%). Less than half the heads of the household (*n* = 39; 44.8%) had high school education, and only 20 (23%) had tertiary education. The majority of households had a monthly income of R1 500 – R3 500 (*n* = 45; 51.7%). Most of the residents (*n* = 84; 96.5%) use the primary health clinic for their healthcare needs.

Table 4.1: Demographic characteristics of household heads.

Demographic factor	*n* (%)
Gender	
Female	51 (58.6)
Male	36 (41.4)
Marital Status	
Married	33 (37.9)
Single	25 (28.7)
Widowed	15 (17.2)
Living together	11 (12.6)
HIV Status	
Negative	56 (64.4)
Positive	31 (35.6)
Education Level	
Primary School	24 (27.6)
High School	39 (44.8)
Tertiary Education	20 (23)
No formal education	4 (4.6)
Monthly household income	
Less than R 1 200	13 (14.9)
R1 500 – R3 500	45 (51.7)
R4 000 – R6 000	24 (27.6)
R10 000 – R15 000	3 (4.6)
More than R15 000	1 (1.1)
Health facility used	
Public Clinic (free)	84 (96.5)
Private (paid by head of household)	1 (1)
Private (Medical aid)	1 (1.1)

*All percentages do not total to 100 as some participants did not answer all questions.

4.3 Demographics of the total population

It was found that more than half of the study population were female (*n* = 221; 55%). Only 24 (6.0%) of the total household members were HIV positive. Almost a fifth of the study population (*n* = 79; 19.7%) reportedly fell ill or thought that they fell ill from something they ate in the past 3 months.

4.4 Symptoms experienced by those who fell ill from food-borne diseases

A total of 109 (27.3%) household members fell ill from food-borne diseases in Ncera, Mpongo and Needscamp villages. Vomiting was reported by 49 (44.9%) of these respondents, while both nausea and abdominal cramps were experienced by 37 (33. 9%) of those who were infected. Chi-square tests showed no statistical significant relationships existed between those who fell ill and their gender (*p* = 0.152). Most of the participants who contracted food-borne disease were between 35 to 49 years old.

Half (*n* = 56; 51.3%) of the respondents who fell ill with food-borne diseases did not seek medical treatment for their illness. Meanwhile, 41 (37.7%) of the people who had food-borne diseases sought medical treatment at primary healthcare clinics, which provided free treatment (*n* = 19; 46%) and two (4.8%) sought medical treatment from private practitioners. Some used home remedies (*n* = 6; 14%) and others bought over the counter medication from the pharmacy (*n* = 5; 12.1%) to treat their condition. These results are shown in Table 4.2. A large number of household heads reported that they were not diagnosed with cholera when suffering from diarrhoea (*n* = 82; 94.2%) and only one (1.1%) person had diarrhoea while being ill with influenza. Table 4.2 depicts the health facilities used by those who sought medical treatment when they fell ill and illustrates the interventions by healthcare providers. Only four people (9.7%) were requested to provide a stool sample, for testing, when they presented symptoms of food-borne illness, while three (7.3%) reported that the healthcare provider did nothing.

Table 4.2: Health facilities used and interventions

Demographic factor	*n* (%)
Health facility used	
General practitioner	2 (4.8)
Public clinic	19 (46)
Self-treated over counter	5 (12.1)
Homemade remedy	6 (14)
Interventions by healthcare provider	
Took blood samples	1 (2.4)
Asked for stool sample	4 (9.7)
Prescribed medication	16 (39)
Nothing	3 (7.3)

*All percentages do not total to 100 as some participants did not answer all questions.

Table 4.3 reports the common food preparatory methods. A majority of households in these villages have electricity; therefore, most households use electric stoves (*n* = 72; 82.8%) to prepare their meals. It was observed that very few households are using open dung fire to prepare meals (*n* = 4; 4.6%).

Table 4.3: Common food preparatory method in households.

Methods of food preparation	***n* (%)**
Stove	72 (82.7)
Open wood fire	11 (12.6)
Open dung fire	4 (4.6)

Figure 4.1 displays the percentage of food safety concerns by household heads on food prepared away from home. Most household heads reported that they were not concerned at all about the safety of food prepared away from home (*n* = 46; 52.9%) and only were very concerned (*n* = 15; 17.2%).

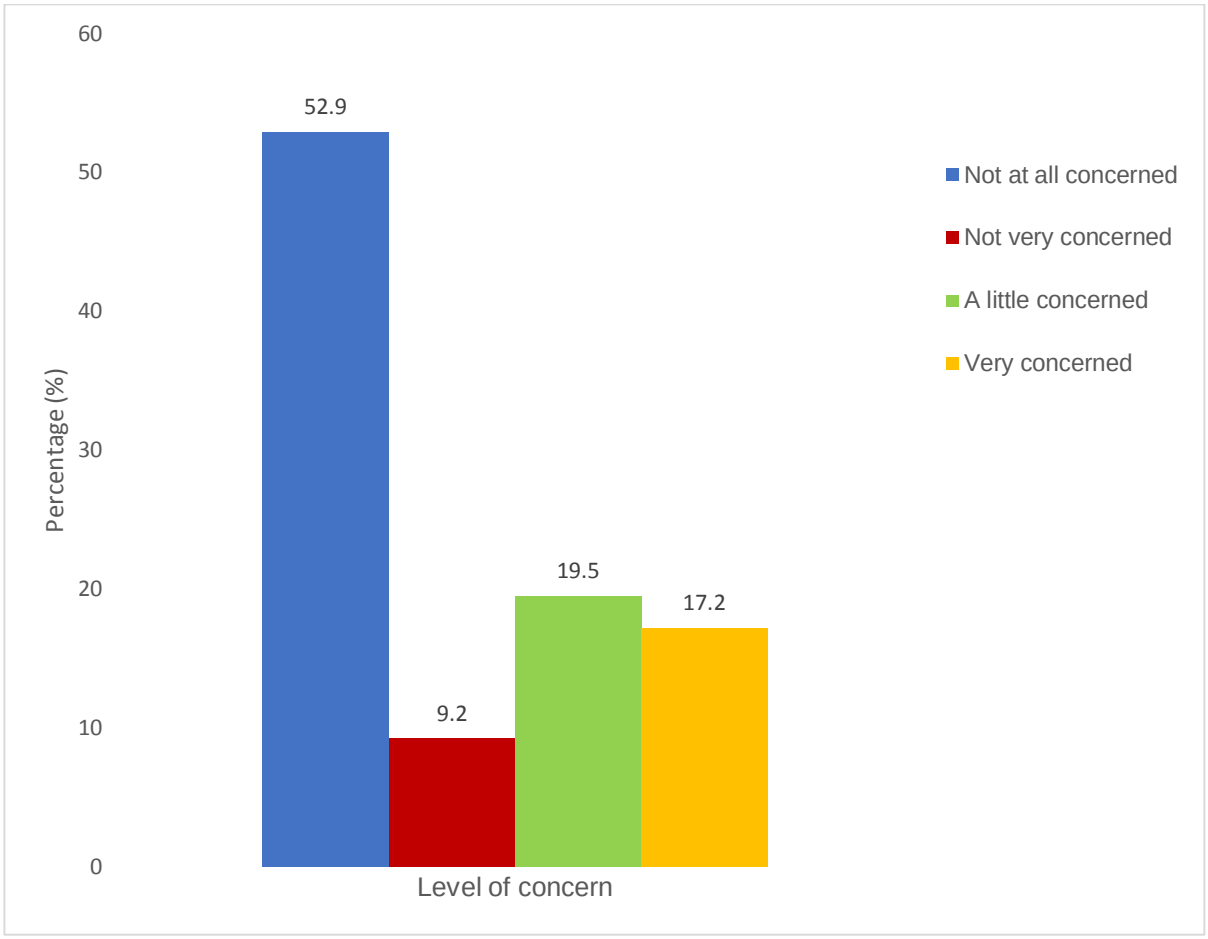

Figure 4.1: Food safety concern levels about food prepared away from home.

In Figure 4.2 the percentage of those concerned about the safety of food prepared at home is reported. Only six (6.9%) were very concerned about the safety of food prepared at home while 43 (49.4%) were not concerned at all.

