FOOD HYGIENE RISKS AND RELATED PRACTICES IN CENTRAL SOUTH AFRICAN HIV/AIDS HOSPICES: A QUALITATIVE ASSESSMENT

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DECLARATION OF INDEPENDENT WORK

I, Jane Sebolelo Nkhebenyane, do hereby declare that this research project submitted to the Central University of Technology, Free State for the degree PhD: ENVIRONMENTAL HEALTH is my own work, and that it has not been submitted before to any institution by me or any other person in fulfillment of the requirements for the attainment of any qualification.

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SIGNATURE OF STUDENT DATE

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If one dream should fall and break into a thousand pieces, never be afraid to pick up one of those pieces and begin again. (Flavia Weedn)

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LIST OF ACRONYMS

AIDS: Acquired Immune Deficiency Syndrome
AMR: antimicrobial resistant bacteria
ART: antiretroviral therapy
ATCC: American type culture collection
CDC: Centre for Disease Control
CLSI: Clinical and Laboratory Standards' Institute
COHSASA: Council for Health Service Accreditation of Southern Africa
CUT: Central University of Technology, Free State
EC: Eastern Cape
EDRU: Enteric Diseases Reference Unit
ESBL: Extended spectrum beta-lactamase
FDA: Food and Drug Administration
FGD: Focus group discussion
FSMS: Food safety management systems
FS: Free State
HACCP: Hazard Analysis Critical Control Programme
HBM: Health Belief Model
HCW: Healthcare workers
HIV: Human Immunodeficiency Virus
HPCA: Hospice Palliative Care Association
IID: Infectious intestinal disease
ISO: International Standard Organization
KAP: knowledge, attitudes and practices
MDG: millennium development goals
MDR-TB: Multi drug-resistant tuberculosis
MIC: minimum inhibitory concentration
MRSA: Methicillin-resistant staphylococcus aureus
NDoH. National Department of Health
NICD: National Institute of Communicable Diseases
PDTS: Product Development Technology Station
PPE: Personal protective equipment
PRP: Prerequisite programme
RR-TB: rifampicin-resistant tuberculosis
SARS: Severe Acute Respiratory Syndrome
SDG: Sustainable development goals
SA: South Africa
TDR: Totally drug resistant
TB: tuberculosis
TPB: Theory of planned behaviour
TVC: total viable count
UNAIDS: The Joint United Nations Programme on HIV and AIDS
UNICEF: United Nations Children's Fund
USDA: United States Department of Agriculture
VRE: vancomycin-resistant enterococci
WASH: Water sanitation and hygiene
WHO: World Health Organization
XDR: Extremely drug resistant

SUMMARY

People living with HIV are at risk of many life-threatening opportunistic infections, the majority of which are caused by exposure to unsafe drinking water and poor hygiene. In South Africa, hospices were established in response to the growing HIV/AIDS pandemic. Hospice is both a programme and a philosophy of care that is dedicated to improving the quality of life for patients with life-threatening illnesses. At the core of a hospice's work is the concept of "palliative care", which is defined by the World Health Organization (WHO) as the active total care of patients whose disease is not responsive to curative treatment, and whose goal is the achievement of the best quality of life for patients and their families. The need for palliative care in South Africa has increased with the escalation of HIV/AIDS. Moreover, resources to provide optimum quality healthcare in hospices are very limited.

Food safety, synonymous with food hygiene, embraces all aspects of food processing, preparation and handling to ensure the safety thereof for consumption purposes. It has also been defined as the concept that food will not cause harm to the consumer when it is prepared and/or eaten according to the intended use. The meals prepared in a hospice have a remarkable associated safety risk, as they are prepared for vulnerable people who are more susceptible to foodborne illness than the rest of the population. During food preparation, micro-organisms can contaminate foods and storage environments, surfaces, tools, equipment and personnel engaged in handling and production activities (Clayton, Griffith, Price, Peters 2002 and Legnani, Leoni, Berveglieri, Mirolo and Alvaro 2003). Food-handling practices in the domestic kitchen influence the risk of pathogen survival and multiplication, as well as cross-contamination to other products. Microbiological risk in the kitchen can be significantly reduced by preparing food properly. People, food and domestic animals, including water and bioaerosols, introduce pathogens continually into the home.

Additionally, these potential pathogens can enter the domestic kitchen via various routes, for example, raw foods and respiratory droplets. Various bacterial species can reside in the kitchen, food preparation rooms and storage facilities, and can be direct sources of food contamination. This is a particularly worrying issue for a hospice setting, where meals are prepared on a regular basis every day. Moreover, this is of great concern for a hospice set-up that has limited isolation facilities. This highlights the important role of food handlers in the transmission of foodborne infections, as the hands are probably the single most important transmission route.

Consequently, the overall aim of the study was to assess food-related hygiene awareness and practices amongst hospice food handlers, and the associated food safety interventions. The study also identified the emerging food safety risks, including the antimicrobial susceptibility profile of potential foodborne pathogens isolated from the food preparation surfaces in the hospice kitchens and food handlers. In order to achieve this, the following objectives were defined for the study: to conduct an investigation into the hygiene awareness amongst staff of HIV/AIDS hospices using KAP (knowledge, attitudes and practices) as an information collection tool to characterise each hospice's microbial profile; to compose and implement an intervention programme in selected hospices to improve the food safety awareness and practices; and, lastly, to evaluate the effectiveness of staff's hygiene awareness and practice interventions.

With regard to the KAP objective, it was found that the majority (68%) of the food handlers did not receive food safety training, whilst only 32% of the respondents had attended at least one formal training course on food hygiene. A descriptive survey of the food handlers' knowledge regarding food safety demonstrated the equivalent of 66.8% correct answers. However, a substantial lack of knowledge regarding the correct temperature for a refrigerator, as well as hot, ready-to-eat food and cold, ready-to-eat food emerged. This was demonstrated by the fact that respectively only 39% and 32% of the respondents were informed about the correct holding temperature of hot and cold ready-to-eat food. Again, this shows that the food handlers in this study had insufficient knowledge regarding time temperature controls.

Similar findings on the lack of adequate knowledge of food handlers regarding temperature controls have also been reported (Panchal, Bonhote and Dworkin 2013). This particular knowledge gap could possibly be attributed to a lack of training of food handlers in hospices on this important food-safety control measure. The majority (64%) of the respondents agreed that preparation of food in advance may contribute to the risk of food poisoning, whilst 68% of respondents were aware of the risks related to reheating dishes prior to consumption.

To determine the antimicrobial susceptibility profile of the isolated foodborne pathogens, the minimum inhibitory concentration (MIC) was determined using the agar dilution method of the Clinical and Laboratory Standards Institute (CLSI). It was noted with concern that the isolated microbial strains are becoming increasingly drug resistant. For example, a 100% resistance of *Acinetobacter baumannii* strains to cefoxitin was noted. Although gentamicin is one of the most important antibiotics used in combination with other antibiotics worldwide for the treatment of *S. aureus* infections, this antibiotic was predominantly inactive against *S. aureus* in this study, since 75% of the organisms were resistant (MIC >16, range ≤0.25 ->16 $mg.ml^{-1}$). Oxacillin also proved to have poor activity against the isolated organisms (MIC_{50} and MIC_{90}, 8 and >16, range (0.25->16 $mg.ml^{-1}$) respectively. Transmission of antibiotic-resistant bacteria in hospices and other healthcare facilities could be due to overcrowding and poor hygiene. The development and provision of food safety training courses are important to achieve behavioural changes, coupled with an improvement in skills and knowledge.

Focus groups were also conducted with hospice food handlers to explore their food safety management systems, and to identify perceived barriers to implementing food safety practices. The following barriers were identified: lack of management support, inadequate resources, and inconvenient location of the pantry from the kitchen. Suboptimal kitchen infrastructure was also identified as a hurdle to implement safe food-handling practices.

In response to the increasing need to educate food handlers about their responsibilities for assuring the safety of food during preparation and handling, food handler training, based on the WHO's Five Keys to Safer Foods, was implemented as an intervention programme. Before training, 32% of food handlers believed that the same cutting board can be used for raw and cooked foods, provided that it looks clean, whilst 73% of respondents, after receiving training, knew that this could hamper food safety. A hazard categorization tool was developed in the course of the study, and it comprises five focus areas: infrastructure, food preparation facilities, sanitation, food handler training and hospice management.

CHAPTER 1

INTRODUCTION: BACKGROUND

1.1 HISTORICAL OVERVIEW OF HIV/AIDS CHALLENGES IN SOUTH AFRICA

HIV, the virus that causes AIDS - “Acquired Immunodeficiency Syndrome” - has become one of the world’s most serious health and development challenges since it was first reported in 1981. South Africa has one the biggest and most high-profile HIV epidemics in the world (UNAIDS 2016). Poverty can increase vulnerability to HIV infection. This is made even worse by the lack of education which perpetuates the cycle between HIV/AIDS. The impact of the HIV/AIDS epidemic on children and families is incremental and affects mainly poor communities with inadequate infrastructure and limited access to basic services. Additionally, poor hygiene, lack of knowledge, no access to water supplies, and poor housing and health services often occur concurrently, leading to an environment of poor nutrition and susceptibility to infectious diseases (Calder and Jackson 2000). Even though the Millennium Development Goals (MDGs) strategy was declared a success, the inhabitants of low-income countries still suffer an enormous burden of disease owing to diarrhoea, pneumonia, HIV/AIDS, tuberculosis, malaria and other pathogens (Dye 2014).

According to UNAIDS (2014a), sub-Saharan Africa is home to only 12% of the global population, yet accounts for 71% of the global burden of HIV infection. Additionally, it has been stated by the WHO (2016a) that, since the beginning of the epidemic, more than 70 million people have been infected with the HIV virus, and about 35 million people have died of HIV. It is also further reported that globally, 36.7 million (30.8 - 42.9 million) people were living with HIV by the end of 2016. Of these, 2.1 million were children (<15 years old). By the middle of 2015, high levels of HIV diagnosis were achieved in South Africa, with an estimated 85.5% of HIV-positive adults diagnosed (Johnson, Dorrington and Moola 2017). East and Southern Africa are the regions that are hit the hardest by HIV. In the year 2016 there were 790,000 new HIV infections in East and Southern Africa - 43% of the global total (UNAIDS 2017). Furthermore, in the same year, South Africa had 270 000 (240 000 - 290 000) new HIV infections, and 110 000 (88 000 -140 000) AIDS-related deaths (UNAIDS 2017).

According to Sips, Mazanderani, Schneider, Greeff and Barten (2014), the excessive health burden of HIV/AIDS has made it difficult for South Africa's healthcare system, like other low- and middle-income countries, to cope with the epidemic. The deficiencies in the health system are caused by inefficient government spending, and a shortage of material and human resources, especially in the rural areas (Schneider, Blaauw, Gilson, Chabikuli and Goudge 2006). These difficulties mount additional pressure on the already vulnerable and weak healthcare system (Coovadia, Jewkes, Barron, Sanders and McIntyre 2009; Habib and Saha 2010). Consequently, hospices were established in SA using lay workers to provide palliative care to HIV-infected people.

1.2 THE PREDICAMENT OF HIV/AIDS AND TB CO-INFECTION

Tuberculosis (TB) is an infectious disease caused by the bacillus *Mycobacterium tuberculosis*. In 2015, there were an estimated 10.4 million cases of tuberculosis disease globally, and people living with HIV accounted for 1.2 million (11%) of all new TB cases (WHO 2016b). In the same year an estimated 480 000 new cases of multidrug-resistant TB (MDR-TB), and an additional 100 000 people with rifampicin-resistant TB (RR-TB), who were also newly eligible for MDR-TB treatment, were reported. In 2015, 78% of people living with HIV who were also diagnosed with active tuberculosis were placed on ART (WHO 2016b). Currently, the success rate of TB treatment is lower for people living with HIV (75%) - mainly as a result of an already compromised immune system - than for those who are HIV-negative (83%) (WHO 2016b). It is for this reason that the WHO (2013) recommends that treatment for common co-infections should be provided simultaneously with HIV treatment, and patients receiving such treatments should be carefully monitored in order to manage the possibility of drug interactions.

1.3 TREATMENT AND CARE OF HIV/AIDS IN SA

The 2016 UNAIDS Global AIDS Update highlights the “enormous gains” that have been made, particularly with regard to access to treatment. According to the report, since 2014, the number of people living with HIV/AIDS on ART has increased by about a third, and by two million in comparison with the 2015 target of 15 million on treatment. Seventeen million people globally living with HIV/AIDS are receiving ART. South Africa still has the largest number of people with HIV/AIDS on treatment, namely a whopping 3.4 million (UNAIDS 2016).

The treatment of HIV/AIDS includes the use of combination antiretroviral therapy (ART) to attack the virus, and medications for prevention and treatment of opportunistic infections. Effective ART was first introduced in 1996, leading to dramatic reductions in morbidity and mortality (Marston, Michael, Wringe, Isingo, Clark, Jonas, Mngara, Kalongoji, Mbaga, Changalucha, Todd, Zaba and Urassa 2012). South Africa has the largest number of individuals living with HIV/AIDS, and the largest antiretroviral therapy programme worldwide (Cornell, Johnson, Wood, Tanser, Fox, Prozesky, Schomaker, Egger, Davies and Boulle 2017). However, the ability to access primary healthcare, including issues such as distance, affordability and quality of care, can have implications on treatment outcomes, especially in rural areas. The number of people on HIV/AIDS treatment in Eastern and Southern Africa - the world’s most affected regions - has more than doubled since 2010, reaching nearly 10.3 million people. Furthermore, AIDS-related deaths in the region have decreased by 36% since 2010. However, huge challenges lie ahead. In 2015 there were 2.1 million (1.8 million-2.4 million) new HIV/AIDS infections worldwide, adding up to a total of 36.7 million (34.0 million-39.8 million) people living with HIV/AIDS (UNAIDS 2016). The report further states that, as of July 2017, 20.9 million people living with HIV/AIDS were accessing antiretroviral therapy (ART) globally, compared to 15.8 million in June 2015, 7.5 million in 2010, and less than one million in 2000.

1.4 RATIONALE

1.4.1. Delineating the problem

In December 2015, the World Health Organization (WHO) released estimates of the burden of human disease attributable to consumption of food contaminated with 31 infectious agents or chemicals. A key element of the estimation was attributing a proportion of the diarrhoea deaths to foodborne transmission of infections. Furthermore, the WHO disease burden estimates were conservative, as, for methodological reasons, they largely excluded diarrhoeal disease associated with human immunodeficiency virus (HIV) infection. It is likely that HIV-infected persons experience a substantial burden of infection from contaminated food, making food safety important for this vulnerable group. Globally, diarrhoeal infections with Salmonella species (including invasive infections), enteropathogenic and enterotoxigenic *Escherichia coli*, norovirus and Campylobacter species were responsible for the greatest burden of foodborne disease.

Patients with infections or carriers of pathogenic micro-organisms admitted to hospices are potential sources of infection for other patients and staff. Moreover, infection control is a critical component of a healthcare setting. Hospice patients are at increased risk of becoming ill when exposed to potential foodborne pathogens. Thus, it is critical that appropriate food-handling practices are maintained. Food handlers in a hospice or any other healthcare setting have a very important role in preventing food contamination during its preparation and distribution. It is estimated that foodborne pathogens (disease-causing agents) are responsible for 76 million illnesses, some resulting in death, in the United States alone every year (CDC 2006). In the developing countries, approximately 2.1 million children die due to diarrhoea-related illnesses annually.

According to the WHO (2015), it is suspected that food and water is the vehicle for many of these illnesses. Indeed, the microbiological safety of drinking water remains a challenge in developing countries, especially in this era of HIV/AIDS. People, food and domestic animals, including water and bio-aerosols, continually introduce pathogens into the home. Moreover, these potential pathogens can enter the domestic kitchen via a variety of routes, for example, raw foods and respiratory droplets. Furthermore, during food preparation, pathogens such as *Campylobacter spp.*, *Salmonella spp.*, *Escherichia coli* and *Staphylococcus aureus* may be spread from infected foods such as raw chicken to hand-and-food-contact surfaces in the domestic kitchen. The inappropriate handling of foods by food handlers has been implicated in 97% of food poisoning cases (Howes, McEwen, Griffiths and Harris 1996; Greig, Todd, Bartleson and Michaels 2007). Poor food-handling and hygiene practices in domestic kitchens are thought to be the cause of a significant amount of foodborne illness.

A South African study (Lambrechts, Human, Doughari and Lues 2014) revealed the unsatisfactory level of hand hygiene among food handlers in some convenient food industries. Moreover, antibiotic-resistant infections are a substantial health and economic burden to the healthcare system, including patients and their families. This resistant infection is common in hospitals due to the clustering of highly vulnerable patients, and the high rates of antibiotic usage in these settings (Golkar, Bagasra and Pace 2014). Moreover, this is even of great concern for a hospice set-up that has limited isolation facilities. In light of these critical issues, the overall aim of the study was to assess food-related hygiene awareness and practices amongst hospice food handlers and the associated interventions.

1.4.2 The related South African scenario

Outbreaks of foodborne disease in humans are common in South Africa, but they are under-reported. Webb and Morancie (2015) report that a foodborne disease outbreak can occur as a result of ingesting food items contaminated with micro-organisms and chemicals. Foodborne disease outbreaks known, or considered likely to occur in SA, include the pathogens *Salmonella spp., Shigella spp., E.coli, Bacillus cereus*, *Clostridium perfringens*, Campylobacter and Hepatitis A (NICD 2009). The recent listeriosis outbreak in SA due to contaminated sausages and cold meats was a reminder of the importance of assuring food safety in the supply chain. Additionally, there was an outbreak of foodborne *S. enterica* serotype Virchow during December 2006 among school teachers in Mpumalanga after they consumed food prepared by school food handlers. Isolates of *S. enterica* serotype Virchow is an uncommon serotype in the SA human population, accounting for only 25 of the 4 966 Salmonella isolates received by the EDRU (Enteric Diseases Reference Unit) from 2003 to 2005 (Smith, Gouws, Hoyland, Sooka and Keddy 2007). In the year 2012, an SA pediatric ward reported a nosocomial outbreak of extended spectrum β lactamase, producing multidrug resistant *Salmonella* Typhimurium, which occurred among hospitalised patients (Smith, Mthanti, Haumann, Tyalisi, Boon, Sooka and Keddy 2014). Further investigations revealed that the temperature of the food distributed to the wards was not adequately controlled. Preparation of meals in advance, and insufficient cooking temperature, have been identified as the factors mainly responsible for foodborne outbreaks, hence the importance of food safety education for food handlers.

1.4.3 Aims of the study

The following are the aims of the study:

- to conduct an investigation into the hygiene awareness amongst staff of HIV/AIDS hospices using KAP (knowledge, attitudes and practices) as an information-gathering tool;
- to characterise the hospice microbial profile;
- to compose and implement an intervention programme in selected hospices for purposes of improving food safety awareness and practices; and
- to evaluate the effectiveness of the designed hygiene awareness and practice intervention.

1.5 SIGNIFICANCE AND VALUE OF THE RESEARCH

The study aims to make a significant contribution in terms of reducing the mortality, and improving the well-being of HIV/AIDS patients in hospices in Central South Africa, and beyond. This will be accomplished through the provision of information to these hospices on the status of their kitchen hygiene and safety, and by proposing novel interventions to enhance food safety and wholesomeness.

1.6 LAYOUT OF THE CHAPTERS

The chapter layout of this study is as follows:

CHAPTER 1: An introductory background to the study outlining the HIV/AIDS challenges in South Africa, and the study objectives.

CHAPTER 2: A focus on the summary of current and relevant literature related to the project.

CHAPTER 3: The information-gathering tool: Knowledge, Attitudes and Practices (KAP) assessment of the level of hygiene awareness amongst hospices' HIV staff.

CHAPTER 4: A focus group discussion including key informant interview.

CHAPTER 5: Discussion of the antimicrobial profile of hospice food pathogens.

CHAPTER 6: Determination of the efficacy of the WHO training interventions.

CHAPTER 7: Drawing from recommendations and future strategies to improve food-handling behaviour and hygiene.

1.7 CONCLUSION

The overall endeavour of the study was to contribute to the reduced prevalence of hospice foodborne pathogens, to improve the quality of life of hospice patients, and ultimately to implement intervention strategies towards improved food-handling behaviour and hygiene.

Whilst this Chapter provided an overview of the research conducted, the next chapter contains a discussion of the literature review conducted on foodborne disease, and the impact thereof on immunity-compromised patients. Furthermore, the devastating effects of HIV/AIDS worldwide are revealed, and food hygiene risks and related practices in Central South African HIV/AIDS hospices are identified.

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CHAPTER 2

LITERATURE REVIEW: THE STATUS QUO OF HIV/AIDS HOSPICE KITCHEN HYGIENE IN CENTRAL SOUTH AFRICA

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2.1 INTRODUCTION

In Chapter 1, a historical overview of South Africa's HIV challenges was provided. The predicament of HIV and TB co-infection was discussed, as well as the treatment and care of HIV/AIDS patients in South Africa. The rationale for, and aim of the study were made clear.