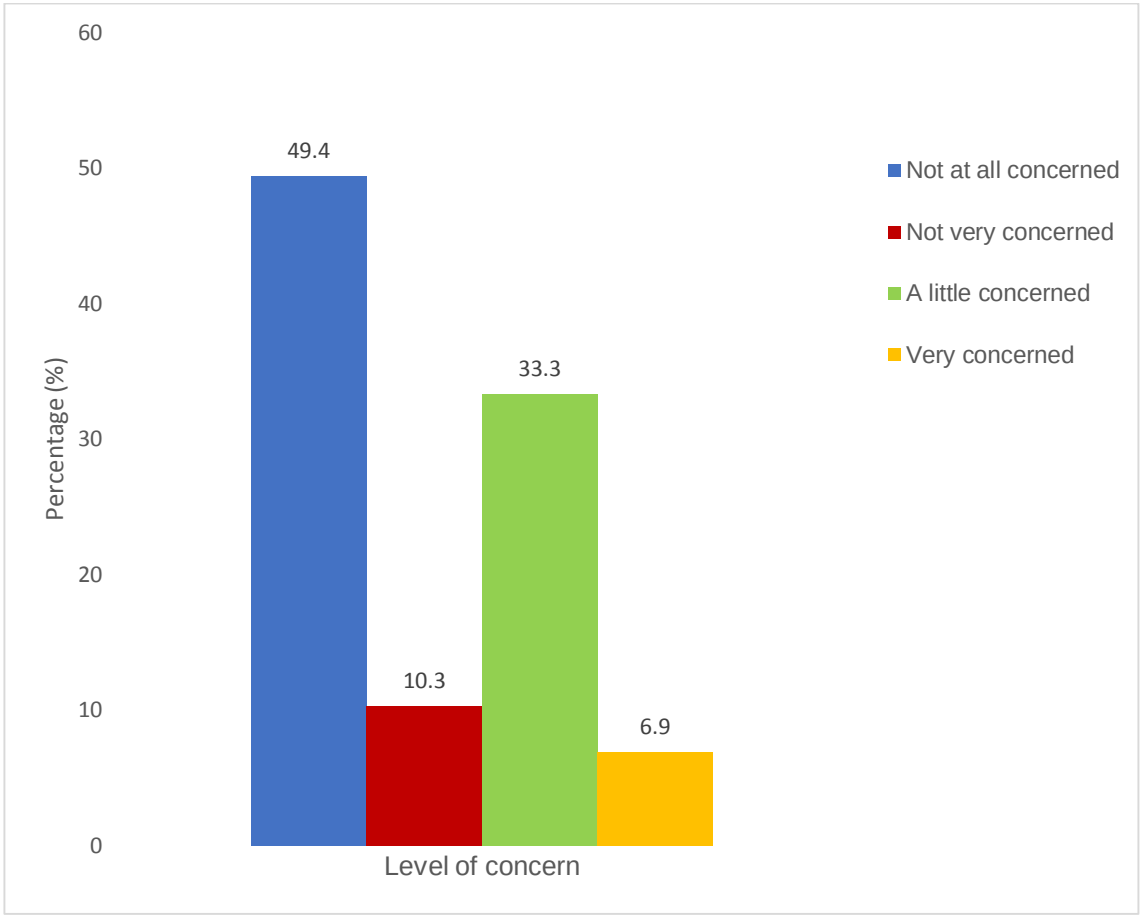

Figure 4.2: Food safety concern levels about food prepared at home.

4.5 Household food safety management

Some household heads had the perception that beef (*n* = 19; 21.8%) and pork (*n* = 16; 18.3%), respectively, pose a great risk to human health in terms of food-borne illnesses. Only three (3.4%) household heads felt that chicken was a risk for food-borne illness. A large number of households consume chicken (*n* = 48; 55.1%) compared to beef (*n* = 20; 22.9%) and pork (*n* = 9; 10.3%). Most household heads reported that they store their perishable foodstuff in a refrigerator (*n* = 69; 79.3%). Only nine (10.3%) households did not have a refrigerator. A small number of households (*n* = 4; 4.5%) buy food daily as required because they either do not have a refrigerator or electricity.

More than half of the household heads (*n* = 50; 57.4%) indicated that increased inspections to food outlets in the villages and urban areas would reduce the risk of food-borne illnesses. Another 16 (18.3%) indicated that health education would reduce the risk. Less than a tenth (*n* = 7; 8.0%) indicated that increased monitoring programmes in food outlets were required and six (6.9%) respondents reported that stiffer penalties for those food handlers who contravene health regulations would reduce the risk of food-borne illness. Most household heads in these villages reported that they wash hands with detergent before handling food (*n* = 78; 89.7%).

Some of the respondents who did not seek medical treatment used homemade remedies. The home remedies used by household heads were aloe mixtures (*n* = 2; 2.3%), camphor (*n* = 4; 4.6%), coke (*n* = 2; 3%) and rooibos tea (n = 3; 3.4%). No traditional healer prescription was reported.

Figure 4.3 displays the available sources of water by the household heads in the sample. Most households receive piped water (*n* = 67; 77.0%), although 15 (17.2%) of these households depended on jojo water tanks. Five (5.7%) consume water from communal tap/tank.

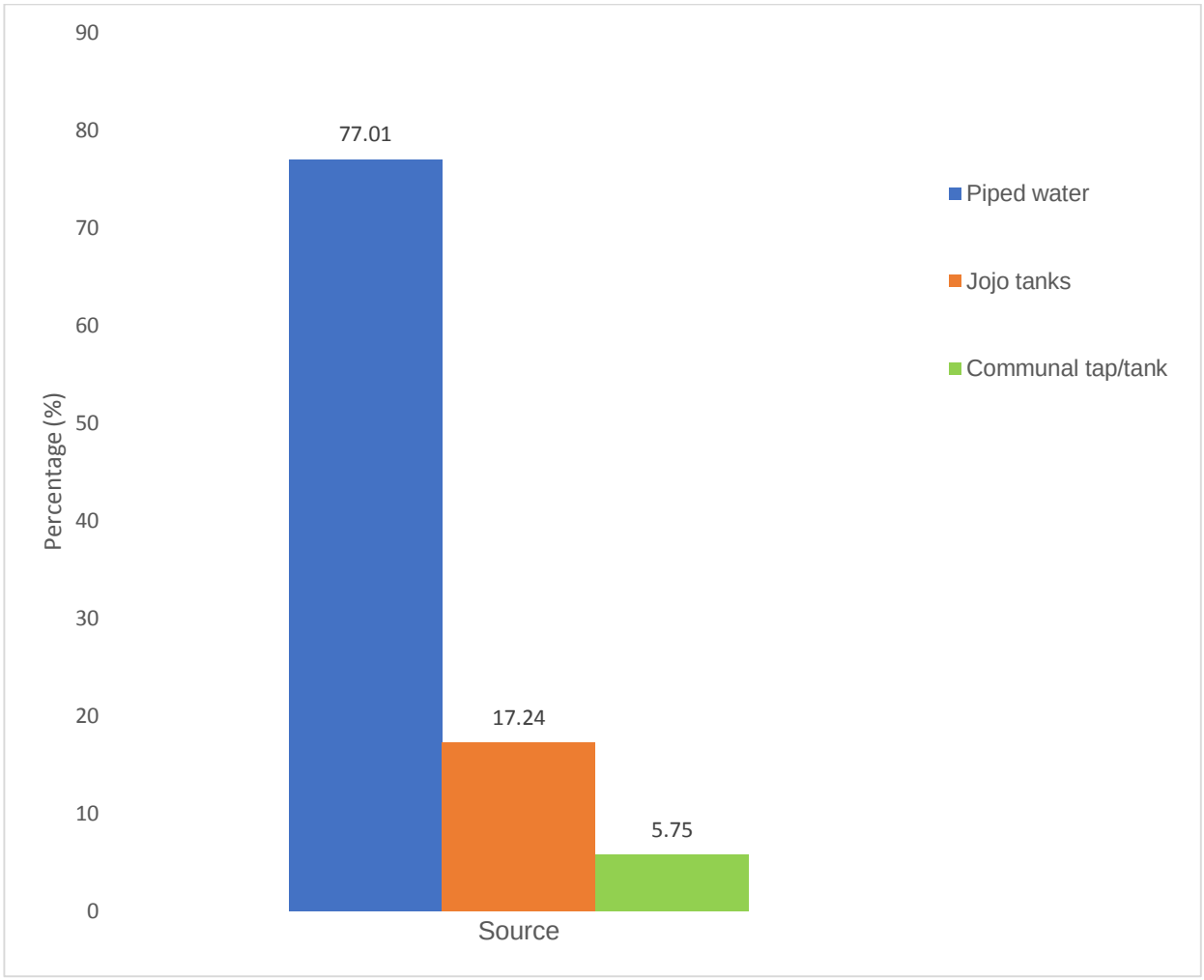

Figure 4.3: Source of drinking and potable water.

4.6 Analysis of relationships between variables

This section focuses on the relationship between variables that were investigated using the Chi-square test. The household income range in relation to educational level of household heads in the sample is shown in figure 4.4. A total of 19 (67.9%) household heads who had no formal education or primary school education earned between R1 500 – R 3 500 per month. Those who had post high school education (*n* = 11; 55%) earned between R4 000 – R 6 000 per month. A further four (20%) of those who had post high school education earned R 10 000 monthly. The relationship between education level of household heads and their income was statistical significant (*p* = 0.03). The pattern indicated that those with higher qualifications earned more than those who had lower qualifications.