In this chapter, a background on SA hospices and their infrastructure is provided. Based on the literature review conducted, foodborne pathogens in auxiliary health settings are discussed, and food safety and transmission routes of foodborne disease in hospices and related facilities are determined. Food safety management systems, and their applicability in hospice food preparation, are investigated. The role of hand hygiene in the spread of foodborne infection is emphasised. Foodborne pathogens and antimicrobial resistance in healthcare settings, as well as the impact of food handling on foodborne illness, are determined. Finally, flowing from the literature review, intervention strategies towards improved care of HIV/AIDS patients through hygiene intervention - which will ultimately impact on their quality of life - are advocated.

2.2 DYNAMICS OF HIV/AIDS CARE IN SOUTH AFRICA

HIV/AIDS has had a devastating impact across the globe. In South Africa where this epidemic is of paramount concern, the nature of the disease, our weak public health infrastructure, spiraling health costs, and a lack of resources have made hospice care a necessity in the continuum of care. According to UNAIDS (2004), HIV/AIDS, along with tuberculosis and malaria, is the major cause of illness and death in low- and middle-income countries where health services already struggle with limited resources and poor infrastructure. In recent years, the largely silent epidemic of HIV has grown into a highly visible epidemic of AIDS throughout the world. In South Africa, a country with a population of more than 45 million, over 320,000 people died of AIDS during 2005 (Geffen 2006).

Due to the pressure that the HIV pandemic has placed on public hospitals and clinics, an increasing number of patients are now being referred to hospices for palliative care. Moreover, the hospice services are widespread, focusing on diverse communities, and they are offered in diverse settings, including in-patient care, day care as well as home care (Meier and McCormick 2015). Palliative care focuses on promoting the best possible quality of life for patients and their families at all stages of a life-threatening illness. For many years, South African hospices have been striving towards the delivery of quality palliative care to patients.

2.2.1 Hospice background and infrastructure in Central South Africa

It has been reported (WHO 2002b) that healthcare providers and hospitals are overloaded by the HIV/AIDS epidemic, resulting in more than 50% of hospital beds occupied by HIV/AIDS patients. Consequently, the vulnerable immune-compromised patients are being cared for at home by their families and home-based caregivers. In 2013, there was an estimated 1.5 million new HIV infections in sub-Saharan Africa (UNAIDS 2014). A hospice is both a programme and a philosophy of care that is dedicated to improving the quality of life of patients with life-threatening illnesses.

At the core of a hospice's function is the concept of "palliative care", which is defined by the World Health Organization (WHO 1990) as the active total care of patients whose disease is not responsive to curative treatment, and whose goal is the achievement of the best quality of life for patients and their families. In South Africa the need for palliative care has increased with an escalation of HIV/AIDS. Moreover, resources to provide optimum quality healthcare in hospices are very limited. The scale and character of these problems create particular difficulties in offering palliative care for people with HIV infection during critical opportunistic infections, often in deeply impoverished circumstances. Additionally, some of the hospices operate under suboptimal conditions, and with inadequate infrastructure. In some cases, hospitals play a crucial role by granting their facilities to the hospices.

For example, some local hospitals have set up direct links with a hospice's home-based care programmes, offering office or ward space in their facilities. This can be in the form of a 'step-down facility', which offers a similar service to the in-patient unit of a hospice, but is attached to the hospital itself. Sunflower Hospice in the Free State province is a successful example of such a model, where an under-utilised ward of a hospital is used to cater for hospice patients. A hospice kitchen is considered to be an important part of the infrastructure. Typical layout of a hospice kitchen involves the following areas: main cooking area, dishwashing and storage area. This set-up is different from the hospital kitchen layout in which there is an allocated area for all the tasks. For example, a hospital kitchen has a receiving area, a storage area and a breakfast preparation area.

2.3 FOODBORNE PATHOGENS OF RELEVANCE IN AUXILIARY HEALTH SETTINGS

It is estimated that foodborne pathogens (disease-causing agents) are responsible for 76 million illnesses, some resulting in death, in the United States alone every year (CDC 2006). Foodborne illness generally refers to illnesses caused by micro-organisms consumed by eating any type of food. The etiologic agents of foodborne illness are bacteria, viruses, parasites and food toxins. Bacteria are the causative agents of foodborne illness in 60% of cases requiring hospitalisation (Mead, Slutsker, Dietz, McCaig, Bresee, Shapiro, Griffin and Tauxe 1999). In the developing countries, approximately 2.1 million children die due to diarrhoeal-related illnesses annually. Listeriosis is a foodborne illness that may cause very severe disease in pregnant women, neonates, the elderly and immune-compromised patients. South Africa experienced the largest ever outbreak of listeriosis that killed 193 people since the beginning of January 2018 (NICD 2018). Of those who died, 81 were babies younger than 28 days, and the other 10 deaths were children aged between one and 14. As of 24 April 2018, a total of 1 024 laboratory-confirmed listeriosis cases have been reported to NICD since 01 January 2017. The source of the outbreak was identified as ready-to-eat processed meat products manufactured at Enterprise Foods' Polokwane production facility.

Since 5 December 2017, the Department of Health amended the list of notifiable diseases to include listeriosis, which is now a notifiable condition in SA. Persistence *of L. monocytogenes* in food processing environments is still considered to be the major source of ready-to-eat food contamination. According to Ricci, Allende, Bolton, Chemaly, Davies, Escamez, Girones, Herman, Koutsoumanis, Nørrung, Robertson, Ru, Sanaa, Simmon, Skandamis, Snary, Speybroeck, Ter Kuile, Threlfall, Wahlstroom, Takkinen, Wagner, Arcella, Felicio, Georgiadis, Messens and Lindqvist (2018), persistence appears to be the result both of improper hygiene conditions and the high adaptive capacity of these bacteria against physical-chemical factors such as biofilm-forming capacity. Foodborne bacterial intoxication is caused by the ingestion of food containing preformed bacterial toxins, such as the toxins produced by *Staphylococcus aureus* and *Clostridium botulinum*, resulting from bacterial growth in the food. *Staphylococcus. aureus* is commonly found in the nose and throat (and thus on the hands and fingertips), and on the hair and skin of more than 50% of healthy individuals (Fredheim, Flaegstad, Askarian and Klingenberg 2015). Any food item that requires handling in preparation may therefore easily become contaminated. A variety of foods can support the growth of *S. aureus*, e.g. meat, meat products, poultry and fish. Staphylococcal food intoxication is estimated to cause 185,000 cases of foodborne illness annually (Mead, Slutsker, Dietz, McCaig, Bresee, Shapiro, Griffin and Tauxe 1999).

Given adequate time, temperature, pH, water activity and atmosphere for growth, contaminating *S. aureus* may multiply, and many strains may produce enterotoxins when the population exceeds 10^5 cells/g. The presence of potentially life-threatening pathogens in our environment, coupled with the ability thereof to proliferate under-refrigeration, indicate the seriousness of the potential hazards with which we are faced. Foodborne illnesses are more likely to be life-threatening for the immune-compromised, the young and elderly, including individuals debilitated by underlying health problems. *Clostridium difficile* is a gram-positive spore-forming anaerobic bacterium that causes disease in humans and animals, ranging from asymptomatic colonisation to diarrhoea and colitis. It has been hypothesised that food is the common source of this pathogen in community settings.

Recent studies have isolated *C. difficile* from retail foods intended for human consumption in the United States (Songer, Trinh, Killgore, Thompson, McDonald and Limbago 2009), and from meat products intended for consumption by pets (Weese, Avery, Rosseau and Reid-Smith 2005). Bacteria of the genus *Campylobacter* are gram-negative rods that are spirally curved and motile. They are transmitted to humans through faecal-oral routes, and by ingestion of contaminated water and ice, but most commonly by consuming raw or undercooked meat (Robinson, Batt and Patel 2000). This bacterium is also responsible for 15% of foodborne illness-related hospitalisations, and 6% of foodborne illness-related deaths (Scallan, Hoekstra, Angulo, Tauxe, Widdowson, Roy, Jones and Griffin 2011; CDC 2011). Fruits and vegetables can also be a source of infection when washed with contaminated water, or when prepared on a cutting board that was used for cutting raw poultry meat, and then left unwashed. When storing raw meats that are commonly associated with campylobacteriosis, freezing temperatures are best, since the number of bacteria can be reduced. Using separate cutting boards for meat, and for fruits and vegetables, can prevent cross-contamination. Proper handling, cooking and storage practices in food service operations and in the home can prevent the majority of foodborne illnesses.

2.4 FOOD SAFETY AND PATHOGEN TRANSMISSION ROUTES IN HOSPICES AND RELATED FACILITIES

Food safety is an increasingly important public health issue. Inadequate food safety control was a key contributor to the 2.1 million deaths from diarrhoeal disease globally in 2000 (WHO 2002). Foodborne disease caused by microbial pathogens remains a significant public health problem in the 21st century. Food safety, synonymous with food hygiene, embraces anything in the processing, preparation or handling of food to ensure it is safe to eat. It has also been defined as “the concept that food will not cause harm to the consumer when it is prepared and/or eaten according to its use” (BSI 2005; CAC 2003). A safety hazard has been determined as a “biological, chemical or physical agent in food, or condition of food, with the potential to cause adverse health effects” (FDA 2017).

The food chain, like any other chain, is only as strong as its weakest link, and the responsibility for food safety lies not only with producers and processors of food, but also with governments and consumers themselves (Griffith 2000). Food-handling practices in the domestic kitchen influence the risk of pathogen survival and multiplication, as well as cross-contamination to other products. Microbiological risk in the kitchen can be significantly reduced by preparing food properly. Contamination of food via the hands may be through direct contact, or indirectly through poor practices such as handling and contaminating equipment that is subsequently used for food preparation (Taylor and Holah 2000). Ready-to-eat foods, and foods served without cooking, can become a source of foodborne illness if they become contaminated with foodborne pathogens. This contamination can occur as a result of cross-contamination following contact with pathogens on the hands or food contact surfaces in the kitchen. The potential for transmission of pathogens, including *Campylobacter spp* and *Salmonella spp* via the hands and hand-and-food contact surfaces (such as cutting boards and cleaning cloths) is supported by studies related to the domestic setting.

Studies modeling domestic food preparation practices have shown that preparation of raw chicken contaminated with *Campylobacter o r Salmonella* resulted in cross-contamination in approximately 30% of food preparation sessions (Redmond, Griffith, Slader and Humphrey 2004). Moreover, it was also found that the isolation rates of these organisms following cross-contamination were highest for hands, chopping boards and cleaning cloths respectively (Cogan, Slader, Bloomfield and Humphrey 2002). Therefore, it is important to understand the adhesion mechanism of pathogenic bacteria to common kitchen utensils that are used during food preparation. These organisms are also the causative agents of acute gastroenteritis, which is a major cause of morbidity and mortality among children (Chunga, Wanga, Shen, Kuob, Hoa, Hsiunge, Muf, Wuf, Huang, Huang, Huangd, Chid, Lind and Liua 2017). It is now increasingly recognised that intestinal infections circulating in the community are by no means all foodborne; a substantial proportion of the total intestinal infectious disease burden in the community is due to person-to-person spread within households. Within the hospice and other healthcare settings, there is a chain of events, as described in Figure 2.1, which results in the transmission of infection from its source to a new recipient.

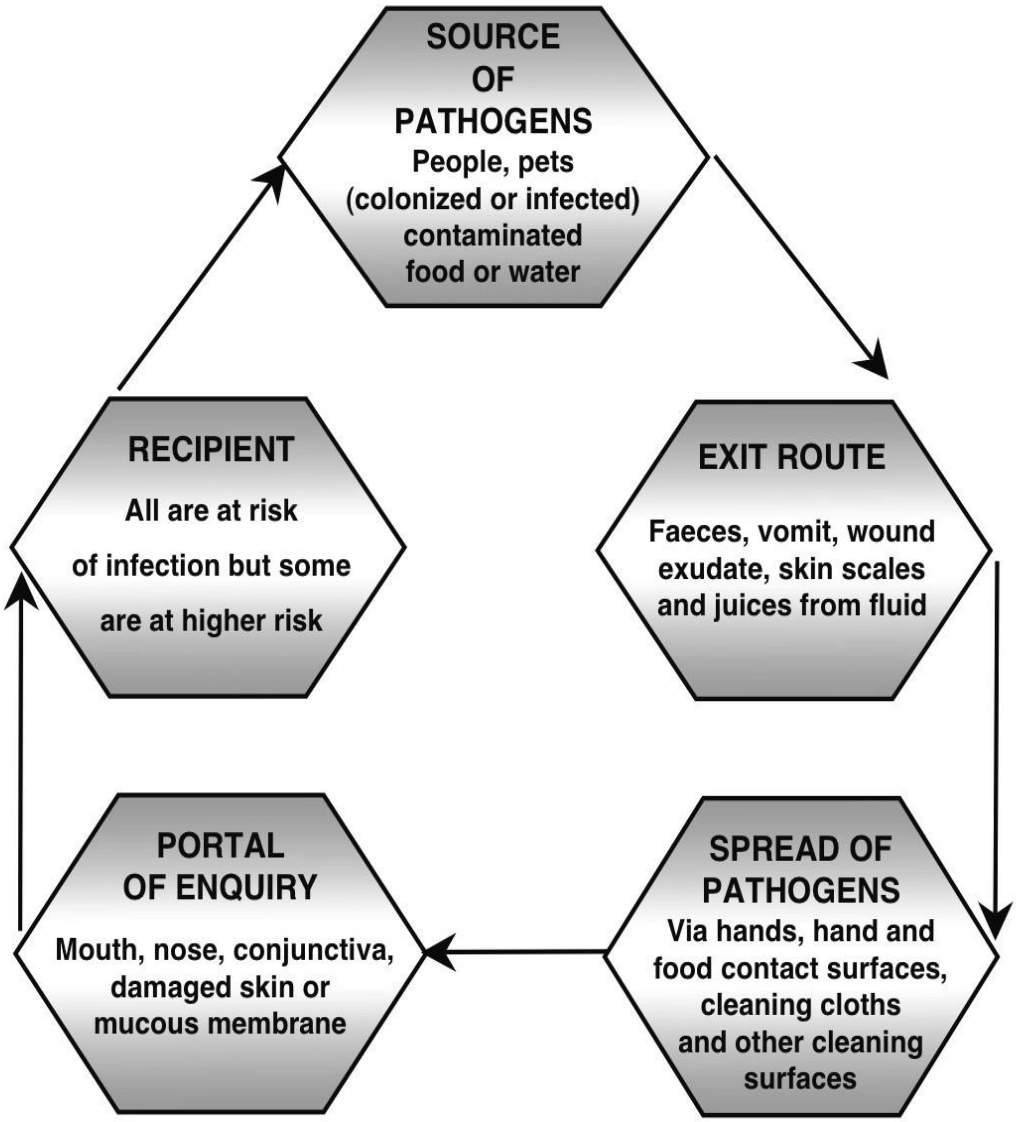

Figure 2.1: Chain of infection transmission in the home as it relates to kitchen infection transmission from its original source to a new recipient (Bloomfield, Aiello, Cookson, O'Boyle & Larson 2007)

In a set-up typical of a hospice kitchen layout, the extent of bacterial contamination is dependent on the hospice set-up with regard to kitchen infrastructure and the food-handling practices of the occupants and/or food handlers. A study (Nkhebenyane 2010) found that mean total viable counts (TVC) isolated from food contact surfaces and hands in a hospice kitchen, were respectively in a range of 2 cfu.cm^{-2} to 5 cfu.cm^{-2}. It is generally accepted that TVC indicates the level of contamination of a particular foodstuff, as well as the presence of pathogens in a food processing environment. The same study also revealed bio-aerosol contamination in the hospice kitchens to be in a range of 7.90 mg.m^{-3} inside the kitchen, compared to 8.0 mg.m^{-3} outside. Therefore, in a set-up like a hospice, where resources are constrained, the education of the food handlers on best hygienic practices is the best preventive measure. More especially, since sporadic infections might be a result of cross contamination from kitchen hygiene practices usually regarded as acceptable. It is therefore envisaged that breaking the chain of transmission will discourage the spread of infection. Finally, standard prerequisites that apply to any kitchen will also be relevant in this regard, e.g. pest control, and infrastructure including washbasins.

2.5 FOOD SAFETY MANAGEMENT SYSTEMS AND ITS APPLICABILITY IN HOSPICE FOOD PREPARATION

A food safety management system is a risk-based method of controlling operational food safety hazards in businesses. Furthermore, it involves the control of both general and specific hazards through the implementation of food safety practices based on GHP (Good Hygiene Practice) and HACCP (Hazard Analysis Critical Control Point) respectively. The International Organisation introduced the Food Safety Management System (FSMS) for Standardization (ISO). The FSMS set interrelated or interacting elements to establish policy and objectives, and to achieve those objectives. The FSMS is used to direct and control an organisation with regard to food safety (ISO 2007). These systems are the most effective and economic way of ensuring a safe food supply, especially in light of the worldwide food safety problems that many countries have been enduring (Trienekens and Zuurbier 2008).

Sanitation practices used in the preparation of food, and the occurrence of the gastrointestinal illness affecting mainly people who are being served food in the hospices, raise many concerns. Food safety is about ensuring that food products are safe to eat, and taking care that all aspects of food preparation and production lead to a final product that is not contaminated. A preventive approach to food safety ensures that the food handler examines every stage of the process, identifies the essential procedures, and ensures that process standards remain consistent. This is done by means of establishing and maintaining a food safety programme. The majority of food handlers, including consumers, do not practice adequate food safety, despite the recognised importance of this aspect. Foodborne illness continues to be an increasing global public health concern, despite significant theoretical and practical developments in food safety management (Fischer, Frewer and Nauta 2006).

Hazard Analysis Critical Control Point (HACCP) is a system of food safety management that can be applied at all stages of the food chain - from primary production to final consumption. HACCP provides a framework to identify food safety hazards and the stages in a production process that are critical to their control in order to produce safe food and ensure consumer protection. In order for an HACCP system to be effective, prerequisite programmes must be in place to control factors such as good manufacturing practice, raw material control, production control, pest control, sanitation and maintenance, use of approved suppliers and supplier auditing schemes. However, in the hospice settings, use of approved suppliers and supplier auditing schemes remain challenging areas, since the majority of hospices rely on food donations from various retailers. Worldwide, it is recognised that the application of the HACCP system to food production and preparation has clear benefits, and the potential of enhancing food safety and preventing many cases of foodborne diseases (WHO 1999). It is widely accepted that no training programme is complete without an evaluation of its effectiveness, and literature is scanty on the reported evaluations of the effectiveness of food hygiene education in South Africa. Moreover, there has been no documented training on food hygiene in the hospices around South Africa.

2.6 THE ROLE OF HAND HYGIENE AND ITS ROLE IN THE SPREAD OF FOODBORNE INFECTION

It is generally accepted that hand hygiene is the single most effective measure to prevent healthcare-associated infection. Healthcare workers' hands are the most common vehicle for the transmission of healthcare-associated pathogens from patient to patient, and within the healthcare environment. For generations, hand washing with soap and water has been considered a measure of personal hygiene. Hand washing with soap can also prevent other health problems. For example, it has been shown to reduce the risk of respiratory infections by about 23 % (Rabie and Curtis 2006). However, some organisms are capable of surviving on a person's hands for at least several minutes following contamination (Edmonds-Wilson, Nurinova, Zapka, Fierer and Wilson 2015). The spread of infection can be interrupted by good hygiene practice, which includes adherence to hand hygiene recommendations and cleaning and disinfecting contaminated environmental surfaces.

Infectious agents introduced into the home via food include *Salmonella, Campylobacter*, *Listeria,* and *E. coli* O157. Good hygiene practices during food preparation are essential in preventing cross-contamination of prepared foods from raw foods, and for preventing contamination of food by an infected household member. Person-to-person transmission in the home can occur by direct hand-to-mouth transfer, via food prepared in the home by an infected person, or by transmission as a result of aerosolised particles. Therefore, adherence to appropriate hand hygiene practices is an important means of reducing the risk of healthcare-associated infections (Pratt 2001). A report (WHO 2006) indicates that insufficient, or very low compliance rates, have been reported by both developed and developing countries. Multiple reasons have been provided to explain the low compliance, and these may vary according to the setting and the resources available.

For example, the lack of appropriate infrastructure and equipment to enable hand hygiene performance, the cultural background, and even religious beliefs can play an important role in hindering good practices (Allegranzi, Memish, Donaldson and Pittet 2009). Further, the problem of antibiotic resistance has been a major concern in healthcare settings, including hospitals. Infection with antibiotic-resistant bacteria negatively impacts on public health, due to an increased incidence of treatment failure and severity of disease. Food may represent a dynamic environment for the continuing transfer of antibiotic resistance determinants between bacteria. The potential for transmission of pathogens from hands to ready-to-eat foods is supported by a number of studies.

Nevertheless, little is known about the prevalence of antibiotic resistance in the hospice community, and the potential role of the hand flora as a reservoir for such resistance. In a model domestic kitchen, 29% of food preparation sessions using campylobacter-contaminated chicken resulted in positive campylobacter isolations from prepared salads, cleaning materials, and food contact surfaces (Redmond, Griffith, Slader and Humphrey 2004). Antibiotic-resistance problems greatly hamper the treatment of infectious diseases. This means that we need to rely on hygiene strategies to an increasing extent to prevent the proliferation and spread of antibiotic-resistant strains.

2.7 FOODBORNE PATHOGENS AND ANTIMICROBIAL RESISTANCE IN HEALTHCARE SETTINGS

Food safety is globally challenged by the constant emergence of new pathogens. Antibiotics have been hailed as the recommended treatment regimen to treat infectious diseases. However, the usage of antibiotics in human medicine and animal husbandry has led to the creation of selective pressure that favours emergence of antibiotic resistance among micro-organisms. Emergence or re-emergence of an organism can generally be related to a combination of factors and changes that occur along the farm-to-fork chain, as well as the inherent adaptability and genetic flexibility of micro-organisms (Koluman and Dikici 2013).

For example, *Staphylococcus aureus* is a common member of the natural microbiota of human skin and the nasal passages (Hanson, Dressler, Harper, Scheibel, Wardyn, Roberts, Kroeger and Smith 2011). The main reservoir of staphylococci in humans is the nostrils, although staphylococci can also be found on the hands. Moreover, according to Klevens, Morrison, Nadle, Petit, Gershman, Ray, Harrison, Lynfield, Dumyati, Townes, Craig, Zell, Fosheim, McDougal, Carey and Fridkin (2007), a methicillin-resistant strain of *S. aureus* (MRSA) has recently emerged as a serious life-threatening infective agent that does not respond to many antimicrobial treatments. To make matters even worse, the emergence and rapid spread of this organism has created important new challenges for infection prevention and control services in hospitals and other healthcare facilities (Kumari, Mohapatra and Singh 2008; Salmenlinna, Lyytikainen and Vuopio-Varkila 2002).

2.8 FOOD HANDLING AND ITS IMPACT ON FOODBORNE ILLNESS

Food handlers are an important source of introducing pathogens into foods during its preparation and storage. Food handlers involved directly or indirectly in food handling, often lack good knowledge of personal hygiene, and are mostly not exposed to appropriate hygienic methods of food processing and food handling (Tessema, Gelaye and Chercos 2014). This is especially true for the local hospice environment, where food handlers are mostly volunteers and rely on stipends to make a living (Fig 2.2). Annual estimates for industrialised countries indicate that up to 30% of the populations are affected by foodborne disease each year (WHO 2002). Moreover, there is a limited body of research on the effectiveness of foodborne disease prevention strategies in the context of food safety management. The number of foodborne illnesses in South Africa continues to rise on an annual basis.

Figure 2.2. Food handlers in a hospice kitchen

Havelaar, Kirk, Torgenson, Gibb, Hald, Lake, Praet, Bellinger, De Silva, Gargouri, Speybroeck, Cawthorne and Mathers (2015) state that many incidents of foodborne illnesses go unreported, and as a result, foodborne disease poses a significant public health problem in South Africa and worldwide. It has also been stated by Jianu and Chris (2012) that the handling of food during all stages of its preparation and storage is vital in reducing the incidence of foodborne illness. A large proportion of the research into foodborne illness appears to show a discrepancy between knowledge of correct food safety behavior, and applying this knowledge during actual behaviour. For example, a study by Byrd-Bredbenner, Maurer, Wheatlye, Schaffner, Bruhn and Blalock (2007) found that, although 97% of their research sample rated their own food safety knowledge as at least fair, 60% did not implement safe food-handling behaviour such as washing their hands with soap and water after touching raw poultry. Several methods have been proposed to investigate social influences and cognitive processes that motivate health behaviours.

The Health Belief Model (HBM) has been applied in a number of studies of hygienic food-handling behaviours with limitations. For instance, the model was successful in predicting behaviours in a study of risk perception (Kuttschreuter, Roseman and Kurzynske 2006). However, McArthur, Holbert and Forsythe (2006) found that the HBM was a poor predictor of compliance in food safety recommendations among undergraduate students. Therefore, the HBM has been criticised, and it has been proposed that other models may be more successfully applied. One such a model is the Theory of Planned Behaviour (TPB) (see Figure 2.3), which focuses on intention as the most salient predictor of future behaviour. It has been effectively applied to predict hand hygiene practices (Clayton and Griffith 2008). Authors (Godin and Kok 1996; Armitage and Conner 2001; Sheeran 2002) have conducted meta-analysis of the TPB-model, and have shown that the TPB-model can be used successfully to support the predictions of intention in single-action behaviours, and across general behavioral categories.

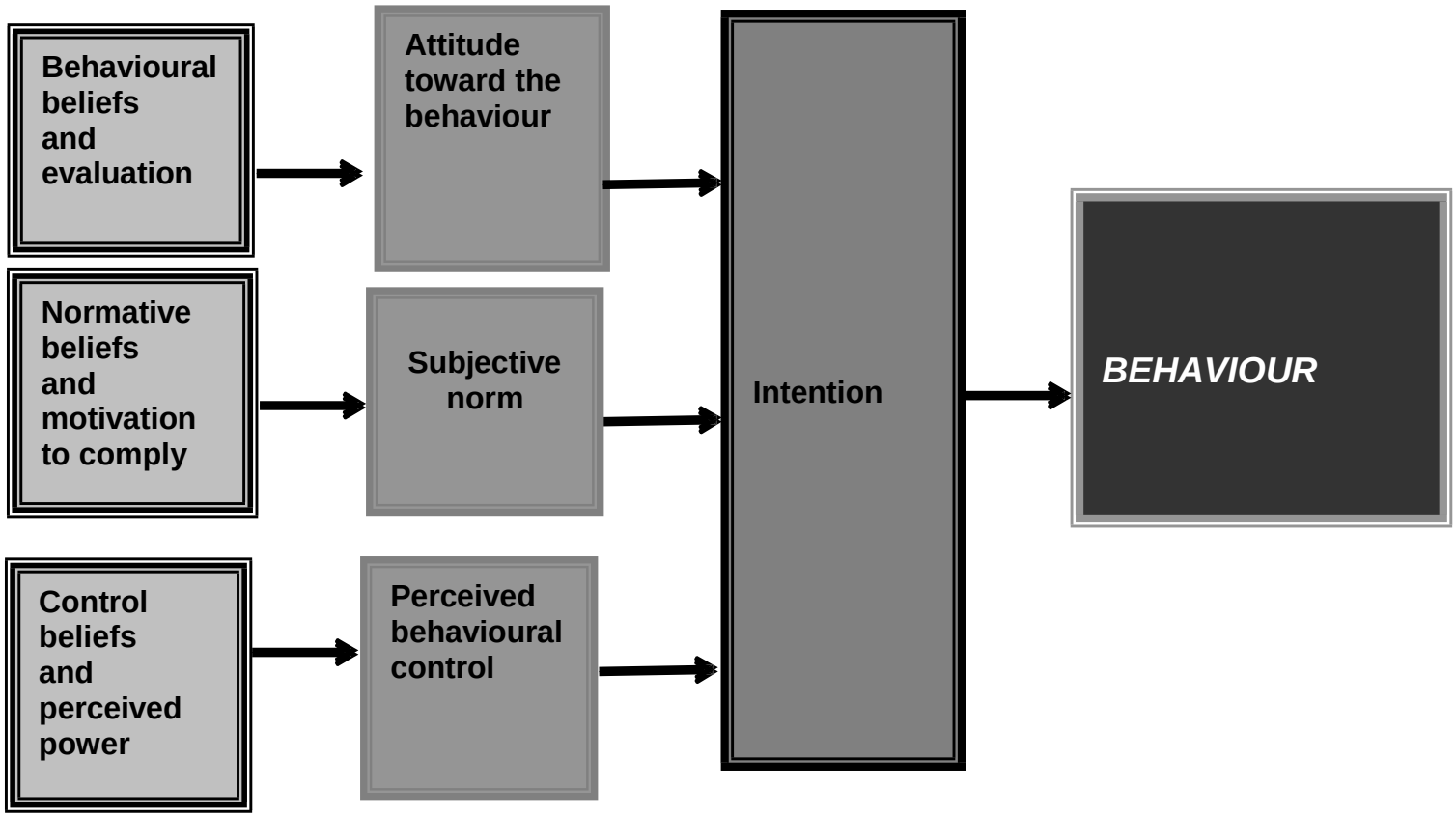

Figure 2.3: The Theory of Planned Behaviour (Ajzen 1985)

2.9 TOWARDS IMPROVED HIV/AIDS CARE: HYGIENE PROMOTION AND RELATED INTERVENTIONS

Hygiene refers to a procedure or system of procedures or activities used to reduce microbial contamination on environmental sites and surfaces in order to prevent the transmission of infectious disease. Infectious diseases continue to be a serious problem, despite major public health and health services improvement, especially in African countries. Several factors are associated with the control of infections. These include hygiene, sanitation and safe drinking water, which are interlinked. The population of people in the community with HIV/AIDS-related immunodeficiency is rapidly increasing. Globally, the number of people living with HIV/AIDS is now 36.9 million; the majority living in developing countries (UNAIDS 2013). Despite significant progress, diarrhoeal diseases remain a principal cause of preventable death in developing countries. Residents of developing nations may experience between five and twenty episodes of diarrhoea per year (Annon 2002). In the developing world, one of the main "drivers" for changing attitudes to hygiene in recent years has been the 2002 UN Millennium Development Goals (MDGs), which has established not only the issues of water and sanitation, but also more recently, hygiene, on the global agenda. Hygiene promotion, together with improved water supply and sanitation, is a key component of intervention programmes, which aim to reduce the burden of diarrhoeal diseases in African countries.

In the year 2015, the Sustainable Development Goals (SDGs) were introduced as the successor framework to MDGs. The SDGs are a United Nations-sponsored process to create a common set of development goals for all communities in every country. The SDG framework comprises 17 sustainable development goals. The aim of goal six is to ensure the availability and sustainable management of water and sanitation for all. Additionally, WHO/UNICEF has identified WASH (water, sanitation and hygiene) as an area with significant potential to improve health and life expectancy. Over and above, WASH practices are essential for maintaining people's health and dignity, and a growing body of literature has demonstrated that these practices are particularly important in programmes to reduce the impact of HIV and AIDS.

WASH practices, such as hand washing, sanitation, water treatment and safe storage have been proven to reduce diarrhoeal rates by 30 to 40% (Curtis and Cairncross 2003; Fewtrell, Kaufmann, Kay, Enanoria, Haller and Colford 2005; Clasen, Schmidt, Rabie, Roberts and Cairncross 2007).

The model named ‘My five moments for hand hygiene’ was developed by the WHO in order to bridge the gap between the results of scientific studies and evidence-based guidelines, including the necessity to provide user-centered practical tools. The WHO has also developed a food safety training tool called ‘Five Keys to Safer Foods’, which are: keeping clean, separating raw and cooked food, cooking thoroughly, keeping food at safe temperatures, and using safe water and raw materials. These five keys to safer food are critically important in developing countries, and they have the potential to equip food handlers in these countries with information that could significantly impact on food safety.

2.10 SUMMARY

This chapter provided an overview of the literature review that was conducted related to foodborne pathogens in auxiliary health settings; food safety and transmission routes of foodborne disease; food safety management systems; and their applicability in hospice food preparation. Foodborne pathogens and antimicrobial resistance in healthcare settings were discussed, as well as the impact of food handling practices on foodborne illness. Some intervention strategies towards improved food-handling practices in hospices in Central South Africa, were provided.

In the next chapter, the knowledge, attitudes and practices of food handlers in Central South African hospices are investigated. Factors affecting their knowledge of food preparation and preservation are clarified, and the hygiene standards and transmission of foodborne diseases in these hospices are looked into foodborne disease control measures are also provided.

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CHAPTER 3

KNOWLEDGE, ATTITUDE AND PRACTICES OF FOOD HANDLERS IN CENTRAL SOUTH AFRICAN HOSPICES

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3.1 ABSTRACT

The increasing number of foodborne illnesses and food poisoning outbreaks demand a better call for improved hygiene standards and food-handling practices. Studies have revealed that 70% of food poisoning outbreaks are due to ineffective time and temperature control of food, while the remaining 30% are the result of cross-contamination. The hands of food handlers have been shown to be vectors in the spread of foodborne diseases, as a result of poor personal hygiene or cross-contamination. To reduce the burden of foodborne diseases, interventions are necessary throughout the food safety continuum from farm to table. The majority of hospice food handlers are not trained in food safety, and they offer their services on a voluntary basis. In this study, a descriptive survey design was utilised to assess the knowledge, attitudes and practices of food handlers (n=100) in Central South African hospices. The majority of participants (68%) had not received basic food safety training, and the average percentage of the correct answers on the knowledge questionnaire was 67%. A statistically significant difference was found between the trained and untrained food handlers with regard to food safety knowledge ($P<0.001$). Only about 39% and 32% of the respondents respectively knew the correct holding temperature of hot and cold ready-to-eat food. There was a substantial lack of knowledge regarding the correct temperature for a refrigerator, hot ready-to-eat food, and cold ready-to-eat food. The study highlights the need for food safety training, with emphasis on temperature aspects such as control.

KEY WORDS: Food handlers, food safety training and food safety knowledge

3.2 INTRODUCTION

Whilst Chapter 2 provided an overview of the literature review that was conducted on foodborne illnesses and their effect on immunity-compromised patients, the focus of Chapter 3 is on determining the knowledge, attitudes and practices of food handlers in Central South African hospices. The data collection materials and instruments are discussed, as well as how sampling was conducted. Statistical procedures that were followed, are clarified, and the research results are discussed in detail.

3.2.1 The global impact of foodborne diseases

As indicated in the preceding chapters, and is evident from the literature review conducted, foodborne diseases are a global problem causing considerable morbidity and mortality annually. The World Health Organization (WHO) states that the rate of foodborne diseases has been escalating in recent years, with greater impact on the health and economy of developing countries than that of developed countries. These foodborne diseases consist of a wide spectrum of illnesses that manifest after the ingestion of contaminated foods and food products. It is also documented that they can be caused by a variety of microbial pathogens, chemicals and parasites that contaminate food at different points in the food production and preparation process. Both developed and developing countries are affected, and every individual in the world is at risk of foodborne disease (Fletcher, McLaws and Ellis 2013). Moreover, they pose a common public health problem worldwide, but are generally under-reported in South Africa.

Infectious intestinal disease (IID) predominantly arises in the kitchen environment during food preparation. The majority of hospice kitchens lack a formal set-up typical of a healthcare setting. Unlike hospital kitchens, hospice kitchens are multipurpose areas, and patients also have access to the kitchen. This, in turn, creates a risk potential in the kitchen preparation area, whereby a range of micro-organisms gain entry and spread to foods, ultimately resulting in illness. Therefore, meals prepared and distributed to patients in the hospices should receive special attention, as the food is intended for a population at risk.

Safe keeping of food (time/temperature), contaminated equipment, food from unsafe sources, poor personal hygiene and inadequate cooking are the most common factors contributing to foodborne disease outbreaks (Lynch, Painter, Woodruff and Braden 2006; Sanlier 2009). The full extent of the burden and cost of unsafe food is currently still unknown, but its impact on global health, trade and development is considerable. Diarrhoeal diseases alone, a considerable proportion of which are foodborne, kill 1.5 million children every year worldwide (WHO 2008). A limited number of studies have affirmed that low-income populations are more likely to experience greater rates of gastrointestinal illness (Gillespie, Mook, Little, Grant and Mclaughlin 2010 and Jalava, Ollgren, Eklund, Siitonen and Kuusi 2011).

Hence, it is important that food handlers adhere to good personal hygiene and sanitary handling practices in an effort to prevent foodborne infections. It is also deemed critically important that each food handler should be involved in each food preparation step, until the finished product is ready to be served to the patients. Epidemiological data from different parts of the globe have shown that a significant proportion of foodborne diseases could be attributed to improper food processing practices in consumers' homes (Redmond and Griffith 2003). The constant emergence of new pathogens, including antibiotic resistant strains and the growing immune-compromised community, are factors responsible for deaths attributable to infectious diseases.

Another concern arises from the common involvement of food handlers who are not specifically trained about food hygiene and HACCP, but who are engaged in the receipt, distribution and serving of ready-made foods in the hospices. The inappropriate handling of foods by food handlers has been implicated in 97% of food poisoning cases (Howes, McEwen, Griffiths and Harris 1996; Gregg, Todd, Bartleson and Michaels 2007). Poor food-handling and hygiene practices in domestic kitchens are thought to be the cause of a significant number of foodborne illnesses. Numerous studies have documented the pivotal role of healthcare workers' (HCWs) hands in the propagation of micro-organisms within the healthcare environment, and ultimately to patients.

Many foods brought into the domestic kitchen are frequently contaminated with naturally occurring pathogenic micro-organisms. For example, *Staphylococcus aureus* is considered the third most important cause of foodborne disease in the world (Normanno, Firinu, Virgilio, Mula, Dambrosio, Poggiu, Decastelli, Mioni, Scuota, Bolzoni, Giannatale, Salinetti, La Salandra, Bartoli, Zuccon, Pirino, Sias, Parisi, Quaglia and Celano 2005). It is well known that the main reservoir of staphylococci in humans is the nostrils, and the hands have also been found to harbour these bacteria. Moreover, hand contamination of food handlers with *Staphylococcus aureus* is an important risk factor for staphylococcal food poisoning (Ho, Boost and O'Donoghue 2015). Knowledge, attitude and practice (KAP) were found to be three factors that play a major role among food handlers in the context of food poisoning and food safety (Sharif and Al-Malki 2010).

The measuring of food handlers' knowledge, attitudes and behaviour can help in designing an effective health promotion initiative. Furthermore, it has been suggested by Angelillo, Foresta, Scozzafava and Pavia (2000) that food handlers with good knowledge of proper food-handling practices could help to control food poisoning cases, as they are in direct contact with food, particularly ready-to-eat foods. Therefore, training programmes are important for improving the knowledge of food handlers. However, it has been disputed by Ansari-Lari, Soodbakhsh and Lakzadeh (2010) that more knowledge of food safety practices always leads to positive changes in food-handling behaviours. Worsfold, Griffith and Worsfold (2004), however, assert that behaviour change in safe food-handling can be attained when the knowledge and skills learned are being rehearsed and used. It has also been stated by Seaman and Eves (2010) that continual training and management support are important elements in the transfer of knowledge into behaviour. Therefore, it is in this context that food safety training should be given priority in the hospices, especially since it is not mandatory for food handlers in SA hospices to attend food safety training. Food hygiene in hospices poses peculiar problems, particularly given the presence of patients who are more vulnerable to microbiological and nutritional risks than healthy subjects. Hence, a major goal of the hospice is to provide safe food to patients who frequently are at higher risk of acquiring infections and related complications. It is also on this note that regular cleaning schedules in hospices are encouraged as part of the hygienic procedure and infection control.

The aim of the study was to evaluate the knowledge, attitudes and practices of hospice food handlers in Central South Africa. Association with demographic and work-related determinants was also investigated. Findings would be helpful in developing food safety training specific to the hospice setting, as well as in developing policies to protect vulnerable patients, and to develop infection control guidelines specifically for hospice settings.

3.3 MATERIALS AND METHODS

3.3.1 Data collection instruments

For the purpose of this study, hospices are defined as non-governmental organisations with no funding from government, which operate under budgetary constraints for operational costs. The food handlers in the hospices are often volunteers with a limited knowledge of food storage and preparation in the compromised health context. They are responsible for cooking, plating and serving food to the patients, and for cleaning the premises.

The knowledge of, attitudes towards and practices (KAP) applied by hospice food handlers regarding food hygiene were assessed by means of a semi-structured questionnaire containing predominantly multiple-choice questions, which was prepared and modified based on questionnaires used in other studies of a similar nature. The questionnaire included five sections: a) demographic characteristics and employment status; b) knowledge about food hygiene; c) attitudes towards prevention of foodborne diseases; d) measures to be used in prevention of foodborne diseases; and e) sources of information about food hygiene. The questions concerning knowledge about foodborne disease agents and foods epidemiologically linked to transmission of pathogens listed some micro-organisms, and respondents were asked to choose from among three options – yes, no, or don't know – about their association with foodborne disease, and to couple at least one food vehicle to each pathogen. Answers were classified as correct when they contained exclusively food items with a well-recognised role as a vehicle for the pathogen under analysis.

The answers in the section of practices were simplified into three choices: always, often and occasionally. To determine construct and content validity, three individuals with expertise in food safety reviewed the questionnaire via a pilot study.