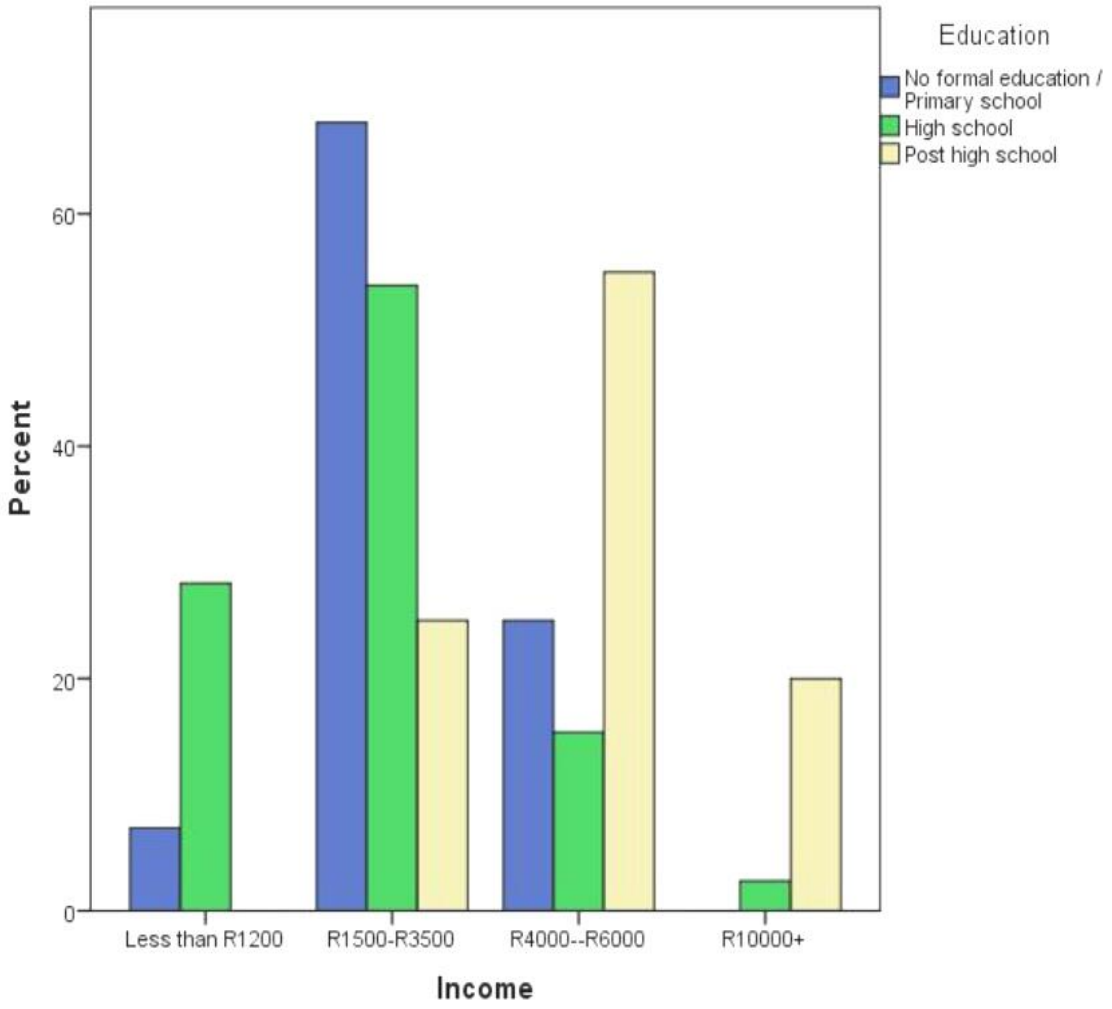

Figure 4.4: Education of household heads in relation to household income.

In table 4.4 the relationship between education levels and food safety concern levels amongst the household heads in the sample is presented. There was a direct relationship between education levels and food safety concern (p = 0.001). It was observed that, people with higher education are more concerned about the safety of food prepared away from home. A large percentage of household heads who did not have formal education or only had primary school education were not concerned at all about the safety of food that is prepared away from home or purchased from Spaza shops and supermarkets (n = 21; 75.0%). Half (n = 19; 50.0%) of the household heads with high school education reported that they were very concerned about the safety of food prepared away from home. In contrast, those with post high school education (n = 20%) were very concerned about the safety of food prepared away from home.

Table 4.4: Food safety concern levels in relation to education levels.

Food Safety Concerns			Education levels		
			No formal education / Primary school	High school	Post High School education
Concern about food prepared away from home	Not at all concerned	Count	21	19	6
		% within Education	75.0%	50.0%	30.0%
	Somewhat concerned	Count	6	13	10
		% within Education	21.4%	34.2%	50.0%
	Very concerned	Count	1	6	4
		% within Education	3.6%	15.8%	20.0%

The study found that the relationship between food safety concern levels about food prepared at home and away from home was statistically significant (p = 0.000). It was observed that most respondents were not concerned about the safety of food prepared at home, in contrast to concerns expressed on the safety of food prepared away from home.

4.7 Clinic records for food-borne diseases.

There was a total of 378 tick registers scrutinized. The tick registers in the Mpongo (119), Ncera (124) and Needscamp (135) clinics were examined from the 2012 to 2014 period. In Mpongo and Needscamp, there were no cases of reported food-borne diseases in the entire period under review. However, there were four recorded cases of food-borne diseases which were self-reported in Ncera clinic in 2012. The professional nurse in charge at the clinic during the examination indicated that they usually refer food-borne diseases cases to Frere Hospital in East London. Nevertheless, these cases did not appear in the transfer book that was used in 2012. Furthermore, it was not clear whether these cases were notified as required by regulation 287 (2010).

CHAPTER 5: DISCUSSION

5.1 Introduction

This chapter presents the discussion of the study findings that were reported in the previous chapter. Literature was used to compare these results to those of previous studies. The study included the scrutinizing of tick registers at Ncera, Mpongo and Needscamp clinics from 2012 to 2014. Thereafter, a community survey through a self-administered questionnaire of 87 randomly selected households in Ncera, Mpongo and Needscamp villages was done.

5.2 Food-borne diseases findings and dynamics

The outcomes of the 378 tick registers from clinics did not correspond with the community survey findings. There were only four cases of food-borne diseases that were recorded in the tick registers. However, the community survey found that more than a quarter of the people who lived in these villages for more than six months reported that they fell ill from a food-borne disease after consuming certain food during the same period, thus indicating a gap in the health surveillance system. Although self-diagnosis is not reliable, they reported food-borne symptoms. This view was considered in line with Wu *et al.,* (2016) argument which stated that there is no single testing method for a food-borne illness.

A health practitioner will likely rely on the patient's symptoms when making a diagnosis. Taege (2010) elaborates further by defining diagnosis as the act of accomplishing a careful history, physical examination, and laboratory evaluation. In another study, healthcare professionals were found to be more focused on treatment of symptoms of the illness rather than confirming diagnosis and reporting of the condition (Arendt *et al.,* 2013). According to Wolf (2013), confirming a diagnosis of food-borne illness is not always as straightforward as perceived, and many of the symptoms of food-borne disease are similar to those for other illnesses (Taege, 2010). Literature highlighted that the most common test to diagnose a food-borne pathogen,

is either blood test or stool sample identification (Humphries & Linscott, 2015). In consideration of the food-borne disease diagnostic complexities, there is a debate in the USA on the introduction of the culture independent diagnostic test (CIDT) that will detect food-borne pathogens and yield results in the doctor's room or clinic in a few minutes (Cronquist *et al.,* 2012). However, the CDC (2013[b]) stated that CIDTs do not provide the information needed to characterize the organisms that cause infections, determine the data that is needed to identify antibiotic resistance or determine outbreaks and monitor disease trends. Although the CIDTs are threatening the public health surveillance system which relies on their laboratory network; inversely, they present an opportunity to reconcile new methods with the clinical laboratories in the best interest of patient management and public health surveillance (Atkinson, Maguire & Gerner-Smidt, 2013).

Stool collection and laboratory capacity is vital for food-borne disease management. Persuad *at el.,* (2013) reported that the underreporting of food-borne pathogens, stool collection and laboratory capacity were major gaps affecting the surveillance of acute gastroenteritis in Guyana. In South Africa, the HIV/AIDS rapid test has been approved for private use; however, there are no CIDTs used in food-borne disease surveillance.

In South Africa, regulation 287 (2010) was promulgated under the NHA (2003) to regulate communicable disease control and management. In terms of regulation 287 (2010), food-borne diseases are regarded as notifiable medical conditions (Table 2.3). Regulation 287 further stipulates that health providers are required to immediately verbally report and thereafter submit a written confirmation within 24 hours of any suspected food-borne cases.

South Africa uses the National Notifiable Disease Surveillance System which only reacts when there is an outbreak or case of a disease. The USA and UK use more than one surveillance system and took advantage of high use of internet by communities. In the USA, they have web health surveillance systems that can be used by the public to report a food-borne case (Ayalew *et al.,* 2013). Nsoesie, Gordon and Brownstein (2014) argue that traditional surveillance systems only capture a fraction

of the estimated 48 million yearly cases of food-borne illness in the United States. Kirk (2014) reported that improved and periodic testing of the surveillance systems of food-borne diseases has contributed to the fall of reported food-borne outbreaks from 1992 to 2000 in England. The researcher did not find any similar online health surveillance system that can be used by community members but managed by the state in South Africa. However, it is unclear whether the health professionals in Ncera clinic complied with the protocol as outlined by communicable disease regulation 287 (2010) in reporting.