3.3.2 Sampling protocol and sampling sites

Hospices were selected by utilising a purposive sampling methodology. The HPCA (Hospice Palliative Care Association) hospice register was used to guide the selection. According to the list, there are 134 registered hospices countrywide. Only about 60 of these hospices have in-patient units and food preparation areas. Hospices with in-patient sections usually consist of houses or buildings set aside via social grants and sponsorships, and they accommodate four to eight staff members, comprising of a registered nurse/s, administrative and support staff, and food handlers.

Central South Africa was defined as the entire Free State province of South Africa, including selected western areas of the Eastern Cape and western areas of the Northern Cape (Figure 3.1). Of such hospices, nine (100%) were identified in the Free State province, three in the Eastern Cape, and three in the Northern Cape, respectively. The in-patient number ranges from 10 to 30. All food handlers were included in the study, averaging approximately six individuals per hospice. A 100% participation rate was achieved via targeted interviews as authorised by the hospice manager. The interviews were conducted once off, necessitating in some instances a repeat visit to some selected facilities. Hospice managers were asked for permission to access the hospice establishments, and to distribute the questionnaires to the food handlers. Prior to the completion of questionnaires, the study background and aim were explained to the food handlers, including their rights and role in the study. The principal researcher and assistants administered and collected the completed questionnaires immediately upon completion. The University of Free State's Ethical Committee granted ethical clearance for the study to be conducted, as per ethical clearance number UFS-HSD2016/1088. Ethical clearance was also obtained from the Hospice Board.

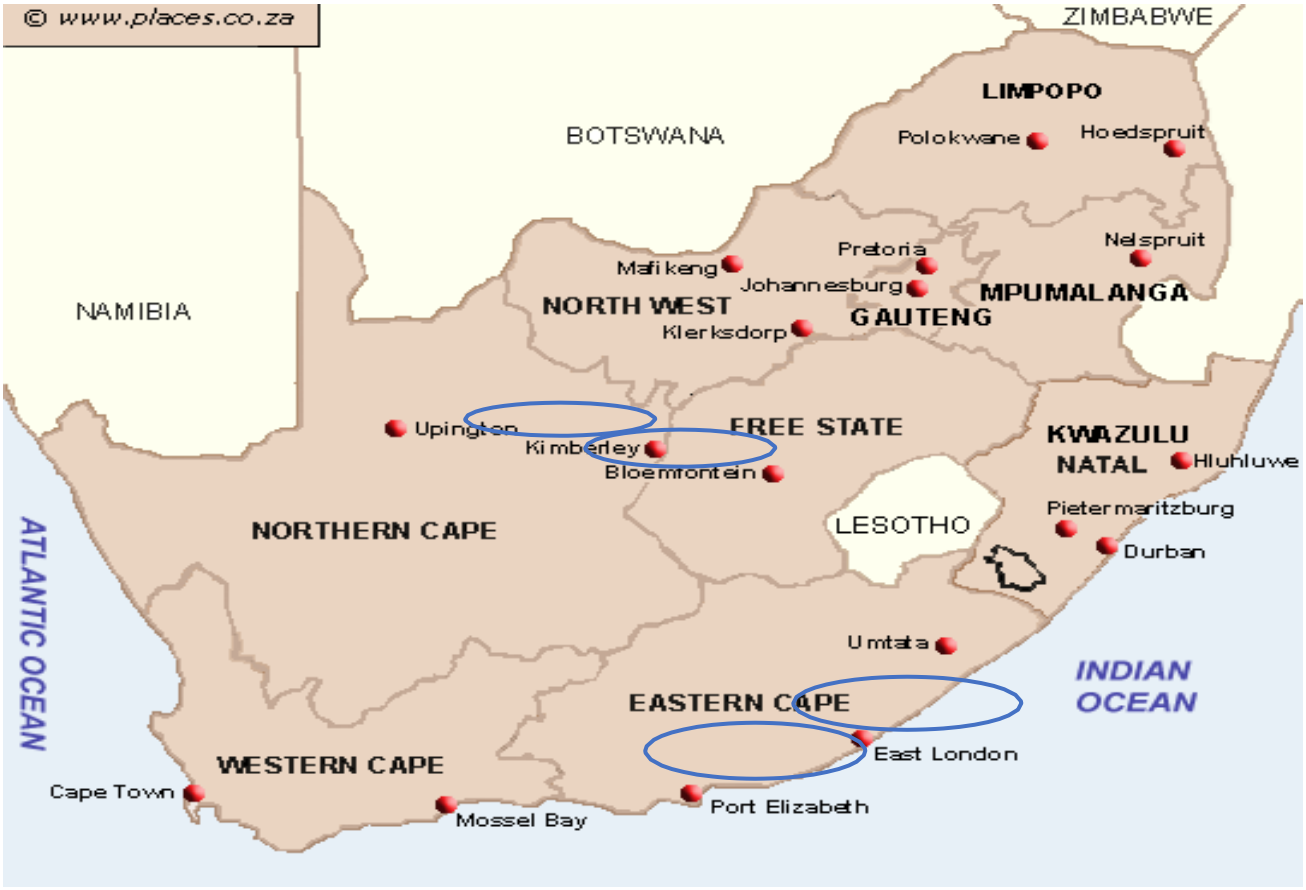

Figure 3.1: A map showing Central South Africa hospices as indicated by the circles

3.3.3 Statistical procedures

Questionnaires were manually coded in order to allow consequent data processing. Food safety knowledge, attitude and practice scores for the respondents were respectively calculated based on a multiple-choice answer to each statement. Responses were assigned a score +1 when the correct option was checked off, -1 in the case of an incorrect option, and 0 in the case of a “don't know” or uncertain response. The total percentage score for the food handlers was then calculated by dividing the score sum by the maximum possible score. Statistical analysis of associations between questionnaire answers and demographic and work-related characteristics, such as the length of service in the employment of the hospice, was performed by categorisation of answers for each section as dichotomous variables:

- knowledge was categorised and recorded as **correct vs. incorrect/unknown**;
- attitudes as **agreement vs. disagreement/uncertain**, and
- practices as **safe** when answered “always” (“occasionally” for the question D6) **vs. unsafe** when answered “often” or “never” (“always” for the question D6).

Data was analysed by the SPSS Software 14.0 version (SPSS, Inc., Chicago, Ill, US). Significance limits were set at $P < 0.05$.

3.4 RESULTS AND DISCUSSION

A total of 100 food handlers participated in the study. All the respondents were females, with a mean age of 35 years (SD= 9.27), and the majority having completed Grade eight (Table 3.1). The mean length of service was four years (SD=2.67). The majority (68%) of the food handlers did not receive food safety training, and only 32% of the respondents have attended at least one formal training course on food hygiene. Approximately 30% of the respondents had the highest qualification of less than Grade 10, while 70% achieved Grade 10, and above.

Table 3.1. Demographic characteristics of interviewed food handlers (n=100) in 15 hospices across central South Africa

Characteristics of survey respondent		Mean (STDEV)
Age (yr)		35 ± 9.27
<35	56	
≥35	44	
Length of service in employment (yr)		4 ± 2.67
<4	57	
≥4	43	
Education level (grade)		10 ± 2.17
<10	30	
≥10	70	
Attending at least course on food hygiene		
Yes	32	
No	68	

3.4.1 Knowledge

The most significant responses for this section are described in Figure 3.2. A spider plot was used to visually reflect the shortcomings of the respondents in selected categories.

The survey of the food handlers' knowledge demonstrated the equivalent of 66.8% correct answers. A notable knowledge in the categories of application of cleaning and sanitisation procedures for equipment, washing hands before handling food, and wearing gloves while handling food, was demonstrated. For all these mentioned variables the food handlers scored more than 80%. For example, 93% of food handlers had the knowledge that washing hands before handling food reduces the risk of contamination. There was, however, a substantial lack of knowledge regarding the correct temperature for a refrigerator, hot ready-to-eat food and cold ready-to-eat food. This is evidenced by only 41% of the food handlers knowing that the correct refrigeration temperature is 1-5°C. This is in addition to 61% of the food handlers who were unaware of the correct temperature for hot ready-to-eat food, and only 32% of the respondents who were aware of the appropriate temperature of cold ready-to-eat food. Panchal, Bonhote, Mark and Dworkin (2013) reported a similar finding on the lack of adequate knowledge on temperature controls by food handlers in a restaurant. This particular knowledge gap in a hospice could possibly be attributed to the absolute lack of information on this important food safety control measure.

The majority (64%) of the respondents were aware that preparation of food too far in advance may contribute to the risk of food poisoning, whereas 68% of the respondents were aware of the contamination risk related to reheating food prior to consumption. Most of the respondents (93%) had the knowledge that incorrect application of cleaning and sanitisation procedures for equipment (refrigerator, slicing and mincing machine), has the potential to increase the risk of foodborne diseases to consumers. The majority of respondents (84%) had the knowledge that wearing gloves while handling food reduces the risk of transmitting infection to consumers.

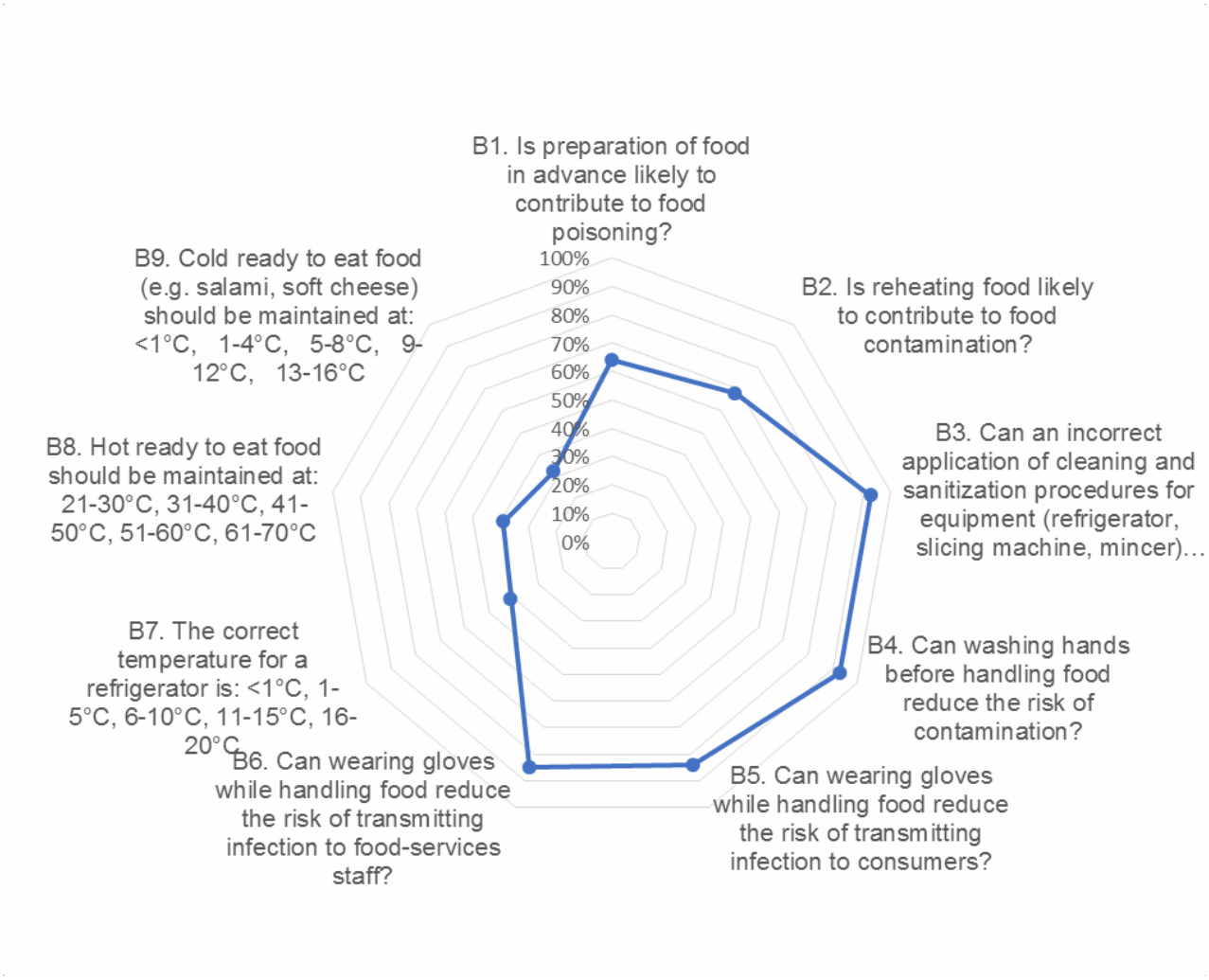

Figure 3.2: Knowledge of food preparation and/or preservation, hygiene standards and transmission of foodborne diseases. B7, 8 and 9: The correct answer was an indication of the correct refrigeration temperature (1-5°C), hot (51-60°C) and cold (1-4°C) ready-to-eat food temperature, respectively.

There seemed to be a common knowledge gap among food handlers with regard to the aspect of optimum refrigeration temperature. Hence, it is not surprising that hospice food handlers demonstrated an apparent lack of knowledge regarding temperature control. To support this, a study conducted by Marais, Conradie and Labadarios (2007) showed that the least successfully answered questions concerning food safety were related to temperature control. Additionally, a study by Akabanda, Hlortsi and Owusu-Kwarteng (2017) indicated that food handlers were less familiar with time and temperature abuse and its negative impact on food safety. It was further reported by Rebouças, Santiago, Martins, Menezes, Araújo and Almeida (2017) that improper handling of food, including the abuse of time temperature, account for most foodborne disease outbreaks. This particular knowledge gap in a hospice could possibly be attributed to a lack of information on this important food safety control measure, since it was observed during the study that the majority of food handlers in the hospice do not use a thermometer to check the temperature of food during cooking.

For the last two questions on knowledge, the respondents were requested to identify diseases that can be transmitted by food (B10), and to mention any common food item that can be associated with the transmission of foodborne disease (B11), as depicted in Table 3.2. In order to effectively reduce foodborne illnesses, it is important that food handlers should be familiar with different ways in which humans come into contact with foodborne illness-causing bacteria.

Table 3.2. Knowledge of food and transmission of disease

Variables	Category	Frequency	Percentage
B10. Which of the following diseases can be transmitted by food?	Hepatitis A	1	1%
	Hepatitis B	1	1%
	Cholera	41	41%
	Botulism	12	12%
	Gastroenteritis	32	32%
	I don't know	13%	13%
B11. Food item that can be associated	Meat/Chicken/Polony	47	47%
	Eggs	6	6%
	Spinach, Broccoli, Salad	12	12%
	Milk, Cheese	3	3%
	Beans, Soup	3	3%
	Rice	3	3%
	Water	3	3%
	I don't know	23	23%

It was indeed interesting to note that the majority of participants (41%) identified Cholera as a disease that can be transmitted by food, since Cholera transmission is closely linked to inadequate access to clean water, while 32% indicated that Gastroenteritis is transmitted by food, and 12% mentioned Botulism. However, about 13% of the respondents indicated that they do not know if any of the diseases listed were transmitted by food. The majority of respondents identified meat, chicken or polony as food items that can be associated with the transmission of foodborne diseases (47%). Eggs were identified by 6% of the respondents as being associated with the transmission of foodborne diseases.

3.4.1.1 Factors affecting the knowledge of food preparation and/or preservation, hygiene standards and transmission of foodborne diseases

In this section, the effects of the demographic variables on the knowledge of food preparation and/or preservation, hygiene standards and transmission of foodborne diseases were evaluated. Seeing that the scale of measurement used in the data collection process is categorical, the most appropriate test statistic to evaluate any relationships between measurements was deemed to be the Chi-square Test.

In order to make the computation of the Chi-square Tests easier and more valid for the questionnaire items B1 to B11, those who responded “I don’t know” and “no” were combined, since only limited respondents elected the “I don’t know” category.

3.4.1.2 Effects of age on the knowledge of food preparation and/or preservation, hygiene standards and transmission of foodborne diseases

The results in Table 3.3 indicate that age has a significant effect on the knowledge of food poisoning (Chi-square=17.686, P-value=0.005), and that the preparation of food in advance is a likely contributing factor.

Table 3.3 Effects of age on the knowledge of food hygiene and transmission of diseases (only significant relationship shown)

Variables		A1. Age group							Fisher's exact Chi-square tests	
		Up to 25 yrs	26–30 yrs	31-35 yrs	36-40 yrs	41-45 yrs	46-50 yrs	Above 50 yrs	Statistic	P-value
B1. Is preparation of food in advance likely to contribute to food poisoning?	Yes	10	16	16	11	8	0	3	17.686	0.005
	No	9	4	2	7	6	5	3		
B2. Is reheating food likely to contribute to food contamination?	Yes	13	14	16	12	10	2	1	12.145	0.047
	No	6	6	2	6	4	3	5		
B8. Hot ready-to-eat food should be maintained at: 21-30°C, 31-40ºC, 41-50ºC, 51-60ºC, 61-70ºC	Yes	5	9	8	6	10	1	0	12.317	0.047
	No	14	11	10	12	4	4	6		

Table 3.3 further indicates that from those below the 25 years' category, 53% indicated that preparation of food in advance is likely to contribute to food poisoning. The age groups 26-30, 31-35, and 36-40, had the highest proportion of those indicating that preparation of food in advance is likely to contribute to food poisoning. All the age respondents in the age group (46-50 years) indicated that preparation of food in advance, followed by storage, is not likely to contribute to food poisoning. This finding is contrary to the results obtained by Martins, Hogg and Otero (2012), who found that the older age group had higher knowledge scores. Furthermore, the results also show that age has a significant effect on the knowledge of whether reheating of food is likely to contribute to food contamination (Chi-square=12.145, P-value=0.047), as well as on the knowledge of the temperature at which hot ready-to-eat food should be maintained (Chi-square=12.317, P-value=0.047). It was also interesting to note that none of the older age group (>50 years) had knowledge of the correct holding temperature of hot ready-to-eat food.

3.4.1.3 Effects of length of service on the knowledge of food preparation and/or preservation, hygiene standards and transmission of foodborne diseases

The results shown in Table 3.4 conclude that length of service has a significant effect on the knowledge of whether wearing gloves while preparing food can reduce the risk of transmitting infection to food service staff (Chi-square=11.689, P-value=0.009).

Table 3.4 further indicates that for all the different service length categories, 100% of the respondents indicated that an incorrect application of cleaning and sanitisation procedures for equipment (refrigerator, slicing machine, mince machine) increases the risk of foodborne disease to consumers, with the exception of the category (1-2 years), where 39% of respondents did not agree.

Table 3.4. Effects of length of service and education on the knowledge of food hygiene and transmission of diseases

Variables		A2. Length of service					Fisher's exact Chi-square tests	
		<1 year	1-2 years	3-4 years	5-6 years	6+ years	Statistic	P-value
B3. Can an incorrect application of cleaning and sanitation procedures for equipment (refrigerator, slicing machine, mincer) increase the risk of foodborne disease to consumers?	Yes	12	18	38	14	11	14.629	0.000
	No	0	7	0	0	0		
B6. Can wearing gloves while handling food reduce the risk of transmitting infection to food services staff?	Yes	10	16	36	12	11	11.689	0.009
	No	2	9	2	2	0		
B7. The correct temperature for a refrigerator is: <1ºC, 1-5ºC, 6-10ºC, 11-15ºC, 16-20ºC	Yes	10	5	18	6	2	16.251	0.002
	No	2	20	20	8	9		

The percentage obtained in this study for the cleaning and sanitation procedure is much higher than that obtained in a study conducted by Bolton, Meally, Blair, McDowell and Cowan (2008), in which study only 35% of the respondents had knowledge of sanitation aspects. The results of this study clearly indicate that length of service has a significant effect on the knowledge that wearing gloves while handling food reduces the risk of transmitting infection to food services staff (Chi-square=11.689, P-value=0.009); and on the knowledge of the correct refrigeration temperature (Chi-square=16.251, P-value=0.002). For example, 90% of respondents with a service length of three to four years were familiar with the correct temperature for a refrigerator.

Education was also found to have a significant effect on the knowledge that reheating food is likely to contribute to food contamination (Chi-square=10.427, P-value=0.049). Approximately 37% of the Grade 12 categories were aware that reheating food is likely to contribute to contamination. Similarly, a study by Martins, Hogg and Otero (2012) found that participants, who have completed the fourth year (primary school), and the sixth year of formal education, produced scores which were statistically significantly different from those which had completed the twelfth year. This could likely be due to the fact that a food hygiene course, in some schools, is offered in Grade 12.

3.4.1.4 Effects of attendance of food hygiene courses on the knowledge of food preparation and/or preservation, hygiene standards and transmission of foodborne diseases

The results shown in Table 3.5 suggest that attendance of courses has a significant effect on the knowledge that preparation of food in advance is likely to contribute to food poisoning (Chi-square=6.474, P-value=0.011), and on knowledge of the correct refrigerator temperature (Chi-square=11.797, P-value=0.001).

Approximately 30% of the food handlers who did not attend a food safety course believed that preparation of food in advance would not contribute to food poisoning. This is of great concern, since it is common knowledge that food becomes a breeding ground for microbial growth when left at room temperature for protracted periods. The working environment of hospice food handlers can be stressful at times, and requires the ability to multi-task, but this practice is a potential contamination hazard. Therefore, it is apparent that untrained food handlers are less familiar with time and temperature abuse, and the effect thereof on food safety. Other studies also reported similar findings. For example, Walker, Pritchard and Forsythe (2003) found that a lack of adequate knowledge on temperature controls by food handlers was common.

Table 3.5. Effects of attendance of courses on food hygiene on the knowledge of food hygiene and transmission of diseases

		A4. Attended courses on food hygiene		Fisher's exact Chi-square Tests	
		Yes	No	Statistic	P-value
B1. Is preparation of food in advance likely to contribute to food poisoning?	Yes	26	38	6.474	0.011
	No	6	30		
B7. The correct temperature for a refrigerator is: <1ºC, 1-5ºC, 6-10ºC, 11-15ºC, 16-20ºC	Yes	21	20	11.797	0.001
	No	11	48		
B8. Hot ready-to-eat food should be maintained at: 21-30ºC, 31-40ºC, 41-50ºC, 51-60ºC, 61-70ºC	Yes	25	14	30.280	0.000
	No	7	54		
B9. Cold ready-to-eat food (e.g. salami, soft cheese) should be maintained at: <1ºC, 1-4ºC, 5-8ºC, 9-12ºC, 13-16ºC	Yes	18	14	12.718	0.000
	No	14	54		

3.4.2 Attitudes

The most significant responses for this construct are illustrated in Figure 3.3.

The majority (92%) of the respondents agreed that raw food should be kept separate from cooked food, and only about 8% did not recognise the need of adopting this key measure to prevent cross-contamination. Also, the majority of respondents (85%) were in agreement that defrosted food should not be refrozen. This is indeed a positive finding, keeping in mind that refreezing of completely thawed food can present a serious health risk, since this faulty process has the potential to accelerate the growth of contaminating bacteria.

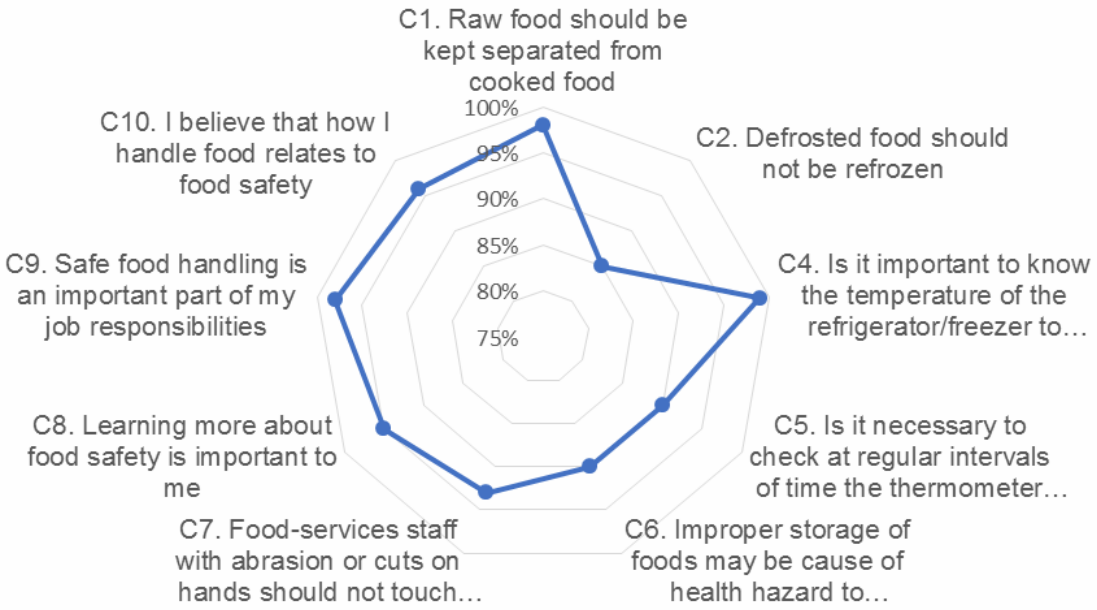

Figure 3.3 Attitude toward food hygiene and related matters

The use of caps, masks and protective gloves, including adequate clothing, was well supported by the respondents, as 94% of them agreed on and recognised the importance of wearing personal protective garment during food preparation. The percentage obtained in this study is much higher compared to that of a study conducted by Akabanda, Hlortsi and Owusu-Kwarteng (2017), wherein 60% of the respondents indicated that using caps, masks, protective gloves and proper clothing minimises the risk of food contamination. It is therefore encouraging to note this positive behaviour, since a reduction in the incidence of foodborne illnesses has been shown to be strongly influenced by the attitudes of food handlers towards the implementation of food safety plans.

Additionally, the majority (90%) of respondents agreed that it is necessary to monitor at regular time intervals the thermometer setting of the refrigerators and freezers, and that improper storage of foods may be a cause of health hazards to consumers. Almost all of the respondents (90%) agreed that improper food storage might be the cause of a health hazard to consumers. Again, the majority of the respondents (93%) agreed that food service staff with abrasions or cuts on hands should not touch unwrapped food. Indeed, this was a positive attitude, since it is well known and documented that infected cuts and abrasions are the breeding grounds for staphylococci. Therefore, it is ideal to remove a food handler presenting with cuts from food-handling duties altogether.

With regard to the aspect of learning more about food safety, the majority of respondents supported food-handling in relation to food safety, and the score range of 95% to 98% evidenced this. In general, the attitude of food handlers towards food safety was satisfactory. Moreover, age and length of service seemed to have a significant difference on the attitude that defrosted food should not be refrozen (respective P values=0.002 and 0.005). For example, 5% of the age group (31-35 and 36-40), and 50% of the age group (> 50), agreed that defrosted food should not be refrozen. A study by Buccheri, Casuccio, Giammanco, Giammanco, La Guardia and Mammina (2007) revealed that a high proportion of respondents (86.8%) were unaware of the fact that defrosted food should ideally not be refrozen. This is of concern, and it presents a potential food safety challenge that can promote microbial proliferation on refrozen food items.

3.4.3 Foodborne disease control measures

Responses for this section are displayed in Table 3.6. The majority (80%) of respondents stated that they always wash their hands before touching unwrapped raw food, while 82% stated that they also wash their hands after touching unwrapped raw food. Only about 17% of the respondents stated that they wash their hands occasionally while touching unwrapped raw food, whilst approximately 7% of the respondents stated that they wash their hands after touching unwrapped raw food.

Regarding the practice of separating kitchen utensils to prepare raw and cooked food, 70% of the respondents agreed. Thawing food at room temperature was supported by 70% of the respondents, with only 12% and 18% respectively reported “often” and “occasionally” for this practice. Approximately 61% of the respondents were in the habit of checking the shelf life of food products when purchasing them and 14% reported that they occasionally perform this practice. The NA (not applicable) section was included to accommodate those food handlers who do not buy food, since not all food handlers who participated in this study were allocated this task.

Attendance of courses had a significant effect on measures for foodborne disease and control (P=0.034). For example, only 2% of trained food handlers indicated that they “occasionally” wash hands before touching unwrapped raw food, while 15% of the untrained food handlers indicated “occasionally”. There was also a significant effect (P=0.021) on the measure of using separate kitchen utensils to prepare raw and cooked food, since an approximate 2% of trained food handlers indicated “occasionally”, while the untrained cohort registered 19% (Table3.6).

Table 3.6 Descriptive statistics of measures for foodborne disease control

Measures for foodborne diseases prevention and control	Occasionally	Often	Always	N/A
D1. Do you wash your hands before touching unwrapped raw food?	17% 17%	3% 3%	80% 80%	- -
D2. Do you wash your hands after touching unwrapped raw food?	7% 7%	11% 11%	82% 82%	- -
D3. Do you wash your hands before touching unwrapped cooked food?	8% 8%	5% 5%	87% 87%	- -
D4. Do you wash your hands after touching unwrapped cooked food?	5% 5%	6% 6%	89% 89%	- -
D5. Do you separate kitchen utensils to prepare raw and cooked food?	21% 21%	9% 9%	70% 70%	- -
D6. Do you thaw food at room temperature?	18% 18%	12% 12%	70% 70%	- -
D7. Do you check shelf life of food products when you buy food?	11% 14%	11% 14%	46% 61%	8.0% 11%

3.4.4 Practices

Only about 62% of the respondents reported that they always use gloves when they touch or distribute unwrapped foods, while 71% reported the same for washing hands before using gloves (Table 3.7). The majority (80%) of the respondents reported that they always wash their hands after using gloves, while 73% reported that they always use protective clothing when touching or distributing unwrapped foods.

A minimal portion (47%) reported the use of a mask when touching or distributing unwrapped foods, while the wearing of a cap when touching or distributing unwrapped food was practiced by 70% of the respondents. Washing of hands before touching unwrapped raw and cooked food was supported by 84% and 91% of the respondents respectively. Also, the majority of the respondents (93%) reported washing of hands after touching unwrapped cooked foods.

Research (Feltes, Arisseto-Bragotto and Block 2017) has shown that foodborne disease prevention requires favorable hygienic conditions during food preparation, which is considered to be a critical stage during which the food handlers play an important role. Additionally, it is during this phase where inadequate food handler practices can contaminate the food. Appropriate food-handling practices are therefore considered to be crucial in the prevention of foodborne diseases during food production and distribution.

Table 3.7 Descriptive statistics of practices

Attitudes towards food hygiene and related matters	Occasionally	Often	Always
E1. Do you use gloves when you touch or distribute unwrapped foods?	21% 21%	17% 17%	62% 62%
E2. Do you wash your hands before using gloves?	4% 4%	25% 25%	71% 71%
E3. Do you wash your hands after using gloves?	10% 10%	10% 10%	80% 80%
E4. Do you use protective clothing when you touch or distribute unwrapped foods?	20% 20%	7% 7%	73% 73%
E5. Do you use a mask when you touch or distribute unwrapped foods?	29% 29%	24% 24%	47% 47%
E6. Do you wear a cap when you touch or distribute unwrapped foods?	15% 15%	15% 15%	70% 70%
E7. Do you wash your hands before touching unwrapped raw foods?	1% 1%	15% 15%	84% 84%
E8. Do you wash your hands before touching unwrapped cooked food?	1% 1%	8% 8%	91% 91%
E9. Do you wash your hands after touching unwrapped cooked foods?	2% 2%	5% 5%	93% 93%

3.4.4.1 Effects of age on practices

Age had a significant effect (P=0.038) on the practice of using protective clothing to touch or distribute unwrapped foods. About 15% of the age group 26-30 and 36-40 indicated that they always use protective clothing when touching or distributing unwrapped foods, while about 5% of the age group 46-50, indicated “always” regarding the same practice.

3.4.4.2 Effects of attendance of courses on practices

The results shown in Table 3.8 confirm that attendance of courses has a significant effect on both the practice of using gloves to touch or distribute unwrapped food (Chi-square= 8.411, P= 0.012), and washing of hands after using gloves (Chi-square=12.560, P=0.001). Only 26% of trained food handlers indicated that they always use gloves when touching or distributing unwrapped foods, while 36% of untrained food handlers indicated “always” for the same practice. Only about 2% of trained food handlers indicated that they “occasionally” use gloves when touching or distributing unwrapped foods, while an indication from the untrained group was 19%. Research has shown that food safety training has the potential to prevent or mitigate food contamination risks by adjusting the practices of handlers and improving their skills. However, it has been emphasised (Acikel, Ogur, Gocgeldi, Ucar and Kir 2008; Campos, Cardonha, Pinheiro, Ferreira, Azevedo and Stamford 2009), that such training should be accompanied by regular inspection of the activities of the workers involved. Moreover, none of the trained food handlers indicated “often” or “occasionally” on the practice of washing hands after using gloves, whereas 10% of the untrained cohort indicated that they occasionally wash their hands after using gloves. However, 48% of the participants who never attended a course on food hygiene indicated that they always wash their hands after using gloves.

Table 3.8 Effects of attendance of courses on practices

Practices		A4. Attended courses on food hygiene		Fisher's exact Chi-square tests	
		Yes	No	Statistic	P-value
E1. Do you use gloves when you touch or distribute unwrapped foods?	Occasionally	2	19	8.411	0.012
	Often	4	13		
	Always	26	36		
E3. Do you wash your hands after using gloves?	Occasionally	0	10	12.560	0.001
	Often	0	10		
	Always	32	48		
E4. Do you use protective clothing when you touch or distribute unwrapped food?	Occasionally	0	20	14.698	0.001
	Often	3	4		
	Always	29	44		
E5. Do you use a mask when you touch or distribute unwrapped food?	Occasionally	2	27	13.532	0.001
	Often	9	15		
	Always	21	26		
E6. Do you wear a cap when you touch or distribute unwrapped food?	Occasionally	0	15	10.053	0.006
	Often	5	10		
	Always	27	43		
E8. Do you wash your hands before touching unwrapped cooked food?	Occasionally	1	0	5.953	0.026
	Often	0	8		
	Always	31	60		

The WHO recommends that hand hygiene must be performed immediately after glove removal to prevent further dissemination and transmission of micro-organisms. Additionally, it has been concluded by Todd, Michaels, Greig, Smith and Bartleson (2010) that gloves, when used correctly, can substantially reduce opportunities for food contamination. Another significant effect was the practice of using protective clothing when touching or distributing unwrapped foods (Chi-square= 14.698, P-value= 0.001), and that of using a mask when touching or distributing unwrapped foods (Chi-square= 10.053, P-value= 0.006).

There was also a significant difference (P value=0.026) on the practice of washing hands before touching unwrapped foods. Approximately 31% of trained food handlers reported that they always wash their hands before touching unwrapped foods, whilst none of the same group reported “often”. The results of this study are higher than those obtained by Bas, Ersun and Kivanc (2004), where only 5% of the food handlers reported that they always wash their hands before touching unwrapped foods. On the contrary, only 8% of the untrained food handlers reported “often” for the same practice. This finding is not encouraging due to the risk factors associated with ineffective hand washing.

3.5 CONCLUSIONS

The kitchen is the focal point of food handling, and consequently also of contamination. During food preparation, handling and storage, food can be mishandled at many localities. Thus, correct handling of food during all stages of its preparation and storage is essential for purposes of reducing the incidence of foodborne diseases. Since food producers, especially those working in sensitive environments, cannot guarantee pathogen-free food supply, the food handler is a critical link in the chain to prevent foodborne diseases. Food handlers in the hospices should be aware of the fact that careful personal hygiene is a key measure to prevent food contamination and the spreading of enteric diseases. This is especially true concerning the fact that some pathogens such as *E.coli* 0157:H7 have a low minimum infective dose.

In this study, the survey of the food handlers' knowledge generally demonstrated the equivalent of 66.8% correct answers. There was an overall lack of sufficient knowledge of the correct responses among the respondents pertaining to refrigeration temperature, including the correct temperature for hot and cold ready-to-eat foods. For example, 61% and 68% of the respondents did not know the correct holding temperature of hot and cold ready-to-eat food, respectively. A similar study (Buccheri, Casuccio, Giammanco, Giammanco, La Guardia and Mammina 2007) revealed that 83.5% and 37.7% of the respondents, respectively, did not know the proper storage temperature of hot and cold ready-to-eat foods. Other studies (Angelillo, Foresta, Scozzafava and Pavia 2001, and Askarian, Gholamhosein, Aminbaig, Memish and Jafari 2004) also revealed a lack of knowledge about critical temperatures among hospital food handlers.

This is of concern, since storage temperature remains a critical variable in the safety of food, especially in cases where meals are prepared for immune-compromised patients. Controlling the time and temperature of food are the most important strategy of keeping food safe. It is against this backdrop that hospice food handlers should be knowledgeable on proper storage temperature, more especially since meals are prepared in advance to cater for the patients.

Hospices cannot afford to discard food that was not consumed at the end of meals resulting in leftovers, with concomitant potential safety risks associated with this practice. It thus remains important for food handlers in this setting to be skilled on proper handling and storage temperature of leftovers to avoid food poisoning. This study, however, showed a general positive attitude towards the practice of separating raw and cooked food, and the importance of knowing the refrigeration/freezer temperature to reduce the risk of food spoilage. There were also positive responses towards the food safety practices, with the exception of using a mask to touch or distribute unwrapped food. In this regard, only approximately 47% of the respondents reported the usage of a mask for touching or distributing unwrapped food.

However, with regard to safe food control measures, a worrying finding was the improper practice of thawing food at room temperature, and not always checking the shelf life of food products when buying them. Meals prepared and distributed in hospices should receive special attention, as the foods are intended for a population with an increased risk of several diseases. This is even more important considering the recent listeriosis foodborne outbreak in South Africa, and this has been a grave reminder of the fact that the young, old, immune-compromised and other vulnerable groups bear the brunt in terms of being victim to the disease and mortality. In the USA, large outbreaks of listeriosis have been reported in recent years, where food commodities initially not considered as primary high-risk foods have been implicated (Garner and Kathariou 2016). These food commodities included mainly produce, lettuce and fruit. Good personal hygiene and sanitary handling practices at the workplace are an essential part of any prevention programme for food safety. Hospices should set up the regulations to be followed by the food handlers in order to ensure high quality meals with minimal bacterial contamination. The results of the study indicate that there is an urgent need for targeted food safety education among hospice food handlers.

Ideally, food safety training should be conducted regularly, and this should be based on, amongst others, food handlers' risk perception. It is further encouraged that the HACCP approach should be used in the hospice kitchens to identify hazards associated with different stages of food preparation and handling, starting with the implementation of robust prerequisite programmes (PRPs).

In the next Chapter, the perceptions of food handlers in hospices in Central South Africa related to Management's approach to food safety; as well as the availability of sufficient human and other resources in such hospices, and the effects thereof on food safety, are looked into by means of a qualitative investigation and discussion.

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CHAPTER 4

FOOD HANDLER PERCEPTIONS OF MANAGEMENT APPROACH AND RESOURCES AT HIV/AIDS HOSPICES: A QUALITATIVE INVESTIGATION

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4.1 ABSTRACT

Food handlers working in hospice kitchens fulfil a very important role with regard to ensuring safe food provision. Hand hygiene has been identified as a core element to protect patients against healthcare acquired infections and colonisation with, for example multi-resistant micro-organisms. In this study, focus groups were conducted with hospice food handlers to explore the food safety management behaviours in their various localities, and to identify perceived barriers to implementing effective food safety practices. Barriers identified included a lack of management support, inadequate resources, and inconvenient location of the pantry in relation to the kitchen. All the participants agreed that food safety training is useful in improving related food safety practices. Participants agreed that not being given due recognition from management was a key deterrent towards performance and safe food handling. Additionally, participants without an employment contract felt marginalised due to the fact that they are excluded from regular meetings between management and other staff members. However, the participants acknowledged and valued the support they received from management with regard to the provision of protective personal equipment and other resources in the kitchen.

KEYWORDS: **Food handlers, resources, hospice managers**

4.2 INTRODUCTION

The focus of this Chapter is centered around the mechanisms put in place by hospice Managers to support safe food-handling practices. Factors that prevent food handlers from following safe food-handling practices, are investigated. The value of food safety training to improve food-handling practices, is discussed, whilst the importance of having sufficient human and other resources available in hospices, is emphasised. Food handlers' knowledge of practices such as the washing of hands before handling food, and the use of separate utensils and cutting boards when preparing raw and cooked food, is tested, as well as their knowledge pertaining to antimicrobial resistance. The aim is to establish improved food-handling practices in hospices in Central South Africa.

4.2.1 The role of food handlers in preventing contamination during food preparation

Food handlers have a pivotal role in preventing contamination during food preparation and distribution. Codex alimentarius defines a food handler as "any person who directly handles packaged or unpackaged food, food equipment and utensils, or food contact surfaces, and is therefore expected to comply with food hygiene requirements" (Codex Alimentarius Commission 2003). Therefore, it is imperative that safe food-handling practices should be adhered to and prioritised. It has been estimated that approximately a quarter of the population of many developed countries experience foodborne illness annually (Mead, Slutsker, Dietz, McGCaig, Bresee, Shapiro, Griffin and Tauxe 1999; The Food-safety Information Council 2008). While data on foodborne illnesses are believed to consistently underestimate their true incidence, correct handling of food during all stages of its preparation and storage is essential in reducing the incidence of foodborne-illness (National Health and Medical Research Council 2003).

A South African study focusing on bacterial contamination of food handlers' hands showed unsatisfactory levels of hand hygiene among the food handlers in some convenient food industries (Lambrechts, Human, Doughari and Lues 2014). This is of particular importance at hospices where it is encouraged that hospice managers play a leading role in encouraging food handlers to enact the safe practices as learnt through food hygiene training. This is, however, not without challenges, since undesirable hygiene practices are often observed in the kitchen environment, and are not easily changed, even by the most intensive food safety training programmes. Moreover, it has been suggested by Clayton, Griffith, Price and Peters (2002) that, in order to design effective training for food handlers, there is a need to fully understand all the factors underlying food hygiene behaviour in the workplace.