This investigation reported that more than a quarter of household members fell ill from food-borne diseases in Ncera, Mpongo and Needscamp villages from 2012 to 2014. This is higher than the 25% of people who suffered from food-borne diseases during the same period in Northern Ireland (Burazeri *et al.,* 2015). A report by CDC (2015) stated that during 2012, 831 food-borne disease outbreaks were reported, resulting in a total of 14 972 cases. Akabanda, Hlortsi and Owusu-Kwarteng (2016) conducted a study in Ghana and found that in 43 case-patients, 44.2% of people who fell ill were males. Africa was estimated to have the highest burden of food-borne diseases (WHO, 2016). Although there is no easily available official statistics on the prevalence of food-borne diseases in South Africa, sporadic food-borne disease outbreaks occur frequently. In the BCMHD alone, there was a food-borne disease outbreak that involved more than 1000 pupils from 12 schools who fell ill after consuming sour milk and pap (Dispatchlive, 2016).

This study reported that more than half of the people who fell ill with food-borne diseases in these villages from 2012 to 2014 did not seek medical treatment for their illness. The practice of not seeking treatment is in line with the findings by WHO (2015) which suggest that food-borne diseases are under-reported worldwide. Another study conducted in Guyana, South America, found that the burden of syndromic acute gastroenteritis cases in the population for 2009 was estimated to be 131 012 cases compared to the reported 30 468 cases, suggesting a 76.7% of under-reporting, which implied that for every syndromic case of acute gastroenteritis reported, there were an additional 4.3 cases occurring in the community. For every laboratory-confirmed case

of acute gastroenteritis pathogen reported, it was estimated that approximately 2 881 more cases were occurring in the population of Guyana (Persuad *et al.,* 2013). A similar study by Arendt *et al.,* (2013) found that health officials are concerned by under-reporting of food-borne illnesses and thus reported that there were barriers which could be overcome with targeted education and improved access and information on the reporting process. The challenge for consumers and healthcare providers suspecting a food related incident is to navigate among various government organizations to identify the right one to take appropriate action. The report further alluded that consumers' reluctance to report appeared to be due to unwillingness to cause damage to the reputation of a food outlet.

Some respondents indicated that they became ill during the weekends so they could not find transport to a medical facility while others reported that they did not see the need to seek medical treatment. The long distances and limited public transport in these villages remain a challenge in order to access the nearest clinic. While a few respondents were advised by other people to try other methods of treatment instead of going to the clinic. The alternative treatment included, rooibos tea, camphor, aloe mixture and coke. These included people who had medical aids or could afford to pay for a private healthcare practitioner or could afford to buy medication from the chemist. According to Hussain and Dawson (2013), this is a common practice, that healthy adults do not see the need to seek medical help for minor to medium food-borne cases. Frean (2010) stated that food-borne diseases are under-reported and poorly investigated in South Africa. It is estimated that the reported incidence of food-borne disease represent one percent of the actual incidence (Van De Venter, 2000). In the USA food-borne and water-borne diseases are preventable; however, most surveillance systems rely on the data supplied by the local health facilities in order to implement appropriate interventions (CDC, 2016).

The ECDC (2016) reported that more than 60% of people in the Eastern Cape have access to a public healthcare facility. In congruent, this research found 46% people who had food-borne diseases and subsequently sought medical treatment at public clinics for free. The African continent had 92 Million reported food-borne illnesses, thus

making it the highest food-borne disease burden continent (WHO (2015). Newell *et al.,* (2010) argue that although food safety standards depend on the continuous vigilance maintained by surveillance and monitoring, the rise of other food-related complications such as obesity, food security and climate change have led to a fierce competition of resources. Literature suggests that within the global agenda, climate change adaptation and food security occupies the forefront resulting in the overshadowing of food safety issues. When WHO celebrated the World Health Day on the 7 April under the theme 'food safety' in 2015, it was a strategic move to refocus the countries' attention to food safety (WHO, 2015). This study found that less than a tenth of those who sought medical treatment reported that the health provider did nothing even though they felt ill. It appeared that there is minimum communication between patients and health officials, as patients felt the practitioner did nothing after consultation. In terms of the South African government Batho Pele Principles, the client must be informed, treated with courtesy and consulted; it promotes openness and transparent healthcare professionals as key stakeholders in the surveillance of food-borne diseases. Arendt *et al.* (2013) reported that healthcare professionals indicated that the incubation period, not seeking treatment by those who are ill, lack of knowledge, cost associated with food-borne management and lack of knowledge on collection of stool samples are some of the barriers to food-borne diseases management in the USA. A similar study conducted in the USA revealed that 61% of the community members believed what they are told by a healthcare professional about their health (Arendt *et al.,* 2013). Therefore, more communication and health education by healthcare professionals on food-borne diseases to patients will increase awareness and improve the reporting of food-borne incidences.

Almost half of those who fell ill reported vomiting, while both nausea and abdominal cramps were experienced by more than 10% of those who were infected. According to the FDA (2016), vomiting, nausea and abdominal cramps are common food-borne diseases symptoms.

According to WHO (2015) food-borne diseases are endured by individuals of all ages, particularly people in low-income regions of the world. However, this study reported

that the highest number of people who had food-borne disease were between 35 to 49 years of age. A study in Ghana revealed that the most affected age group by food-borne diseases was between 15 and 34 years (Osei-Tutu & Anto, 2016). Other researches show a higher food-borne disease incidence in children under five years and also in the age group of 50 to 60 years (Foodnet, 2012). A study conducted in Turkey discovered that food safety knowledge of young consumers is at an insufficient level, and their food handling practices are inappropriate (Knight & Warland, 2004). The CDC (2014) stated that senior citizens who are 65 and above were particularly at risk of food-borne illnesses. However, people between 65 to 80 years in this study reported the lowest food-borne incidence.

A relatively low percentage of those who fell ill from food-borne diseases used homemade remedies. Home remedies that were used, include aloe mixtures, camphor, coke and rooibos tea. There are many websites that prescribe homemade remedies to cure food-borne diseases. A study that was conducted by Sander and Baumeister (2016) found that people are increasingly relying on the internet for information on management and treatment of different conditions because it is more cost effective and convenient.

In South Africa, there was no online food-borne reporting system found or reported for public usage. In the USA and UK, there are online systems to report food-borne illness to the public which are monitored by the health ministries and by interested health organisations. In the UK, technology and innovation has been used to develop methods and systems that will detect food-borne agents faster (Genova, 2012).

This study also found that almost half of household heads perceived beef and pork as posing the greatest risk to human health in terms of food-borne diseases. Food safety perception is influenced by social status. A study by Sarma (2015) that was conducted in United Arab Emirates found that English, Emirate and Arab consumers read the expiration dates and ingredients on the food labels; conversely, the Urdu/Hindi-speaking consumers were not too concerned about the expiration dates and ingredients on the food labels, but were more concerned with checking prices. Hindi-

speaking people were less educated, unskilled and worked for low wages (Sarma, 2015). Similarly, the current study shows a relationship between food safety concerns and income, as well as education. A similar study was conducted in Portugal and found that socio-economic and education variables play a vital role when explaining the consumer's perception on food safety (Machado *et al.,* 2014).

The household heads who earned between R1 500 – R3 500 reported that they either had no formal education or only primary school education. However, those who earned R10 000 and more had post high school education. These findings are similar to a study in the USA where it was found that the higher the education, the higher the income (Strauss, 2012). Residents of low socio-economic areas are usually perceived as a vulnerable group as they receive less safe food from local retail premises (Quinlan, 2013). Although low socio-economic status is generally associated with negative health outcomes, its impact on food-borne illness is poorly understood (Quinlan, 2013). A study that was conducted in the USA revealed that *Campylobacter,* salmonellosis and *Escherichia coli* infections were associated with people of high socio-economic status (Newman *et al.,* 2015).

A large proportion of households reported that they consume chicken more often than beef and pork. Literature showed that Americans also eat more chicken than beef even though the CDC[b] (2013) stated that poultry is the food associated with most food-borne infections. To the contrary, the Center of Science in the Public Interest (CSPI) (2015) reported a study conducted in USA which found that fresh produce such as cilantro, peppers, cucumbers and cantaloupes caused 629 outbreaks with almost 20 000 illnesses. The latter report is in line with the results of another study that was conducted from 1998 – 2008 which attributed 51% of food-borne outbreaks to plant commodities which includes: grains, beans, oil, sugars, refined plant foods, fruits- nuts, fungi and vegetables (Painter *et al.,* 2013). Recent studies suggested that plant food is increasingly the cause of most food-borne disease outbreaks. Increased rates of some food-borne outbreaks among minority ethnic populations due to the unique food consumption patterns have been widely reported.

The study reported that 82.8% of households use electric stoves to cook. A study conducted in Ghana found that the microbial quality of cooked food is low and, generally, food handlers at home do not have information on how to prepare, store and handle food safely (Esena & Owusu, 2013). More health and hygiene awarenesses in rural communities are needed in order share information on safe food preparation in a rural setting.

More than half of household heads reported that they were not concerned at all about the safety of food prepared away from home. Nsoesie *et al.,* (2014) alluded to a high number of USA food-borne disease outbreaks that were found to be associated with food prepared away from home. A study that was conducted in Mexico revealed that the expenditure and consumption of food prepared away from home has a positive association with education, area of residence (rural vs urban) and socioeconomic status (Langellier, 2015).

Guthrie and Lin (2012) stated that in the past thirty years, food prepared at home has adapted more in response to dietary guidance, resulting in low fat content and richer in calcium, whereas food prepared away from home did not. It was reported that in the USA, consumption of food prepared away from home has increased from 25.9% in 1970 to 43.1% in 2012 despite the negative health findings by various studies. This was attributed to more women working away from home and access to affordable convenient fast food outlets (Lin, 2011). Fast foods are mostly characterised as energy dense, low in micronutrients and fibre but high in simple sugars and salts (Lin, 2011). Studies have shown that the consumption of fast food in South Africa has also increased (Pereira, 2014). In BCMM report (2016), more than 65% of Spaza shops or food outlets in rural areas do not adhere to health and hygiene standards of food premises and did not have certificates of acceptability as required by South African legislation. Food outlets are the primary source of convenient food in many parts of South Africa; therefore, non-compliance to legislation is unacceptable (NHA, 2003).

A large proportion of household heads indicated that more inspections of food outlets in the village would be the best approach in order to prevent food-borne diseases. The

NEHP (2013) stipulates a ratio of one EHP per ten thousand people (1:10 000) as opposed to one EHP per fifteen thousand people (1:15 000) by the WHO. The current ratio in BCMM is approximated at one EHP per 23 000 (1:23 000) people. This ratio makes it impractical to meet the EHNNS (2013) frequency, which is one inspection per food premises per quarter. This approach in South Africa is not achievable in this current state. More than a tenth of respondents indicated that health education would be the best approach to reduce the risk of food-borne illness. The WHO (2006) developed a health education tool in a form of five keys to safer food, which are keep clean, separate raw and cooked food, cook food thoroughly, keep food at safe temperatures and use safe water and raw material. Other components of prevention include managing and avoiding poor personal hygiene, inadequate cooking, holding temperature and contaminated equipment (Campbell, 2011).

Buffalo City Municipality became a metropolitan municipality in 2011; it includes many low-income villages that were previously serviced by Amatole District Municipality (Figure 3.1). These villages have more than 50 schools which prepare food on school premises. In BCMM, the food premises register includes 65% of informal shops situated in informal settlements and rural areas. These do not have the certificates of acceptability, which is a legal prerequisite for all food handling premises in South Africa (Regulation 962, 2012). The Meat Safety Act 40 (MSA) (2000) states that no person is allowed to slaughter any animal for commercial purposes, except in an approved abattoir. However, the practise of cultural slaughtering is common in these villages.

5.3 Limitations of the study

The researcher assumed that all questions were answered openly and honestly by those who agreed to participate, thus allowing an accurate reflection of the respondents (Brink *et al.,* 2007). The Ncera villages are situated approximately 50 kilometres from East London. The village homes are clustered and in remote areas. These elements limited the visits to the villages to only four visits per month for two months, thereby resulting in many house visits per day and operating under pressure. It was difficult to enter some households with vicious dogs.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

To the best of the researcher's knowledge, this is the first study to investigate the prevalence of food-borne diseases and to determine the level of knowledge of residents on food-borne illness in rural areas in South Africa. The findings of the study showed that the majority of food-borne cases were not reported to the health facilities by residents in Ncera, Mpongo, and Needscamp villages. The data collected from the clinic tick registers showed only four reported food-borne cases from the 2012 to 2014 period in Ncera.

6.2 Major findings of the study

The study revealed that that villagers were highly exposed to food-borne diseases due to their lack of knowledge in terms of communicable disease notification. The majority of the respondents involved in the study were females. Most of them were married and were providers of their households. More than a quarter of the household heads were HIV positive. Most household heads had high school education. The majority of household heads earned between R1 500 – R 3 500 and used a public clinic which provided free service. It was also noted that more can be done by health providers in terms of accurate diagnosis, food-borne disease management and food safety education.

A large proportion of household heads indicated that more inspections of food outlets in the village would help to prevent food-borne diseases. More than half of household heads reported that they were not concerned at all about the safety of food prepared away from home. More than 80% of households use electric stoves to cook. Studies that were reviewed during this study found some association between selected food commodities such as chicken, pork, beef and leafy vegetables. A small proportion of people still believe in home remedies. The terrain of these villages is vast and there is heavy reliance on public transportation, with a few attributing non-reporting or seeking

medical help to these factors. This study found that more than 50% of the people who fell ill with food-borne diseases in these villages during the period of investigation did not seek medical treatment.

It was alarming to find only four food-borne disease cases recorded in the clinic records over a period of three years. These finding introduced an unexpected theme of a possible misdiagnosis by health professionals and treatment of symptoms more that reporting the cases, as suggested by Arendt *et al.,* (2013). The majority of the respondents were not aware that they need to seek medical treatment for food-borne ailments and did not comply with health legislations. Environmental factors such as extreme heat and flooding cannot be excluded as contributing factors to food-borne cases in these villages. Climate change affects the social and environmental determinants of health, clean air, safe drinking water including the quality and sufficiency of food (Mansour, 2014).

Finally, the deficiencies in the tick record to solicit critical data from patients may have contributed to the poor surveillance of food-borne diseases in these villages. The preliminary data suggest a possibility of more residents in these villages that have contracted food-borne diseases but were unaware or they failed to link the food consumed to the illness. There is a need for a broader study that will investigate more variables on the same subject in order to determine any statistical associations between healthcare providers who lack the knowledge on food-borne diseases and poor reporting of food borne cases in these clinics and other variables of interest.

In view of the information gathered during the field surveys and during data analysis, the following recommendations were made:

- The format of the tick register used by nurses in clinics should be reviewed, standardized and should solicit food-borne illness information and demographics of the suspected cases. Legibility when recording data should be highlighted for all healthcare professionals. Developing a separate tick

register that will be used only for notifiable medical conditions or combine it to the current existing record books would be useful.

- Encourage healthcare providers to test patient specimens as part of the routine diagnostic process for possible food-borne diseases.
- A secured online food-borne disease surveillance system should be developed. The system should be user friendly for the public to lodge food-borne cases or suspected cases. The relevant department should monitor and follow up on the cases in conjunction with the local health facility, local municipality and health officials.
- Revive and strengthen the complaint system by consumers.
- Create an awareness and health education of food-borne diseases and sanitation through *Imbizos*, community meetings and health talks at clinics. This includes hygiene education where children and elders are taught the correct hand wash technique. Posters and pamphlets about the dangers of food-borne disease should be developed and written in IsiXhosa for distribution in schools, clinics and shops.
- An alternate work approach should be adopted to curb the rising non-compliant food outlets in these villages. This includes mobilising environmental health practitioners, health promotion, officials from agriculture, prosecutors and the South African police services in order to enforce complaints by food outlets owners.
- Organize and train groups of women, including mothers and young girls, who cook for cultural functions of the villages, on the five keys to safer food and issue certificates. In all these villages, there are people known to the chieftain who slaughter and prepare meals during village activities. This will be both developmental and educative which is in line with the Sustainable Development Goals and South African Development Plan of 2030.

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APPENDICES

APPENDIX A

INSTITUTIONAL RESEARCH ETHICS COMMITTEE CONDITIONAL APPROVAL

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

19 July 2016

IREC Reference Number: **REC 58/16**

Mr K Z Bisholo
127 Golden Highway
Mdantsane
5219

Dear Mr Bisholo

AN EPIDEMIOLOGICAL INVESTIGATION OF FOOD-BORNE DISEASE IN THE NCERA VILLAGES, EASTERN CAPE, SOUTH AFRICA

I am pleased to inform you that Provisional Approval has been granted to your proposal REC 58/16 subject to:

- Piloting of the data collection tool and
- Obtaining and submitting the necessary gatekeeper permission/s to the IREC.

Full approval is subject to meeting the above conditions.

The Proposal has been allocated the following Ethical Clearance number **IREC 062/16**. Please use this number in all communication with this office.

Approval has been granted for a period of two years, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

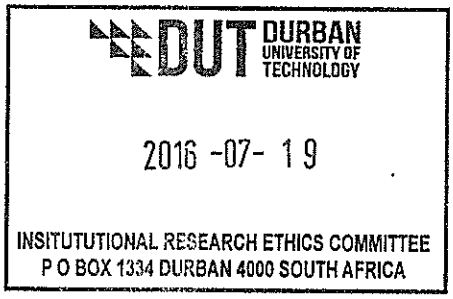
Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Please note that you may continue with validity testing and piloting of the data collection tool. Research on the proposed project may not proceed until IREC reviews and approves the final document. If there are no changes to the data collection tool, kindly notify the IREC in writing.

Yours Sincerely

Professor J K Adam
Chairperson: IREC



APPENDIX B

INSTITUTIONAL RESEARCH ETHICS COMMITTEE FULL APPROVAL

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

25 August 2016

IREC Reference Number: **REC 58/16**

Mr K Z Bisholo
127 Golden Highway
Mdantsane
5219

Dear Mr Bisholo

AN EPIDEMIOLOGICAL INVESTIGATION OF FOOD-BORNE DISEASE IN THE NCERA VILLAGES, EASTERN CAPE, SOUTH AFRICA

The Institutional Research Ethics Committee acknowledges receipt of your final data collection tool for review.