Griffith (2000) stipulates that the hygiene motivation of food handlers can only be as the business and leadership within it requires, allows and encourages them to be, and this, in turn, is influenced by the facilities provided as well as management systems and the culture in place. Culture has been described by Coreil, Bryant, and Henderson (2001) as ‘‘patterned ways of thought and behaviour that characterise a social group, which can be learned through socialization processes and persist through time’’. Yiannas (2009) further elaborates that a food safety culture can be described as how and what the employees in a company or organisation think about food safety. The six indicators of safety culture that may be applied to food safety have been identified as: management systems, leadership, communication, commitment, environment and risk awareness, perception and risk-taking behaviour (Griffith, Livesey and Clayton 2010). Stanwell-Smit (2013) states that a good food safety culture is sometimes characterised as one in which employees share a sense of purpose in maintaining food safety standards. Hence, the role and responsibility of managers are critical factors in ensuring a safe food culture and safe food-handling practices. This can only be accomplished if all employees are well equipped to execute their tasks appropriately. The definition of food Safety Management Systems (FSMS) has been described by Griffith (2009) as “all the documented procedures, practices and operating procedures which influence food safety”.

Therefore, FSMS provides a preventative approach to identify, prevent and reduce foodborne hazards to minimise the risk of food poisoning and to make food safe for consumption. Hazard Analysis and Critical Control Point (HACCP) is a systematic approach to hazard identification, assessment and control. However, it has been emphasised by Wallace, Holyoak, Powell and Dykes 2014) that, even with a good food safety culture, the risk of harming the consumer still remains if there are flaws in a HACCP plan due to technical errors in the construction thereof. Furthermore, it has been stated by De Boeck, Jacxsens, Bollaerts and Vlerick (2015) that, to achieve a good food safety performance, organisations therefore need to have a well-elaborated FSMS and a positive food safety culture in place.

4.3 MATERIALS AND METHODS

This current study is an exploratory descriptive investigation that utilised a qualitative approach via a focus group that consisted of food handlers at hospices. The focus group participants were purposively selected from amongst the hospice food handlers. The focus groups consisted of hospice food handlers who, for the purpose of this study, have previously participated in a specific food safety training session. The focus group study, which is very effective in qualitative research, assessed the knowledge and experience of a group of individuals around a common theme at their workplace. Focus groups offer a platform to produce a wider range of information and insight. Furthermore, through focus groups, participants are afforded the opportunity to actively participate in the study process, and to capitalise on one another's responses in improving their own practices. In this study, the participants were relaxed and comfortable during the session, as a result of attending an information session before the interviews. They were given background information regarding the purpose of this focus group, and anonymity was guaranteed. Additionally, they were also informed that there is no right or wrong answer, and that only their opinions on the different food safety topics matters.

Before the commencement of the discussion, the manager once again introduced the research team to the food handlers, and encouraged them to feel free to participate as much as they can in the discussion. A trained facilitator with experience on facilitating focus groups was appointed, and participants were asked a set of questions. The questions were designed to follow an open-ended conversational sequence (Table 4.1). The focus group discussions were held in a hospice committee room and lasted for two hours. Participants were informed at least a week prior to the interviews. Consent was requested from supervisors, and participation was on a voluntary basis. Participants also remained anonymous. Focus group discussion responses were audio recorded, transcribed and manually coded per topic. Field notes were also used to ensure that the discussions were correctly transcribed. The transcribed texts were consequently verified using the audio recordings and field notes to ensure accuracy and authenticity. To analyse qualitative data for the purpose of encoding and analysis, the researcher and moderator used thematic content analysis as outlined by Flick (2002). Results were presented according to seven food safety management and knowledge topics.

Table 4.1 Food handler focus group questions

Focus group questions
What, if any, are the mechanisms put in place by the manager/supervisor at your workplace to help you follow safe food-handling practices?
What, if any, do you believe are the main factors in the workplace that prevent you from following safe food-handling practices?
Do you think food safety training/education is useful in improving your practices?
Are there adequate resources at your workplace to prepare food safely?
*Do you believe it is important to wash your hands before handling foods?
*Have you heard of the term 'antimicrobial resistance'?
*Do you use separate utensils and cutting boards when preparing raw and cooked food?

*Although not directly questioning management input, the questions were included, as they indirectly reflect management intervention in aspects such as hygiene and basic food safety skills. An emerging health predicament, namely pathogen resistance, was also included to assess the perceptions of contemporary risks.

4.4 RESULTS

4.4.1 Participants' profile

Five food handlers participated in the focus group session. The duration of the session was 1.5 hours. All participants who participated in food safety training were females. Participants' length of employment ranged from one year to six years, with a mean of four years. Described in this section are the themes identified in the participants' discussions of their current food preparation practices, including the factors that influence their ability to engage in these practices.

4.4.2 Mechanisms put in place by the manager to support safe food-handling practices

The first line of questioning sought to establish the support mechanisms put in place at the workplace by the manager to facilitate safe food-handling practices. When participants were asked to state the mechanisms put in place by management to help with safe food-handling practices, the following prominent themes emerged from the discussions: constant provision of personal protective equipment (PPE), and guidance on safe food preparation procedures.

- One participant shared the following: *(sic)* "The manager constantly reminds us to put on our PPE, for example, I have a tendency of forgetting to put on my apron and she will constantly remind us". With regard to the correct food preparation techniques, the same participant highlighted the following: *(sic)* "She provides guidance on the correct storage of 'jam' and how to properly measure the correct volume of water when we have to pour in the bottles". It was further mentioned by two participants that they worked on a voluntary basis, and therefore rely on permanent personnel for proper guidance with regard to PPE: *(sic)* "I work on a voluntary basis and I rely on my permanent colleagues for guidance. For example, if I don't have a cap on they will tell me to go back and put one on before coming back to the kitchen".

Some participants highlighted organisational culture and function as motivating factors towards safe food handling. However, this seemed to be a benefit enjoyed by participants with an employment contract. For example, participants on a formal employment contract mentioned that constant meetings and discussions with management motivate them to perform safe food-handling practices. On the other hand, voluntary workers felt marginalised and excluded from participating in meetings.

- One participant replied as follows: *(sic)* “You see, some of us feel like we don’t belong and are not important here. I am saying this because we are not part of the meetings, and the manager will not even engage us on anything, maybe it is because we are working on voluntary basis and are not really part of the group but the forgotten ones, that is why sometimes we don’t even bother about safe food-handling because, who cares”.

4.4.3 Factors at the workplace that prevent food handlers from following safe food-handling practices

Secondly, the participants were requested to outline barriers to safe food handling.

In response to reasons given regarding factors at the workplace that prevent food handlers from following safe food-handling practices, a range of factors were identified. The practice of not being acknowledged or afforded the due recognition and distractions in the kitchen, such as constant interruption from fellow colleagues (e.g. gardeners and facilities maintenance workers), were the prominent themes that emerged. A lack of resources and support from management, lack of consideration for others, and not having a clear task description were also highlighted as hurdles in the same study areas.

- The participants were of the opinion that the manager occasionally imposes on them her personal preferences on how to prepare food and related recipes. This was explained by one participant as follows: *(sic)* “We are in charge and we cook for the children the way we know but because she is the manager, she will come and impose on us how to prepare the food the way she prefers. For example, I would want to prepare food using my own recipe, but she constantly ignores my input and prefers things her way”.

- To further elaborate on this point, another participant responded as follows: (*sic)* "We don't cook food the same and our recipes are different as individual food handlers. For instance, let us say I am preparing beetroot and want to mix that with Chakalaka right now and I tell her that I need Chakalaka, she will not immediately bring it to me. But, she will rather bring green beans for me to add, which was not what I initially requested, because she understands that beetroot must be mixed with green beans and not according to my recipe".

- With regard to constant interruptions in the kitchen from management or individuals, one participant said the following: *(sic)* "If I am interrupted by someone/people coming into the kitchen to disturb me e.g. wanting me to give him/her water while I am busy working, coming back I forget what I was busy with due to other disturbances by people outside". The same participant further elaborated as follows: *(sic)* "The other thing is constant interference from the manager; she would come to check up on us so that she can shout whenever she finds fault. Whenever she sees something that she does not like and starts to shout, that disturbs me to an extent that I will just go outside to regain my composure and then later on I would come back".

Some participants elaborated about instances where efforts to report issues that carry the potential for risk, or not being satisfactory in terms of hygiene and food safety, were met, with negative responses from management.

- This was illustrated as follows by one participant: *(sic)* "What I also don't like is the fact that the manager will give us meat that is going off and expect us to cook for the children even though she can see it herself. However, I do tell her that the meat is not suitable for cooking to give to the children. I will tell her because I am vocal but she will not listen to me and just expect us to cook the meat nonetheless".

- To further elaborate on this, one participant said: *(sic)* "There is also yoghurt that has expired, and we will bring this to her attention but she will still encourage that we give it to the children".

Selected participants also mentioned issues with resources as barriers to safe food handling.

- One participant explained: *(sic)* “Sometimes we don’t have water and I will alert the manager to the situation, but nothing will be done. However, I have devised a plan seeing that this is a common occurrence; there is water reserve that I hide for myself for later use in case of emergency when water is not available since I am a proactive person”.

- Another participant further elaborated: *(sic)* “Sometimes there is no electricity and we have to use gas because our mandate is to cook, we will not even be asked where the gas is coming from, the expectation is that we have to sort out this mess ourselves”.

- One participant explained further: *(sic)* “There is water leakage below the sink and this is giving us problems, look at the pipe below it is becoming moldy due to water but nothing is being done”.

On the point of feeling incapable due to a lack of guidelines and objectives, another participant responded:

- *(sic)* “I seem to be directionless because I rampantly touch or attend to whatever chore has been assigned to me by my supervisors. In other words, there is not quite a plan or job description schedule for me because of my working conditions; I am only working on a voluntary basis with no contract”.

4.4.4 Food safety training to improve practices

Participants were also interviewed on their perception of food handler training as an intervention to improve food safety practices. It is generally recommended that food safety training should be evaluated in order to attribute value to an intervention. All the participants agreed that food safety training is useful in the improvement of food safety practices. Food and personal hygiene were the key themes that emerged around this topic.

- One participant responded as follows: *(sic)* “Food safety training does make a lot of changes and is useful, for example, we learnt that water should not be stagnant in the sink for a long time because bacteria tend to accumulate on the surface and in water. We also learnt the importance of rinsing utensils with running water and also pest control in the kitchen, knowing hygiene properly because we deal with sick children so it is important to be clean right through”.

The importance of washing hands, cleanliness and hygiene also emerged as some of the major lessons learnt during food safety training.

- One participant explained as follows: *(sic)* “Yes, I learnt the importance of washing hands before touching food and personal hygiene that I need to be clean and my nails also must be short and clean so that dirt does not accumulate in the nails”.

- Still on the subject, another participant commented: *(sic)* “Yes the importance of washing my body and being clean before touching the food”.

- Another participant reiterated this as a highlight of food safety training: *(sic)* “The importance of using bleach to disinfect the dishes and it is important that my dishcloth must remain clean at all times”.

- Lastly and surprisingly one participant shared the impact of food safety training on self-confidence: *(sic)* “It also make you feel good and boost your confidence when you are clean and even people who don’t know you can take an example from you”.

4.4.5 Adequate resources at the workplace

On the question whether there are adequate resources at the workplace, there seemed to be mixed responses. Inadequate kitchen layout and difficulty in accessing some of the grocery were identified as barriers.

- One participant had this to say: *(sic)* “No I don’t think so! The fact that some grocery that I need is in the pantry and not here in the kitchen is an inconvenience. The distance is an inconvenience for me.

- In my opinion, the pantry should be near the kitchen. For me everything must be in the kitchen. Like now I am waiting for the mayonnaise and I am being told to wait, they must first get it from the pantry and this is wasting my time. Having to first order the stuff/particular food ingredient to do my job is what takes up most of my time".

- Conversely, a participant who is employed on a voluntary basis felt that she does not feel like she belongs, or even have a voice: *(sic)* "Hmm! In this kitchen whatever I need I have to ask from my supervisors. I don't think I have a right/voice since I am a volunteer. Even if I like something to prepare the food, I must ask from my supervisor e.g. last week I wanted mayonnaise from the manager and I was reprimanded by the manager and told to always ask from my colleagues. They are treating us differently from the permanent staff members, we feel like we don't belong, even as volunteer, management never bothers to call a meeting with us for a discussion just to find out how things are going".

- Another participant commented: *(sic)* "Yes but sometimes not, we are in charge of cooking and we are cooking for the children and therefore we know the number and quantity, but our manager likes to limit the quantity of food stuff for us to cook. For example, when I am given 2 kg rice to cook for the children, I become confused and irritated because I know it will not be enough for the children".

4.4.6 The importance of washing hands before handling food

In the current study, the focus group approach was to determine food handlers' perception on the importance of washing hands before handling food. Participants discussed positive influences on hand washing within the hospice environment. All participants agreed that it is important to wash hands before handling food, and all participants also recognised the importance of hand hygiene. Furthermore, participants demonstrated fair knowledge on the role of bacteria and viruses in the spread of foodborne illnesses, and they emphasised that these should be kept away from the food to decrease the transfer of pathogens from hands to food.

- An example is the following comment from one of the participants: *(sic)* “Yes, it is important to wash hands before handling food because the virus is around us and everywhere, so I need to constantly wash my hands to reduce the germs on my hands”.

- Another participant emphasised the previous comment, but focused on bacteria: *(sic)* “Yes, before touching food it is important to wash hands to avoid bacteria getting into the food, and this we must do to avoid getting sick also”.

Additionally, participants indicated that they usually wash their hands after touching their face, including the eyes, and most importantly after having used the toilet.

- Participants explained: *(sic)* “Yes, it is important to wash hands, sometimes one has watery eyes and will obviously use the hand to wipe the fluid off, and therefore it is important to wash hands. We also go to the toilet and one is not sure if accidentally the faeces were touched or not, therefore it is very important to wash hands”.

Participants also outlined that in the line of duty, they are conscious of the different items that they frequently touch in the kitchen while preparing food. It was further mentioned by the participants that the items that they frequently touch have nothing to do with food preparation; hence, it is important for them to wash hands immediately after touching.

- This was explained by one participant as follows: *(sic)* “Yes, it is important to wash hands so that bacteria and germs are killed. The common practice in the kitchen is to also constantly touch our cell phones; therefore, it is important to wash hands before touching food”.

- Another participant elaborated: *(sic)* “Yes, the practice of washing hands is important; this practice of washing hands kills germs. I know that I sometimes scratch myself; hence I should wash my hands”.

4.4.7 Knowledge of antimicrobial resistance

Given the sensitive environment of the hospice setting and the escalating problem of antimicrobial resistance, the participants in this study were also questioned on their knowledge of antimicrobial resistance. It was not expected that the participants should have detailed technical information on antimicrobial resistance due to their socio-economic background. However, the aim was to find out just how much they do know regarding the subject.

Interestingly, some participants had quite a fair knowledge on the subject, and some could even comment on the relationship between antimicrobial resistance and non-compliance regarding TB medication. Additionally, participants mentioned communicable diseases, e.g. Ebola and HIV, in their attempt to demonstrate some knowledge on antimicrobial resistance. A hospice foodborne pathogen study (Nkhebenyane and Lues 2013) revealed the extent of the prevalence of antimicrobial resistant pathogens in hospice kitchens. For example, the study showed that 80% of *Staphylococcus aureus* strains isolated from food preparation surfaces and food handlers' hands were resistant to cefoxitin.

- To demonstrate knowledge of antimicrobial resistance, one participant said the following: *(sic)* "I only have a faint idea and I heard that HIV and Ebola are becoming resistant towards treatment".

- Another participant shared the following on antimicrobial resistance: *(sic)* "I know that TB is a problem in our community, and it is becoming multi-drug resistant once the patient stops taking medication or does not finish the prescribed course".
- Participants seemed to be aware of the circumstances that usually give rise or aggravate antimicrobial resistance, as was shared by another participant, through the following narrative: *(sic)* "I don't know much but I do know that not taking medication can lead to antimicrobial resistance".

Generally, participants were conscious of the sensitive nature of their work environment in terms of the interplay between HIV, TB and extreme drug resistance.

- The following was shared by one of the participants: *(sic)* “You see, in this environment all that I know is that once someone with HIV stops taking medications, it leads to resistance coupled with TB that is also extremely drug resistant”.

- In one instance, a participant shared with the group that she absolutely has no knowledge of the term antimicrobial resistance: *(sic)* “I absolutely don’t know”.

4.4.8 Using separate utensils and cutting board when preparing raw and cooked food

Lastly, the participants were interviewed on the usage of separate utensils and cutting boards to prepare raw and cooked food. There was a generalised misconception amongst some participants that it is okay to use one utensil for both food items, as long as there is rinsing in-between. However, other participants were aware that it is wrong to use one item for both raw and cooked food, especially in the context of cross-contamination.

Only two food handlers confirmed that they use separate utensils and cutting boards to prepare raw and cooked food, and that they do this to avoid cross-contamination.

- Responses included: *(sic)* “Yes, I separate utensils e.g. cutting boards and knives. Tomato is not like onion so I don’t use the same cutting board and knife for both, more especially because I want to avoid cross-contamination”; and “Yes I do. I work a lot with onion and meat and I know that I cannot use one knife right through, especially when the meat is involved”.

- One participant mentioned that she only uses one knife right through, but constantly rinses with water in-between the tasks: *(sic)* “I only use one knife throughout but I constantly rinse that knife in water to keep it clean”.

- On the same topic another participant commented: *(sic)* “I occasionally separate and if I don’t, I constantly rinse my utensils in water to kill the germs, especially when I am cutting the meat”.

A common theme among the participants of rinsing the utensils in-between tasks was noted, and this was coupled with the wrong perception that the practice is correct only if one chopping board and knife is used:

- This was further elaborated by another participant: *(sic)* “To be honest, I use one chopping board and one knife right through, although I do rinse in-between. It is not right to use just one knife for different food items and not rinse in-between”.

4.5 DISCUSSION

Valuable insight and knowledge were gathered from the food handlers who participated in the focus groups. All the participants valued the support given by the manager with regard to the provision of protective clothing when preparing food in the kitchen. Although there was a tendency from some participants to forget to wear their protective gear, they pointed out that the manager would immediately remind them to go back and put on the gear. In a hospice kitchen set-up with its limited resources, it is critical that management should exercise their supportive role to the food handlers.

It has also been emphasised by Kotsanopoulos and Arvanitoyannis (2017) that control and monitoring are essential functions of management that ensure the safe production of food and compliance with legal requirements. However, some participants also highlighted that lack of resources and support, and not having a clearly defined job description, was some of the factors that prevented them from following safe food-handling practices. This is similar to the findings by Howels, Roberts, Shanklik, Pilling, Brannong and Barrett (2008), who conducted focus group discussions with food service workers, and found that time constraints; inadequate training; inconvenience; and not having enough resources were identified as barriers to not being able to perform safe food-handling practices. Food safety culture is increasingly cited in reports and papers relating to food safety incidents and outbreaks, and it is being identified as a significant emerging risk factor. Food safety culture has been described by Yiannas (2008) as “how

and what the employees in a company or organization think about food safety". It is also the food safety behaviours that the employees routinely practice and demonstrate. In the current study, management systems and communication were partial deterrents towards the practice of safe food handling, since the food handlers mentioned that they do not cook food in a similar way, and that they are individuals with different preference styles. There were also indications that they sometimes do not enjoy management's support.

It should be emphasised that food safety is a vital factor in hospices, and food safety training is therefore fundamental to ensure the safety of food. Moreover, it has been reported by authors (Choudhury, Mahanta, Goswami and Mazumder 2011; Jackson 2013 and McIntyre, Vallaster, Wilcot, Henderson and Kosatsky 2013) that training using different strategies (e.g. lectures, demonstrations, videos etc.) can be transformative and can change food-handling practices and concomitant an increase in food safety knowledge. However, researchers who conducted research in food service facilities have found that, even when food service employees demonstrate sufficient knowledge of food safety, their practices may not always be consistent with required standards (Giampaoli, Cluskey and Sneed 2002; Henroid and Sneed 2004; Strohbehn, Paez, Sneed and Meyer 2011). This observation was evident in this study, as one of the participants admitted that she uses one utensil for all the tasks, but rinses it in-between, even though she is aware that the practice is inappropriate, and the risk of implicating foodborne illness was perceived to be low.

All the participants agreed that food safety training is useful in the improvement of food safety practices. This was also supported by the examples shared by the participants during the session. For example, the participants mentioned that they have learned that water should not remain stagnant in the sink for a long period, since bacteria tend to accumulate in water. One participant also mentioned the importance of personal hygiene and of keeping the nails short and clean to discourage dirt accumulation.

With regard to adequate resources, the participants had mixed responses, but the distance between the kitchen and pantry was mentioned as a major issue. They felt that everything must be located under one roof in the kitchen and not in the pantry, which is quite a distance from the kitchen.

On the contrary, the participants who are not full-time employees felt that not being recognised as part of the organisation played a crucial role. They felt voiceless and undermined, as they had to constantly ask the supervisors for whatever they needed in the kitchen. Consumption of food contaminated with pathogenic micro-organisms can cause serious illness, or even death - especially among vulnerable populations such as infants and individuals with compromised immune systems (Smith 1997). Hand washing has been recognised as a simple and effective method for reducing the risk of infection with certain viruses and other infectious agents. It is therefore encouraging to observe that, without exception, all participants recognised the importance of washing hands before handling food, with some even mentioning bacteria and viruses, and how important it is to keep these away from food. The participants mentioned that they often visit the toilet and scratch their faces in-between tasks, and that it is therefore important that hands should be washed before handling food. According to Fischer, De Jong, Van Asselt, De Jonge, Frewer and Nauta (2007), many people claim to understand the importance of this simple strategy for avoiding foodborne illness, but they often fail to consistently wash their hands effectively during food preparations. A hygiene behaviour study (Curtis, Danquah, Robert and Aunger 2009) revealed that 'disgust' emerged as a motivator for hand washing, and the most commonly mentioned contaminants were feaces and urine.

Another major problem over and above foodborne pathogens is antimicrobial resistance. Hospice patients are especially vulnerable to infection due to suppressed immune function and complex disease, which also compromise host resistance (Vitetta, Kenner and Sali 2000; Nkhebenyane and Lues 2013). This problem is made even worse by nosocomial transmission, which was initially considered to be the principal cause of the spreading of multi-drug-resistant organisms, including extended-spectrum beta-lactamase-(ESBL)-producing Enterobacteriaceae. Recent reports, however, point to the importance of the food chain as a continuous source of dissemination (Kluytmans, Heck, Rijnsburger, Vandenbroucke-Grauls, Savelkoul, Johnston, Gordon and Johnson 2013). The participants had a faint idea on the subject of antimicrobial resistance. However, some mentioned that they are aware that TB is becoming multi-drug resistant, and that this becomes worse when the patient stops taking medication prematurely without finishing the course.

Cross-contamination is the transfer of micro-organisms from raw foods (usually animal foods) to cooked or ready-to-serve foods. It is well known that raw foods can contain high numbers of bacteria, and it is critically important to ensure that bacteria from raw foods are not transferred to cooked or prepared foods. According to De Jong, Verhoeff-Bakkenes, Nauta and De Jonge (2008), kitchen utensils and cutting boards have been identified as key cross-contamination routes. In this study, cross-contamination was repeatedly mentioned, and only two participants agreed to using separate utensils and cutting boards to prepare raw and cooked food. Of great concern was the general belief among some participants that it is correct to use one utensil, in this case a knife, for all the foodstuffs concerned, as long as there is rinsing in-between. A study conducted in the UK (Kennedy, Jackson, Blair, McDowell, Cowan and Bolton 2005) suggests that 14% of all foodborne illnesses may be due to inadequately cleaned cutting boards and knives. This indeed is alarming, and points to the fact that food handlers should be provided with more training, with emphasis on the role of cross-contamination in transmission of foodborne illness.

4.6 CONCLUSIONS

The current study assessed food handlers' perceptions of safe food handling and food safety knowledge. The hurdles that prevent safe food handling were also discussed. In this study, focus group discussions were utilised to explore food handlers' perceptions of safe food-handling, and to explore food safety management systems. The results showed that hospice food handlers were aware of the important role that they play in the provision of safe nutritious food to patients with a compromised immune system. Food handlers also elaborated on the role of hospice managers to influence the safety of food practices. This was, however, described as both a facilitator and barrier towards safe food practice. The positive role played by the hospice manager in influencing safe food-handling behaviour was also highlighted. For example, participants had an appreciation of the support provided by management with regard to the provision of personal protective equipment and guidance in the kitchen during food preparation.

Other studies on this topic have reported similar findings. For example, a study (Clayton and Griffith 2002) identified several of the same barriers and facilitators that are also reported in this study, which include availability of properly working equipment, and management's concern for and attention to food safety. However, the participants also highlighted that in other instances they do not feel that they are duly recognised and acknowledged by management; participants working on a voluntary basis especially elaborated on this matter. The voluntary workers felt that they are voiceless and have no say or contribution to the operational aspects of safe food handling. The same workers also bemoaned the feeling of neglect and felt that managers did not appreciate them, and because of their exclusion from regular meetings they are not consulted when important decisions are being made. This indeed is of great concern, since participants in a study by Clayton, Smith, Rutkow and Neff (2016) mentioned that it was easier to adhere to safe food-handling practices and hygiene when they felt valued as team members, and when they have a personal relationship with the manager.

Abidin, Arendt and Strohbehn (2014) attest that food safety culture is recently becoming popular because of its critical role in improving employees' safe food-handling behaviours. Food safety culture has been described by Griffith, Livesey and Clayton (2010) as "the shared attitudes, values and beliefs towards the food safety behaviours that are routinely demonstrated" in a food-handling organisation. Therefore, it is apparent that food safety culture within an organisation is almost entirely dependent on management's leadership and motivation; how food safety is communicated to the employees; and how well the employees trust in management. This important concept is also highlighted in a study by Neal, Binkley and Henroid (2012), wherein participants identified the role of management as a critical factor for a food safety culture, meaning that food service employees want not only consistency within the organisation, but accountability by management. Hence, it is strongly encouraged in this study that hospice managers should demonstrate appreciation and respect through regular engagement and performance appraisal with all the food handlers, regardless of their conditions of employment.

Lack of resources (e.g. financial, supplies and time) and issues related to employees' motivation, turnover and training were frequently cited as some of the barriers to perform safe food-handling practices. These findings indicate that a variety of organisational factors contribute to the success of food safety. Research (Steyler, Holton, Bates, Burnett and Carvalho 1998) has shown that environmental factors such as supervisor support, supervisor sanctions, peer support, situational constraints, and resources used in the job setting in which the training is to be used, have a significant influence on trainees' motivation to transfer training to the workplace.

In this study, respondents expressed the need for better design of the workspace and more resources to allow safe food-handling, and to appreciate the impact of food safety training. For example, the location of the pantry was a problem in this study, since all the respondents complained that it is situated too far from the kitchen, and that it should be located near the kitchen to enhance workflow, and to save time during food preparation. It is further recommended that future food safety training should include antimicrobial resistance as a food safety problem. On this aspect it was revealed that participants had minimal knowledge about antimicrobial resistance, although some had some knowledge pertaining to the link between TB and drug resistance.

Considering the socio-economic status of the participants, it is recommended that hospice managers develop infection control policies specifically aimed at a hospice setting. This should include simplified, non-technical information on antimicrobial resistance. Furthermore, it is recommended that food safety training for food handlers must use a risk-based approach. A risk-based approach considers both the hazard and exposure scenarios, with the ultimate aim of improving consumer safety decisions. The information gathered in this study can provide a basis for the development of training resources and food management systems to foster a safe food culture, and to encourage food managers to be actively involved in the holistic approach of safe food-handling. Suboptimal infrastructure is a common problem for the majority of the hospices. Therefore, due to the financial constraints, hospices are encouraged to collaborate and work with the health sector, which is well placed, by utilising its system approach and infrastructure that reaches into most affected communities in the developing world.

Hospices can only benefit if the government can strengthen the health systems to deliver integrated services to communities. In a resource-poor setting, home-based palliative care has been shown to be the most cost-effective model; however, this also has its own challenges, since patients that are poor are not able to travel to the treatment centres. Hospice board members should lobby for recognition of community palliative care services, and not just hospital services. It is recommended that training for volunteers be centrally coordinated and standardised. Governments must include hospice and palliative care as part of all government health policies, and should integrate hospice and palliative care training into the curricula of all health professionals. The most commonly identified workplace factors influencing food safety practices include time pressure, understaffing, high customer volume, management/co-worker emphasis on proper procedures, and issues with resources and workplace design (e.g., inconvenient sink location, small spaces). Some participants mentioned experiences where efforts to report issues or meet health and hygiene requirements were met with negative responses or consequences. Whilst this chapter focused on safe food-handling practices in hospices in Central South Africa, the next chapter entails a discussion of the development of antimicrobial susceptibility amongst microbiota from HIV hospices, and the emerging health risks that it poses.

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CHAPTER 5

ANTIMICROBIAL SUSCEPTIBILITY AT HIV/AIDS HOSPICES: AN EMERGING HEALTH RISK

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5.1 ABSTRACT

The emerging challenge of antibiotic resistance is generally accepted to be a serious threat to global public health. High prevalence of resistant and multi-resistant bacterial strains worldwide is placing a significant burden on healthcare settings and the society at large. Among gram-positive pathogens, *Staphylococcus aureus* and *Enterococcus spp*. are the species which currently pose major challenges in terms of antibiotic resistance. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a major public health concern and is responsible for both hospital- and community-associated infections worldwide. The study investigated the antimicrobial susceptibility profile of hospice foodborne pathogens. In this study, 60% of *Staphylococcus aureus* isolates were resistant to tetracycline (MIC range, 32-128 $mg.ml^{-1}$). *Enterococcus faecalis* strains were also resistant (90%) to gentamicin (MIC range, 0.25->128 $mg.ml^{-1}$). *Acinetobacter baumanii* strains were all resistant to cefoxitin. Antimicrobial resistance in settings accommodating vulnerable individuals presents pronounced risk both in terms of possible mortality and environment offering fertile ground for resistance and tolerance development.

KEYWORDS: Antibiotic resistance, MRSA, healthcare setting.

5.2 INTRODUCTION

Although the availability of antibiotics to treat infectious diseases has drastically improved human and animal well-being, their efficacy to treat infections is rapidly declining. Rates of antimicrobial resistance among hospital and community pathogens have increased considerably during the past decade. This can mainly be ascribed to the built-up of antibiotic resistance. In this Chapter, the development of antimicrobial susceptibility amongst microbiota from HIV hospices, and the emerging health risks that these poses, are discussed in detail.

5.2.1 The dangers associated with antibiotic resistance

It has been well documented that antibiotics used in human medicine and animal husbandry create selective pressure that favours the emergence of antibiotic resistance among micro-organisms, with the potential to undermine the effectiveness of antibiotics. It has also been indicated by the WHO (2014), that in low-resource settings where sanitation is poor, antibiotics assume a major role to decrease the morbidity and mortality associated with foodborne and other poverty-related infections. The availability of antibiotics to treat infectious diseases has radically improved human and animal well-being, including plant health, although to a lesser degree. However, their efficacy to treat infections is now rapidly declining. Frieri, Kumar and Boutinc (2017) claim that bacterial infections are once again becoming an emerging threat, this, after the successful treatment of patients with antibiotics for many decades. Even more worrying is the morbidity and mortality associated with nosocomial infections. During the past decade the epidemiology of healthcare-associated infections has been characterised by the emergence of especially Gram-negative multi-drug-resistant organisms, including extended-spectrum beta-lactamase-producing (ESBL) Enterobacteriaceae (Tschudin-Sutter, Frei, Stephan, Hächler, Nogarth and Widmer 2014).

The food chain is considered a potential route of transmission of antibiotic-resistant bacteria to humans. Kluytmans, Overdevest, Willemsen, Kluytmans-van den Bergh, Van der Zwaluw, Heck, Rijnsburger, Vandenbroucke-Grauts, Savelkoul, Johanston and Gordon (2013) state that nosocomial transmission was initially considered to be the principal cause of the spread of antibiotic resistant bacteria. However, recent reports point to the contribution of the food chain as a continuous source of dissemination. Food has, for example, been reported as a transmission vector for ESBL-producing *Klebsiella pneumoniae* in a hospital outbreak in 2015 (Calbo and Garau 2015). Transfer of antimicrobial resistance can involve different kinds of micro-organisms. Human bacterial pathogens can be acquired directly by person-to-person spread, and from the environment, as well as from animals, including both food-producing animals or as foodborne pathogens directly from food. Antibiotic use is the key factor in the selection of resistant bacteria, with community and hospital settings forming the principal ecological niches of emergence in human health (O'Neill 2015).

Methicillin-resistant *Staphylococcus aureus* (MRSA) (Fig 5.1) is a major public health concern, and is responsible for both hospital- and community-associated infections worldwide (Fasihi, Kiaei and Kalantar-Neyestanaki 2017). The use of antimicrobial agents in animals, plant production and the production of other sources of food has adverse public health consequences, by creating a reservoir of resistant bacteria and of bacteria-borne resistance genes that can be passed on to humans (EFSA 2008). The livestock food chain, more especially from farms and hatcheries through slaughter facilities and dairy processing plants to food processing, packaging and retail facilities, is a major area under particular scrutiny (FAO 2016). This has been partly driven by concern over evidence of multi-resistant pathogens, including Salmonella DT104 (Antunes, Mourao, Pestana and Peixe 2011), livestock-associated methicillin-resistant *Staphylococcus aureus* (Cuny, Friedrich, Kozytska, Layer, Nübel, Ohlsen, Strommenger, Walther, Wieler and Witte 2010) and extended-spectrum β-lactamase *E. coli* (Blaak, Van Hoek, Hamidjaja, Van der Plaat, De Heer, De Roda, Husman and Schets 2015) on farms and in the food chain. The extensive use of antibiotics as growth promoters for the rapid growth of food animals and fish exacerbates the emergence and spread of antibiotic resistance (FAO 2015).

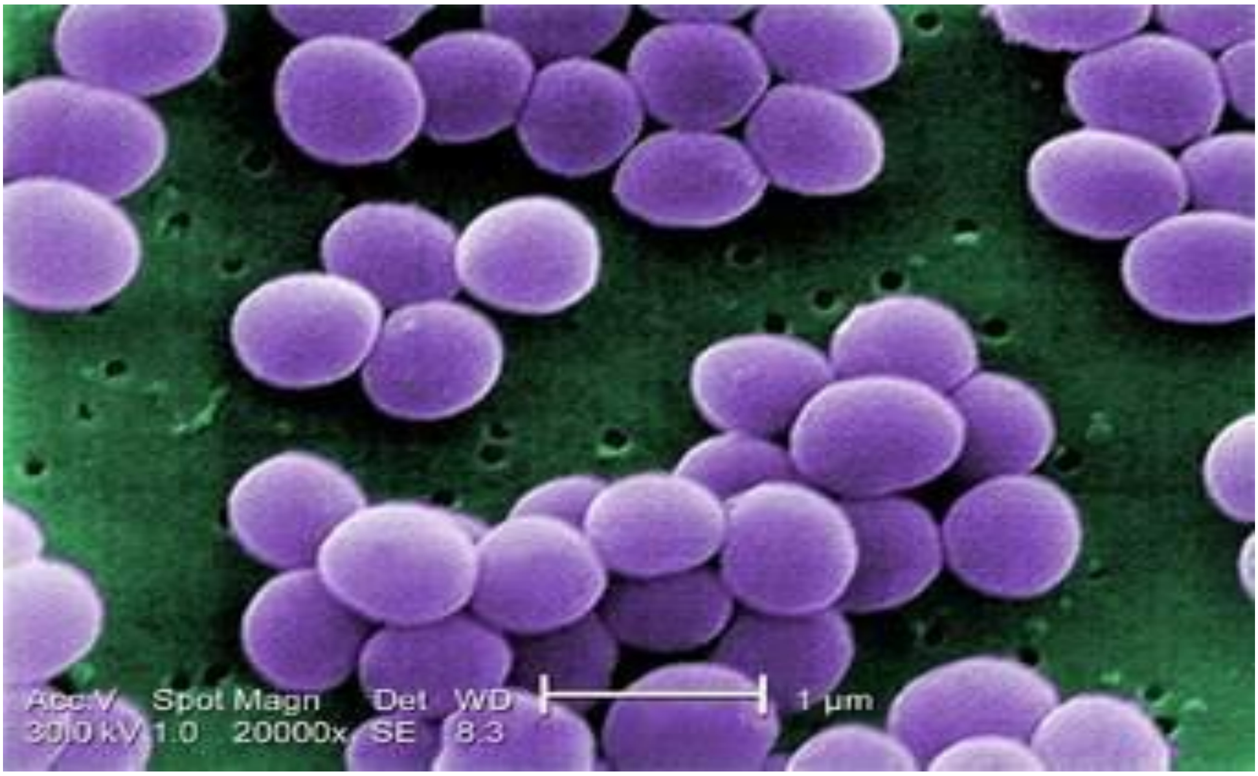

Figure 5.1. A scanning electron micrograph showing methicillin-resistant *Staphylococcus aureus*

Additionally, massive amounts of antibiotics have been used for prophylaxis and the treatment of infections among farm animals and in aquaculture, increasing the selective pressure on both commensal and pathogenic micro-organisms that can spread to humans through direct contact and via the food chain, or indirectly from the environmental pollution of farm effluents (Liebana, Carattoli, Coque, Hasman, Magiorakos, Mevius, Peixe, Poirel, Regula, Torneke, Torren-Edo, Torres and Threlfall 2013). Emerging pathogens are generally classified as infectious agents that have only recently appeared in a population, or that are well recognised, but their incidence is rapidly increasing, or they have the probability of increasing in the future (Jones, Patel, Levy, Storeygard, Balk, Gittleman and Daszak 2008; Duffy, Lynch and Cagney 2008; Engering, Hogerwerf and Slingenbergh 2013). The problem of emerging pathogens is made even worse by the accompanying emergence of antimicrobial-resistant organisms that are accelerating, while novel drug development is not keeping pace. The possible role of contaminated environmental surfaces to contribute to the transmission of healthcare-associated pathogens depends on a number of factors. These include the ability of pathogens to remain viable on a variety of dry environmental surfaces, and the level of contamination, resulting in transmission to the patient (Russotto, Cortegiani, Raineri and Giarratano 2015).

Antibiotic-resistant infections are a substantial health and economic burden to the healthcare system, including patients and their families, since this leads to elevated costs of treatment. This resistant infection is common in hospitals due to the clustering of highly vulnerable patients, and the high rate of antibiotic usage in this setting (Golkar, Bagasra and Pace 2014). There has been an alarming increase in rates of extended-spectrum beta-lactamase (ESBL)-producing Gram-negative bacteria in South Africa (Perovic, Singh-Moodley, Duse, Bamford, Elliott, Han, Kularatne, Lowman, Whitelaw, Nana, Wadula, Lekalakala, Saif, De-Smit and Marais 2014), and carbapenem-resistant Enterobacteriaceae (CRE), which have been reported from every province (Brink, Coetzee, Clay, Corcoran, Van Greune, Deetlefs, Nutt, Feldman, Richards, Nordmann and Poirel 2012).

Antibiotic overuse and misuse has been implicated as the main driver of antibiotic resistance (Mendelson, Rottingen, Gopinathan, Hamer, Wertheim, Basnyat, Butler. Tomso and Balasegaram 2016). Further, it has been stated by Visser, Moore, Whitelaw, Lowman, Kantor, Hoosen, Madhi, Brink, Van den Bergh, Devenish, Moodley, Apalata, Duse and Gelband (2011), that in SA poor infection prevention practice in healthcare settings fuels the spread of resistant bacteria, which is responsible for nosocomial infections. According to the NDoH (2014), the South African Standard Treatment Guidelines and Essential Medicines List (SA STG/EML) for the primary healthcare level recommends that antibiotics should not be administered for uncomplicated acute bronchitis, but should be considered in patients infected with HIV, as they are at a high risk of developing bacterial lower respiratory tract infections.

It is only recently that the increasing prevalence of antimicrobial resistance is receiving widespread attention. Moreover, this is of great concern for a hospice set-up that has limited isolation facilities. Various common human pathogens are involved in this increasing resistance, predominantly *Enterococcus faecium, Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa*, and other species of the genus Enterobacter (Carlet, Collignon, Goldman, Goossens, Gyssens, Harbarth, Jarlier, Levy, N'Doye, Pittet and Ricthmann 2011). Of particular concern are gram-negative pathogens that are becoming extremely drug resistant (XDR) or totally drug resistant (TDR) to nearly all antibiotic drug options available, creating situations reminiscent of the pre-antibiotic era (Rossolini, Arena, Pecile and Pollini 2014). For example, *Acinetobacter baumannii* being a gram-negative opportunistic bacterium that can cause infectious outbreaks in critically-ill patients presents limited treatment options due to antibiotic resistance (Montero, Villar, Millo, Martın, Sanchez and Pizarraya 2015). Additionally, *A. baumannii* is also a commensal microbe existing on human skin and mucous membranes, capable of opportunistic infections, especially in immuno-compromised individuals, including, pneumonia, septicemia, and urinary tract infection that is rapidly emerging as a resistant organism (Matlhouthiai, Bouhalilia, Lamine, Somai, Bouhali-Besbes, Bakour, Rolain and Chouchani 2017). In healthy individuals, opportunistic pathogens seldom produce infection, as they lack the necessary mechanisms of pathogenicity and invasiveness that enable them to overcome the host immune system.