We are pleased to inform you that the questionnaire has been approved. Kindly ensure that participants used for the pilot study are not part of the main study.

In addition, the IREC acknowledges receipt of your gatekeeper permission letters.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Yours Sincerely,

[redacted]

Professor J K Adam
Chairperson: IREC

DUT DURBAN UNIVERSITY OF TECHNOLOGY

2016 -08- 25

INSITUTUTIONAL RESEARCH ETHICS COMMITTEE
P O BOX 1334 DURBAN 4000 SOUTH AFRICA

APPENDIX I

PERMISSION REQUEST TO CONDUCT A STUDY IN THE EASTERN CAPE

Durban University of Technology
Department of Community Health Studies
Durban

To: Eastern Cape Department of Health
Attention: Mr Z. P. Merile
CC: Buffalo City Metro Health District
Attention: Dr M V Nkohla
Ward 32 Councillor
Attention: Cllr V Peter
From: Shanaz Ghuman
HOD: Community Health Studies
Date: 13 October 2015

RE: PERMISSION REQUEST TO CONDUCT A STUDY IN THE EASTERN CAPE

Dear Mr Merile

Khanya Zukolwakhe Bisholo presently registered as a Masters student (21556724) at the Durban University of Technology in the Department of Community Health Sciences in Environmental Health. The proposed title of his research project is: *"An epidemiological investigation of food-borne diseases in the Ncera villages, Eastern Cape, South Africa"*. The aim of the study is to investigate the epidemiology of food-borne diseases in Ncera villages in the Eastern, South Africa.

Objectives:

- To determine the prevalence of foodborne disease from clinic records.
- To determine the community's level of understanding of food-borne illness.

- To determine reasons for not seeking medical help and for not reporting food-borne illnesses in these communities.

I hereby request your permission to conduct the research project at the Buffalo City Health District in the following clinics, namely; Ncera, Mpongo, Open Shaw and Needs camp Clinics. The research proposal and ethical clearance certificate will be sent to you once available. Your support and permission will be appreciated. Please feel free to contact me or my supervisor.

Sincerely

[redacted]

Khanya Bisholo
M-TECH Student
Community Health Studies
043 705 2908/0728245413

[redacted]

Shanaz Ghuman
Supervisor, HOD:
Community Health Studies
031 373 2807/083 588 3245

APPENDIX II

GRANTED PERMISSION TO CONDUCT THE STUDY IN THE EASTERN CAPE

Eastern Cape Department of Health

Enquiries:	Madoda Xokwe	Tel No:	040 608 0830
Date:	22 July 2016	Fax No:	043 642 1409
e-mail address:	madoda.xokwe@echealth.gov.za		

Dear Mr. K. Bisholo

Re: AN EPIDEMIOLOGICAL INVESTIGATION OF FOOD-BORNE DISEASE IN THE NCERA VILLAGES, EASTERN CAPE, SOUTH AFRICA. (EC_2016RP11_320)

The Department of Health would like to inform you that your application for conducting a research on the abovementioned topic has been approved based on the following conditions:

1. During your study, you will follow the submitted protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.
2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.
3. The Department of Health expects you to provide a progress on your study every 3 months (from date you received this letter) in writing.
4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Epidemiological Research & Surveillance Management. You may be invited to the department to come and present your research findings with your implementable recommendations.
5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.

[redacted]

SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE

PGDP EASTERN CAPE 2004 - 2014

Ikamva eliqaqambileyo!

APPENDIX III

GRANTED PERMISSION TO CONDUCT THE STUDY IN THE BUFFALO CITY METRO HEALTH DISTRICT

Province of the
EASTERN CAPE
HEALTH

BUFFALO CITY METRO HEALTH DISTRICT

OFFICE OF THE DISTRICT MANAGER
9 Vincent Road • Vincent •East London •5200, Eastern Cape
Private Bag X 9015 •Main Post Office, East London • 5200 • Eastern Cape
Tel.: +27 (0)43 7111 1100 •Fax: +27 (0)43 721 1810 • Website: www.ecdoh.gov.za
Enquiries: Ms Z Mntuvedwa

INTERNAL MEMORANDUM

To:	Sub-District Manager Clinic Supervisors Operational Managers: Ncera, Mpongo, Needs Camp Clinics Programme Managers
From:	District Manager
Subject:	Permission to conduct Research Study: Mr K Bisholo
Date:	8 August 2016

Purpose

The purpose of this memorandum is to inform relevant Buffalo City Health District staff and patients of permission granted on research study to be conducted by Mr K Bisholo towards a Masters Programmes in Department of Community Health Sciences in Environment with the Durban University of Technology.

Background and Exposition of Facts

Mr K Bisholo is currently enrolled for a Masters Programme at the Durban University of Technology. The aim of his research study is an epidemiological investigation of food-borne diseases in the Ncera Village in Eastern Cape Province, South Africa.

He has requested for permission to do research in Buffalo City Metro Health District in the following facilities: Ncera Clinic, Mpongo Clinic and Needs Camp Clinic. Mr Bisholo has submitted all the required documents for a research study in the Eastern Cape Department of Health facilities and as such permission has been granted to him by the Research unit to conduct the study in terms of his research protocol and methodology.

PERMISSION TO CONDUCT RESEARCH STUDY: Mr K Bisholo

Approval by the district

1. Kindly note that this memorandum serves as an approval at district level for Mr K Bisholo to conduct his research study in terms of the approved research protocol, ethical clearance and permission letter from the research unit subject to him producing all necessary supporting documentation on request to prospective participants in the research study and management of the district;

2. All posters advertising the research must first be tabled with Sub-District Manager to ensure compliance with departmental policies;

3. Patient details and addresses will only be provided to the researcher on those who have consented to participate in the research subject to the terms and condition of the letter of approval from the Research Unit of the Eastern Cape Department of Health.

APPROVED

[redacted]

DR MV NKOHLA
DISTRICT MANAGER
BUFFALO CITY METROHEALTH DISTRICT

08/08/2016
DATE

APPENDIX IV

INFORMATION LETTER IN ISIXHOSA AND ENGLISH (LOCAL LANGUAGE)

INCWADI YENKCUKACHA ZOPHANDO

Isihloko Sophando: AN EPIDEMIOLOGICAL INVESTIGATION OF FOOD-BORNE DISEASES IN THE NCERA VILLAGES, EASTERN CAPE, SOUTH AFRICA

Umphandi oyintloko: Khanya Bisholo (B-Tech: Environmental Health)

Abancedisana nomphandi: Dr S Ghuman (PHD: Public Health) & Dr F Haffejee (PhD: Optics & Imaging, Medicine)

Injogo yoluphando ngokufutshane: Uyamenywa ukuba uthabathe inxaxheba kuphando oluqhutywa ngu Khanya Bisholo. Injongo yoluphando kuku jonga ngokubanzi isigulo esiza ngokutya ukuba sande kangakanani na apha kwezilali zase Ncera, empumakoloni, Emzantsi Africa.

Injongo yophando:

- Kukuphanda ukunwenwa kwesigulo sokutya ngoku gqala ovimba be klinics ezikulengingqi.
- Kukuphanda ukuba abahlali ngokubanzi banolwazi olungakanani ngesisigulo.
- Ukuphanda izizathu zokuba abantu abanesisigulo bangafuni ukuyakwa gqirha okanywe bangasichazi.

Ukuchaza ingqubo ezkulandelwa: Oluphando luqhutyelwa kwilali zase Ncera ezikude kufuphi nedolophu yase monti. Kuqikelelwa ukuba imizi eyi 90 kwezi lali izondwendwelwa ukuyokwenza udliwano ndlebe nabo. Uza kunikwa uludwe lwemibuzo malunga ngesigulo sokutya ekuzofuneka uyiphendule. Ukuba ufuna ukuncedwa, umphandi angakuncendisa ubhala impendulo zakho. Ukuba uyavuma ukubayinxalenye yoluphando uzakutyikitya isivumelwalo. Nceda uqaphele, igama lakho aliyikubhengezwa kuzo zonke imbalelwano ezinophuma ngenxayophando. Kodwa ingxelo gabalala iyakusetyenziswa yona.

Okubasesichengeni kwabo bathabatha inxaxheba: Kolu phando akukhonto yazekayo enokubeka abobathabatha inxaxheba eschengeni.

Inzuzo: Oluphando liza kunceda ukuqonda esisigulo singachazwa ngokufanelekileyo kwananjalo luzakufundisa abahlali balengingqi ngesisigulo,

kwakhona luzakunceda ekukwazi ukufumana abantu abanesigulo ngendlela ephucukileyo.

Isizathu esinobangela ukukhutshwa kothabatha inxaxheba: Ukungafumaneki ngexesha lodliwano ndlebe nalowo uthabatha inxaxheba, uyakuthi akhutshwe koluphando.

Umrholo: Akuzobakho mrholo kwabo bathabatha inxaxheba koluphando.

Indleko ngenxa yoluphando: Abo bathabatha inxaxheba baya kwenziwa udliwano ndlebe emakhayeni abo, abayikukhupha mali.

Imfihlelo: Inkcukacha zakho aziyi kuchazwa nabani na ongaphandle koluphando nakwi ncwadi ezinophuma ngenxa yoluphando.

Ukubonelelwa xa uthe wonzakala koluphando: Akukho mali yasibonelelo kuba oluphando linongcipheko oluphantsi kakhulu.

Umntu wemibuzo: Nceda unxulumelane nabaphathi (Dr S Ghuman & Dr F Haffejee) kwe zinombolo 031 373 2807 or 031 373 2395. Mna Khanya Bisholo ndifumaneka kule nombolo 043 705 2908 or 072 824 5413. Iziko lophando (Institutional Research Ethics administrator) lifumaneka kule nombolo 031 373 2900. Izikhalazo zonke zichazwa kule nombolo ilandelayo; DVC: TIP, Prof F. Otieno on 031 373 2382 or dvctip@dut.ac.za

LETTER OF INFORMATION

Title of the Research Study: AN EPIDEMIOLOGICAL INVESTIGATION OF FOOD-BORNE DISEASES IN THE NCERA VILLAGES, EASTERN CAPE, SOUTH AFRICA.

Principal Investigator/researcher: Khanya Bisholo (B-Tech: Environmental Health)

Co-Investigator/s/supervisor/s: Mrs S Ghuman (Masters: Public Health) & Dr F Haffejee (PhD: Optics & Imaging, Medicine)

Brief Introduction and Purpose of the Study: You are invited to participate in a research study conducted by Khanya Bisholo. The purpose of this research is to investigate the epidemiology of food-borne diseases in Ncera villages in the Eastern, South Africa.

Objectives:

- To determine the prevalence of food-borne disease from clinic records.
- To determine the community's level of understanding of food-borne illness.
- To determine reasons for not seeking medical help and for not reporting food-borne illnesses in these communities.

Outline of the Procedures: This study is being conducted in the Ncera villages that are situated 50 kilometers from East London. Approximately 90 households' within the villages will be visited and interviewed. You will be provided with a questionnaire on food poisoning which you are required to fill in. if you need assistance in filling it in, the researcher will write down the answers for you. If you agree to participate in this study, you will first be required to sign a consent document. Please note that your name will not be used in any publication. All the data will be collated and only overall data will be used.

Risks or Discomforts to the Participant: There are no known risks associated with this research.

Benefits: This research will help to understand the reporting of foodborne disease while providing health education and information to the community which will contribute to better surveillance of food poisoning in this area.

Reason/s why the Participant May Be Withdrawn from the Study: Unavailability for interviews will result in non-participation in this study.

Remuneration: There will be no remuneration for participants.

Costs of the Study: Participants will be interviewed in the households.

Confidentiality: Your anonymity will be maintained neither to anyone external nor in any publications resulting from this study.

Research-related Injury: There is no compensation since the research is low risk category.

Persons to Contact in the Event of Any Problems or Queries:

Contact my Supervisor Dr S Ghuman & Dr F Haffejee) on 031 373 2807 or 031 373 2395. Please contact the researcher (Khanya Bisholo) on 043 705 2908 / 072 824 5413 or the Institutional Research Ethics Administrator on 031 373 2900. Complaints can be reported to the Director: Research and Postgraduate Support, Prof S Moyo on 031 373 2577 or moyos@dut.ac.za

APPENDIX V

LETTER OF CONSENT IN ISIXHOSA AND ENGLISH (LOCAL LANGUAGE)

IMVUME

Imigangatho yesivumelwano sokuba yinxalenye soluphando:

- Ndiyavuma ukuba inkcukacha zonke zoluphando ndizinikiwe nguphandi oyintloko, u**Khanya Bisholo**, malunga nendlela olucwanciswe ngalo, ngendlela oluzakwenziwa ngalo, nengeniso kwa kunyenoncipheko olunxulumene noluphando - Research Ethics Clearance Number: _____,
- Kwakhona ndiyifumene incwadi ecacisa ngoluphando, ndayifunda, ndayiqonda (Participant Letter of Information).
- Ndiyazi ukuba iziphumo zoluphando, kuquka inkcukacha zam ezifana ne sini , iminyaka , neminyaka yokuzalwa aziyikuchazwa ngokuphandle nakwi ngxelo yeziphumo.
- Ngokubona imigangatho yoluphando, ndiyavuma ukuba imiba efunyenweyo koluphando isetyenziswe, ifakwe kwi khompuyutha ngendlela umphandi abona ngayo.
- Ndinakho, nangesiphi isgaba, ndingoyiki, ndizikhwebule koluphando.
- Ndibe nexesha elaneleyo lokubuza imibuzo, ngokuzithandela ndavuma ukuba ndikulungele ukuthatha inxaxheba koluphando.
- Ndiyaqonda ukuba imiba emitsha enovela ngoku uphando lusaqhubayo engqamene nokuthabatha inxaxheba kwam ndokwaziswa ngayo.

_____	_____	_____ _____
Igama lomhlali	**Umhla**	**Signitsha / bhontsi wasekunene**

Mna, **Khanya Bisholo** ndiyaqinisekisa ukuba bonke abathatha inxaxheba koluphando banolwazi olupheleleyo malunga nemiba, nendlela eluzokwenziwa ngayo, kwa kunyenoncipheko olunxulumene noluphando.

_____	_____	_____
Igama lomphandi	**Umhla**	**Signitsha**
_____	_____	_____
Igama lobonileyo	**Umhla**	**Signitsha**
_____	_____	_____
Igama lomzali	**Umhla**	**Signitsha**

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher (Khanya Bisholo) about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, **Khanya Bisholo** herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____	_____	_____
Full Name of Researcher	**Date**	**Signature**
_____	_____	_____
Full Name of Witness (If applicable)	**Date**	**Signature**
_____	_____	_____
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

APPENDIX VI

CERTIFICATE OF ACCEPTABILITY FOR FOOD PREMISES (TEMPLATE)

BUFFALO CITY
METROPOLITAN MUNICIPALITY
==========
ANNEXURE B
[Regulation 3(6)(a)]
CERTIFICATE OF ACCEPTABILITY FOR FOOD PREMISES

CERTIFICATE No.: .....

OFFICIAL STAMP

A. ISSUING LOCAL AUTHORITY:

Buffalo City Metropolitan Municipality
City Health Department
P.O. Box 673, East London
5200
Telephone: 043 705 2901/04/07 | 043 604 8569

B. FOOD PREMISES

Name (if any)	
Address: (Location or trading area, erf no. or vehicle registration no.) Telephone Number:	
Address where food is processed:	

C. PERSON IN CHARGE

Name :	
I.D. NUMBER	

D. CERTIFICATE AND RESTRICTION

It is hereby certified that the abovementioned food premises comply with the provisions of regulations 5 and 6 made by Government Notice No. 962 of 2012 In respect of the handling of food in the manner specified.

Restrictions, conditions or stipulation in terms of regulation 3(1)(b)

E.

NAME OF INSPECTOR:		SIGNATURE:	
Official designation:	Snr Environmental Health Practitioner	DATE	
APPROVED BY: NAME:		SIGNATURE:	
Official designation:	Chief Environmental Health Practitioner	DATE	

F.

ENDORSEMENTS/EXEMPTIONS In terms of regulation 15	DATE	SIGNATURE OF INSPECTOR

NB: THIS CERTIFICATE IS NOT TRANSFERABLE.

APPENDIX VII

REASERCH TOOL BEFORE THE EXPERT INTERROGATION

DUT DURBAN UNIVERSITY OF TECHNOLOGY

FACULTY OF HEALTH SCIENCES

Questionnaire on Food Poisoning

Part I: Demographics

Head of Household only (Question 1 – 2)

1. What is your gender
   - ☐ Female
   - ☐ Male

2. Which education level closely represents your education level?
   - ☐ No formal education
   - ☐ Primary School
   - ☐ High School
   - ☐ College
   - ☐ University qualification and Above

3. What is the number of people living in the household? _____

4. How many males and females are there in your household?
   Female _____
   Male _____

5. How many people in your household are between the following ages?
   ___18 - 25 years old
   ___26 - 34 years old
   ___35 - 49 years old
   ___50 - 64 years old
   ___65 - 80 years old

6. What is the annual household income range?

   - ☐ less than R 1,200
   - ☐ R 1,500- R 3,500
   - ☐ R 4,000- R 6,000
   - ☐ R 10,000- R 15,000
   - ☐ more than R 15,000

7. What type of healthcare plan(s) do you use as the household?

- ☐ Public clinic, free
- ☐ Private, paid by myself
- ☐ Medical Aid
- ☐ None
- ☐ Other, please specify _____

8. What is your ethnicity?

- ☐ Black
- ☐ Indian
- ☐ Coloured
- ☐ White
- ☐ Other, please specify _____

Part II: Food Safety

9. In general, how concerned are you about the safety of food you purchase for preparation at home?

- ☐ Not at all concerned
- ☐ Not very concerned
- ☐ Somewhat concerned
- ☐ Concerned
- ☐ Very concerned

10. In general, how concerned are you about the safety of food prepared away from home (examples: Informal shops (spazas), vendors, hospitals, or school feeding scheme)?

- ☐ Not concerned
- ☐ Somewhat concerned
- ☐ Concerned
- ☐ Very concerned

Part III: Food Poisoning

11. What type of food do you believe poses the greatest risk for food poisoning?

- ☐ Beef,
- ☐ Pork
- ☐ Chicken
- ☐ Fish
- ☐ Milk
- ☐ Cheese
- ☐ Yogurt
- ☐ Eggs
- ☐ Fresh Produce (fresh fruits and fresh vegetables)

- ☐ Packaged Foods (canned, frozen, and wrapped)
- ☐ Bread
- ☐ Pastry
- ☐ Cereals
- ☐ Fried rice)
- ☐ Other; please specify _____

12. What do you think would be the best approach to use to reduce the risk of food poisoning?

- ☐ More inspections by Environmental Health Practitioners
- ☐ Improved quality legislation
- ☐ Stiffer penalties
- ☐ Increased government monitoring programs
- ☐ Health education
- ☐ Other; please specify_____

13. **In the past 3 months**, have any household member become ill or thought you became ill from something that you ate?

- ☐ Yes. If yes go to Question. 14
- ☐ No. If no, you are completed

14. Did you experience any of the following symptoms?

- ☐ Nausea
- ☐ Vomiting
- ☐ Diarrhea
- ☐ Abdominal cramps
- ☐ Headache

15. How many people fell ill? _____

16. Did they all get ill at the same time?_____

17. What is the gender of those that had food poisoning?
- ☐ Male
- ☐ Female

18. What are the ages of those that had food poisoning?

- ☐ Please specify _____
- ☐ Please specify _____
- ☐ Please specify _____

19. For this illness, did they seek medical treatment?

- ☐ Yes
- ☐ No. If no, go to Question 20.

20. For this illness, where did they go for help?

- ☐ Doctor's surgery
- ☐ Public clinic
- ☐ Self-treated with over the counter medication
- ☐ Used a homemade remedy
- ☐ Other; please specify _____

21. What did the healthcare provider do?

- ☐ Taken blood samples
- ☐ Asked for a stool sample
- ☐ Prescribed medication
- ☐ Recommended increased fluid intake
- ☐ Recommended rest
- ☐ Nothing
- ☐ Other; please specify _____

22. Did the medical provider confirm the food poisoning diagnosis with testing of a stool sample?

- ☐ Yes
- ☐ No

23. Provide reasons for not seeking medical treatment below?

_____
_____
_____
_____
_____
_____
_____
_____
_____

APPENDIX VIII

AMENDED RESEARCH TOOL AFTER THE EXPERTS INTERROGATION

STUDY ID

DUT DURBAN UNIVERSITY OF TECHNOLOGY

FACULTY OF HEALTH SCIENCES

QUESTIONNAIRE ON FOOD POISONING

Thank you for agreeing to be part of this study and for taking the time to fill out this questionnaire with us.

PLEASE READ THIS BEFORE STARTING.

- It's your choice whether or not to do the survey.
- Your answers will be kept **confidential**.
- Whether or not you answer the questions will **not** affect your health care or any benefits you may get.
- You can skip questions you don't want to answer.
- Please put a cross (X) next to your chosen answer.

Part I: Demographics

Head of Household only

1. What is your gender?

   ☐1 Female
   ☐2 Male

2. What is your marital status?

   ☐1 Married
   ☐2 Living together
   ☐3 Single
   ☐4 Widow
   ☐5 Other specify_____

3. Do you know your HIV status? If **yes**, state it next to your answer

   ☐1 Yes _____
   ☐2 No

4. Is there anyone in your household who is HIV positive? If **yes**, how many?

   ☐$_1$ Yes _____
   ☐$_2$ No

5. Do you have any medical condition? If **yes**, state it below

   ☐$_1$ Yes _____
   ☐$_2$ No

6. Which is your highest level of education?

   ☐$_1$ No formal education
   ☐$_2$ Primary School
   ☐$_3$ High School
   ☐$_4$ College
   ☐$_5$ University qualification

7. How many people live in your household? _____

8. How many males and females are there in your household?_____

9. How many people in your household are between the following ages?_____

   ___18 – 25 years old
   ___26 – 34 years old
   ___35 – 49 years old
   ___50 – 64 years old
   ___65 – 80 years old

10. What is the monthly household income range?

    ☐$_1$ less than R 1,200
    ☐$_2$ R 1,500- R 3,500
    ☐$_3$ R 4,000- R 6,000
    ☐$_4$ R 10,000- R 15,000
    ☐$_5$ more than R 15,000

11. How do you pay for the household's medical expenses?

    ☐$_1$ Public clinic, free
    ☐$_2$ Private, paid by myself
    ☐$_3$ Medical Aid
    ☐$_4$ Other, please specify _____

12. Was anyone diagnosed with cholera after having diarrhoea?

    ☐$_1$ Yes
    ☐$_2$ No

13. Did anyone have flu whilst they had diarrhoea?

☐1 Yes
☐2 No

14. Which foodstuffs do you eat often in your household?

☐1 Beef
☐2 Pork
☐3 Chicken
☐4 Sour milk
☐5 Fresh cow milk

15. Did those who had diarrhoea eat any of the foodstuffs chosen in question 13? If **yes**, state the foodstuffs they ate.

☐1 Yes_____
☐2 No

16. What season was it when they had diarrhoea?_____

17. What is your ethnicity?

☐1 Black
☐2 Indian
☐3 Colored
☐4 White
☐5 Other, please specify _____

Part II: Food Safety

18. Which is a common food preparatory method that is used in your households?

☐1 Meals prepared using a stove
☐2 Meals prepared using open wood fire
☐3 Meals prepared using open dung fire
☐4 Other specify_____

19. Do you think hand washing with a detergent is practiced in your household before handling food? If **no,** state why?

☐1 Yes
☐2 No_____

20. In general, how concerned are you about the safety of food you purchase for preparation at home?

☐1 Not at all concerned
☐2 Not very concerned
☐3 A little Concerned
☐4 Very concerned

21. In general, how concerned are you about the safety of food prepared away from home (examples: Informal shops (spazas), vendors, hospitals, or school feeding scheme)?

☐$_1$ Not at all concerned
☐$_2$ Not very concerned
☐$_3$ A little Concerned
☐$_4$ Very concerned

Part III: Food Poisoning

22. What type of food do you think poses the greatest risk for food poisoning?

☐$_1$ Beef
☐$_2$ Pork
☐$_3$ Chicken
☐$_4$ Fish
☐$_5$ Milk
☐$_6$ Cheese
☐$_7$ Yogurt
☐$_8$ Eggs
☐$_9$ Fresh Produce (fresh fruits and fresh vegetables)
☐$_{10}$ Packaged Foods (canned, frozen, and wrapped)
☐$_{11}$ Bread
☐$_{12}$ Pastry
☐$_{13}$ Cereals
☐$_{14}$ Fried rice)
☐$_{15}$ Other; please specify _____

23. Where do you store your perishable foodstuffs? _____

24. Where do you get your drinking and cooking water?

☐$_1$ Piped water
☐$_2$ Nearby river
☐$_3$ Jojo tanks
☐$_4$ Borehole
☐$_5$ Other specify_____

25. What do you think would be the best approach to use to reduce the risk of food poisoning?

☐$_1$ More inspections by Environmental Health Practitioners
☐$_2$ Improved quality legislation
☐$_3$ Stiffer penalties
☐$_4$ Increased government monitoring programs
☐$_5$ Health education
☐$_6$ Other; please specify_____

26. **In the past 3 months**, has any household member become ill or thought that they became ill from something that they ate?

☐1 Yes
☐2 No

27. **In the past 3 or 4 years**, has any household member become ill or thought that they became ill from something that they ate?

☐1 Yes
☐2 No
If **yes** go to Question 28
If **no,** you are completed with the questionnaire

28. Did you experience any of the following symptoms?

☐1 Nausea
☐2 Vomiting
☐3 Diarrhea
☐4 Abdominal cramps
☐5 Headache

29. How many people fell ill? _____

30. Did they all get ill at the same time? _____

31. What is the gender of those that had these symptoms? Next to each also state how many of each gender were affected

☐1 Male _____
☐2 Female _____

32. What are the ages of those that had food poisoning?

☐1 Please specify _____
☐2 Please specify _____
☐3 Please specify _____

33. For this illness, did they seek medical treatment?

☐1 Yes
☐2 No

34. For this illness, where did they go for help?

☐1 Doctor's surgery
☐2 Public clinic
☐3 Self-treated with over the counter medication
☐4 Used a homemade remedy
☐5 Traditional healer
☐6 Other; please specify _____

35. What did the healthcare provider do?

☐1 Taken blood samples

☐$_2$ Asked for a stool sample
☐$_3$ Prescribed medication
☐$_4$ Recommended increased fluid intake
☐$_5$ Recommended rest
☐$_6$ Nothing
☐$_7$ Other; please specify _____

36. Did the medical provider confirm the food poisoning diagnosis with testing of a stool sample?

☐$_1$ Yes
☐$_2$ No

37. If you used a homemade remedy, please state what you used.

_____
_____
_____
_____

38. If you went to a traditional healer, do you know what he/she prescribed and if **yes** state what this was.

☐$_1$ Yes
☐$_2$ No

_____
_____

39. If you did not seek medical help, please provide reasons for not seeking medical treatment

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____