However, in immuno-compromised patients, opportunistic pathogens can produce infection, necessitating the use of antimicrobial therapies. Gram-positive micro-organisms that are also of considerable concern in the healthcare setting in terms of posing major antibiotic resistance challenge, include *Staphylococcus aureus* and *Enterococcus spp*. *Staphylococcus. aureus*, in particular, primarily infects people whose immunity to infection is compromised (McKinnell, Miller, Eells, Cui and Huang 2013). Argudin, Mendoza and Rodicio (2010) point out that human nasal or hand carriage of entero-toxigenic *S. aureus* during food processing is an important source of food contamination with *S. aureus.* Food poisoning outbreaks associated with post-process contamination of foods with *S. aureus* have been shown to be primarily supported by food handlers who carry entero-toxigenic staphylococci in their nails or on their skin (Lues and Van Tonder 2007). They have also been found to be a common cause of hospital-acquired infections necessitating antibiotic treatment. A study by Nkhebenyane and Lues (2013) revealed a 20% cefoxitin resistance in *S. aureus* isolated from hospice food handlers' hands. Strains of methicillin-resistant *S. aureus* (MRSA) are of particular concern, given that they represent a significant cause of morbidity and mortality throughout the world (Chen and Huang 2014). There is substantial evidence that MRSA and vancomycin-resistant enterococci (VRE) can be recovered from the environment, sometimes over extended periods (Dancer 2014).

Moreover, methicillin-resistant *S. aureus* has been reported to be resistant to all the available penicillins and other beta-lactam antimicrobial drugs (Stefani and Goglio 2010). According to Beceiro, Tomás and Bou (2013), the two most important factors influencing the emergence and spread of antimicrobial resistance are the use of antimicrobial agents in different hosts, and the spread of resistant bacteria and resistance genes between hosts of the same, or of different species. Figure 5.2 illustrates the various ways in which antimicrobial resistance can predominate in food amidst a background that includes the continued use of antimicrobials in human medicine and in food production. It is in this context that the aim of the study was to evaluate the antimicrobial susceptibility profile of hospice microbiota against commonly prescribed antibiotics in the hospices. The secondary aim of the study was to conduct comparative analysis of the resistance profile.

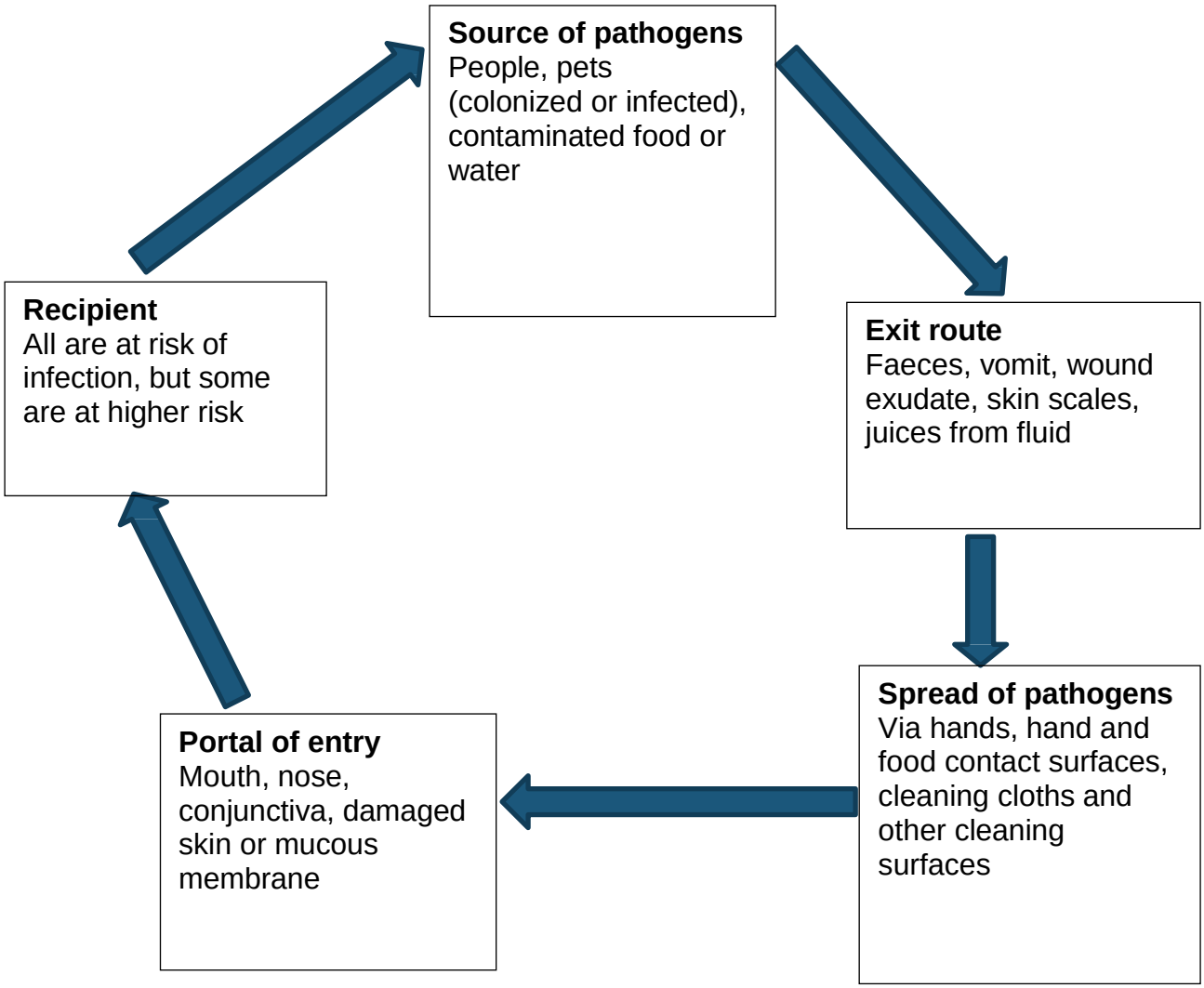

Figure 5.2. A scheme for the possible transmission of antimicrobial resistance *via* food (EFSA JOURNAL)

5.3 MATERIALS AND METHODS

5.3.1 The same sampling protocol and selection was used as described in Chapter 3 (see page 46, 3.3.2).

5.3.2 Sampling protocol

The study utilised 100 strains of various bacteria isolated from fifteen hospices selected for this study in Central South Africa. These bacteria were collected from different food preparation surfaces (cutting boards, sinks, tables and hands). The 100 strains were identified by means of the API system (bioMerieux, France). In each case, the MIC was determined using the agar dilution method of the Clinical and Laboratory Standards Institute (CLSI). Laboratory-standard reagents obtained from Sigma included: chloramphenicol, gentamicin, oxacillin, cefoxitin, nalidixic acid and tetracycline. The inoculum was prepared by direct suspension of colonies from overnight cultures (Mueller-Hinton agar) into a nine-millilitre saline solution, to achieve a suspension equivalent to 0.5 McFarland standards. The plates containing doubling antibiotic concentrations (0.25-256 $mg.ml^{-1}$) were inoculated with 1 x 10^5 cfu/spot using a multipoint inoculator. MICs were read after 48 hours of incubation at 35ºC. MIC is defined as the lowest concentration of antibiotics to inhibit macroscopically visible colonies. Reference strains used were *Enterococcus faecalis* ATCC 29212, *Acinetobacter baumanii* ATCC 19606, *Bacillus cereus* ATCC 14579 and *Staphylococcus aureus* ATCC 29213. Isolates were categorised as susceptible or resistant based on interpretive criteria according to CLSI guidelines (CLSI 2010).

5.3.3 Analysis and calculations

All experiments were performed at least in triplicate, and where relevant, the significance limits were set as $p \leq 0.05$.

5.4 RESULTS

The following definitions are used: MIC 50 is the Minimum Inhibitory Concentration required to inhibit the growth of 50% of the organism, and MIC 90 is the growth required to inhibit 90% of the organism. The results show a high resistance of *Enterococcus faecalis* to gentamicin, and only about 10% of the organisms were susceptible to this agent. A consistent level of resistance was also observed against tetracycline, chloramphenicol and cefoxitin. The overall response to all the antibiotics was 20%. The high resistance level (95%) for both oxacillin and nalidixic acid came as a surprise. *Acinetobacter baumanii* displayed 50% susceptibility to gentamicin, and 40% to tetracycline. The results for both chloramphenicol and nalidixic acid were 30% (see Table 5.1). Oxacillin showed the lowest susceptibility of 20%. All the *Acinetobacter baumanii* strains were resistant to cefoxitin (0% susceptible). Gentamicin for this response showed high activity (90%) against *Bacillus cereus*. Tetracycline and chloramphenicol similarly displayed good activity against these organisms, with the respective susceptibility values of 80% and 85%. Oxacillin and nalidixic acid showed poor activity against *Bacillus cereus*, namely 30% susceptibility for both. Cefoxitin was the lowest active, with only about 20% of the organisms being susceptible. *Staphylococcus aureus* showed 60% susceptibility to gentamicin; and 40% to tetracycline. Chloramphenicol showed the highest activity of 65%. Oxacillin showed 30% susceptibility, followed by 20% for both cefoxitin and nalidixic acid (Table 5.1).

Table 5.1: Antimicrobial susceptibility of groups of foodborne pathogens isolated from the hospice kitchens

Organism (n)	Antimicrobial	% Susceptible	Susceptibility Breakpoint	MIC (mg.ml^{-1})		
				MIC_{50}	MIC_{90}	Range
E. faecalis (30)	Gentamicin	10	256	8	16	0.25->128
	Tetracycline	20	≤4	8	>128	≤0.25-128
	Chloramphenicol	20	≤8	8	32	≤0.25-32
	Oxacillin	5	≤2	16	32	8-64
	Cefoxitin	20	≤2	8	>128	≤0.25->128
	Nalidixic acid	5	≤4	512	512	≤0.25->128
A. baumanii (20)	Gentamicin	50	≤4	8	16	1-32
	Tetracycline	40	≤4	1	4	≤0.25-16
	Chloramphenico	30	≤8	128	256	16->256
	Oxacillin	20	≤2	>128	>128	128->128
	Cefoxitin	0	≤2	128	256	128-256
	Nalidixic acid	30	≤4	8	16	2-32

Table 5.1 (cont): Antimicrobial susceptibility of groups of foodborne pathogens isolated from the hospice kitchens

Organism (n)	Antimicrobial	% Susceptible	Susceptibility Breakpoint	MIC (mg.ml^{-1})		
				MIC_{50}	MIC_{90}	Range
B. cereus (30)	Gentamicin	90	≤4	≤0.25	1	≤0.25-2
	Tetracycline	80	≤4	1.5	4	≤0.25-16
	Chloramphenicol	85	≤8	0.20	1	0.20-2
	Oxacillin	30	≤2	1	>128	≤0.25->128
	Cefoxitin	20	≤2	6	>128	0.5->128
	Nalidixic acid	30	≤4	66	>128	2.5->128
S. aureus (20)	Gentamicin	60	≤4	≤0.25	>16	≤0.25->16
	Tetracycline	40	≤4	32	64	32-128
	Chloramphenicol	65	≤2	8	16	4-16
	Oxacillin	30	≤2	8	>16	0.25->16
	Cefoxitin	20	≤4	16	>32	1.5->128
	Nalidixic acid	20	≤4	16	>32	1.5->128

5.5 DISCUSSION

The use of antimicrobial agents is the main driver for the development and spread of antimicrobial resistance. Rates of antimicrobial resistance among hospital and community pathogens have increased considerably during the past decade. More than 70 per cent of the bacteria that cause hospital-associated infections are resistant to at least one of the drugs most commonly used to treat these infections (CDC 2001). Enterococci usually inhabit the intestinal tract of humans, and have emerged as one of the leading causes of healthcare-associated infections (Yilema, Moges, Tadele, Endris, Kassu, Abebe and Ayalew 2017). They were previously considered commensal organisms of little clinical importance, but have emerged as serious nosocomial pathogens responsible for endocarditis and infections of the urinary tract (Higuita and Huycke 2014). The members of enterococci are different in virulence and pathogenicity, with both *E. faecalis* and *E. faecium* having dominant positions in human disease (Hayden, Blom, Lyle, Moore and Weinstein 2008; Dahlén, Blomqvist, Almstál and Carlen 2012). Even though enterococci are not generally considered to be highly virulent pathogens, their resistance to many antimicrobial drugs complicates the treatment of enterococcal infections. Enterococci have an intrinsic resistance to several clinically used antimicrobial agents, rendering them important nosocomial pathogens. According to Blair, Webber, Baylay, Ogblou and Piddock (2015), the mechanism of resistance is intrinsic or natural. This means that these micro-organisms naturally do not possess target sites for drugs, and therefore drugs do not affect them. Of particular concern is the intrinsic antibiotic resistance among certain species, particularly resistance to aminoglycosides and cephalosporin, or acquired resistance to many others, most prominently vancomycin (Purohit, Gaind, Dawar, Verma, Aggarwal, Sardana and Deb 2017).

In this study the *Enterococcus faecalis* strains showed relatively high resistance to all the antibiotics used. Healthcare workers' hands have often been implicated as the primary mode of spread from patient-to-patient (Weinstein and Hayden 2000). This is supported by the fact that strains in this study were isolated from both food handlers' hands and food preparation surfaces. The MICs of gentamicin-resistant *Enterococcus faecalis* (MIC ≥ 128 mg.ml^{-1}) ranged from 0.25 to 128 mg. ml^{-1} with about 90% being resistant.

This is alarming due to the fact that, of the available aminoglycosides, gentamicin is generally preferred over streptomycin as the synergistic agent used with either an aminopenicillin or a glycopeptide. For tetracycline and chloramphenicol, the MIC ranges were respectively from 0.25 to 128 $mg.ml^{-1}$ and ≤ 0.25 to 32 $mg.ml^{-1}$ (Table 5.1). The results of this study are generally higher than a study conducted by Baldir, Engin, Kucukercan, Inan, Akçay, Ozuyrek and Aksaray (2013), where there was only 20% resistance against gentamicin. Tetracycline and chloramphenicol displayed generally poor activity towards *Enterococcus faecalis* (MIC, >128 and 32 $mg.ml^{-1}$ respectively). Even though tetracycline demonstrated high resistance in this study, the results obtained by Huys, D'Haene, Collard and Swings (2004) were much higher (MIC range, 16-256 $mg.ml^{-1}$). The resistance to oxacillin and nalidixic acid (95%) is similar to the results obtained by Gajan, Shirmohammadi, Aghazadeh, Alizadeh, Deljavan and Ahmadpour (2013), and again this is a cause for concern.

Acinetobacter spp. (predominately *Acinetobacter baumannii*) has become one of the major opportunistic pathogens in the ongoing antibiotic resistance predicament. *A. baumannii* is one of the most severe nosocomial pathogens, because of its longevity in the hospital environment, and its ability to resist various antimicrobial agents, such as broad-spectrum β-lactam antibiotics, mostly via beta-lactamase production (Viehman, Nguyen and Doi 2014). Infections caused by MDR (multi-drug-resistant) *A. baumannii* are associated with high morbidity rates, especially in immuno-compromised patients and those treated with broad-spectrum antibiotics (Turkoglu, Mirza, Tunçcan, Erdem, Dizbay, Yagci, Aygencel and Türköz 2011; Özgür, Horasan, Karaca, Ersöz, Atis and Kaya 2014). Moody, Bradley, Strausbaugh and Muder (2001) and Thom, Maragakis, Richards, Johnson, Roup, Lawson, Harris, Fuss, Pass, Blythe, Perencevich, Wilson (2012) report that multi-drug-resistant *Acinetobacter* infection has been reported among patients residing in rehabilitation and long-term care facilities, including acute care hospitals. Liu, Wang, Ho, Lee, Liu, Wang, Sheng, Hseuh and Chang (2016) state that the emerging resistance mechanism of *Acinetobacter baumanii* impairs aminoglycoside binding to its target site, and confers high-level resistance to all clinically useful aminoglycosides, including gentamicin and amikacin. In this study, gentamicin MICs ranged from 1 to 32 $mg.ml^{-1}$ and about 50% of the isolates were susceptible.

All the isolates were found to be resistant to cefoxitin. These results were in accordance with those reported by Lowings, Ehlers, Dreyer and Kock (2015). Recent studies indicate that most *A. baumannii* isolates are intrinsically resistant to chloramphenicol, although the resistance mechanism for this phenomenon has not yet been described (Manchanda, Sanchaita and Singh 2010). In this study, chloramphenicol also showed marked resistance (MIC >256 $mg.ml^{-1}$) to *A. baumannii*, and the results are similar to those of Roca, Marti, Espinal, Martinez, Gilbert and Vila (2009).

Tetracycline, a family of broad spectrum antibiotics, inhibits microbial protein synthesis, and is bacteriostatic against both gram-positive and gram-negative bacteria. The importance of tetracycline in both human and veterinary medicine is considerable. However, the emergence of microbial resistance has limited their effectiveness in recent years. Tetracycline was found to be active against 50% of the isolates (MIC ≥ 4, MIC_{50} and MIC_{90}, 1 and 4 $mg.ml^{-1}$). On the contrary, the results obtained by Maleki, Sekawi, Soroush, Azizi-Jalilian, Asadollahi, Mohammadi, Emaneini and Taherikalan (2014) showed higher MIC_{50} and MIC_{90}, 32 and 512 $mg.ml^{-1}$ respectively, and 80% of the isolates were resistant to tetracycline. The susceptibility percentage results obtained for tetracycline in this study are notably higher than those obtained by Nam, Lim, Kang, Kim, Moon, Jang, Joo and Jung (2009), who obtained only about 18% tetracycline resistance in their study. The isolates also displayed a high level of resistance against oxacillin (MIC >128 $mg.ml^{-1}$), with only about 20% of the isolates susceptible. This increased occurrence of multi-drug resistance is likely to be due to poor infection control spread through contact with healthcare workers or from patient to patient and prolonged antibiotic use (Fox, Schaaf, Mandalakas, Chiappini, Zumla and Marais 2017). Nalidixic acid was also not highly effective against *Acinetobacter baumanii*, with about 70% of the isolates resistant, and the MIC range 2 to 32 $mg.ml^{-1}$.

Bacillus cereus is a facultative anaerobic, gram-positive, spore-forming bacterium that is widely distributed in the environment due to its ability to resist hostile conditions (Carlin, Brillard, Broussolle, Clavel, Duport, Jobin, Guinebretiére, Auger, Sorokine and Nguyen- Thé 2010; Ceupens, Boon and Uyttenddaele 2013). Furthermore, it is a common food contaminant and it can be found in various types of raw foods such as rice, meat, vegetables, raw milk and other dairy products. According to Fernández-No, Guarddon, Bòhme, Cepeda, Calo-Mata and Barros-Velázquez (2011), the presence of *B. cereus* in food is usually associated with food spoilage and food poisoning, which in turn are associated with emetic and diarrhoeal syndromes. Bottone (2010) concluded that the majority of *B. cereus* isolates are resistant to penicillin and cephalosporin as a consequence of lactamase production. In the present study, gentamicin showed good activity against *B cereus* strains (MIC=2, range ≤0.25-2 $mg.ml^{-1}$), which are slightly higher than results obtained by Turnbull, Sirianni, LeBron, Samaan, Sutton, Reyes and Peruski (2004), wherein the antimicrobial activity obtained was (MIC=0.75, range 0.094-0.75 $mg.ml^{-1}$). Chloramphenicol and tetracycline were also active against the strains, and the respective values were (MIC= 2, range ≤0.20-2 $mg.ml^{-1}$ and MIC=4, range ≤0.25-16 $mg.ml^{-1}$). Oxacillin, cefoxitin and nalidixic acid displayed poor activity against *B cereus* strains, MIC_{90} for all three antibiotics >128.

Staphylococcus aureus a gram-positive bacterium and considered a major threat to food safety (EFSA 2009; CDC 2011). It is a major global pathogen that can cause severe infections both in healthy and immuno-compromised people. The mechanisms described for the contamination of foods with *S. aureus* are mostly of animal or human origin, such as human handling of the food products (Spanu, Spanu, Virdis, Cossu, Scarano and De Santis 2012). *S. aureus* is currently the most common cause of nosocomial and community-based infections. According to the FDA (2012), *S. aureus* can cause toxin-mediated diseases within one to six hours after consumption of contaminated foods. Contamination of foodstuff by *S. aureus* may occur directly from infected production animals, or may result from poor hygiene during production processes and storage, since humans generally harbour it (Huong, Mahmud, Neogi, Kassu, Van Nhien, Mohammad, Yamato, Ota, Lam, Dao and Khan 2010; Vázquez-Sánchez, López-Cabo, Saá-Ibusquiza and Rodriguez-Herrera 2012).

Methicillin-resistant *Staphylococcus aureus* (MRSA) has spread extensively worldwide during the last few decades since its first reporting in 1961 (Rahimi, Katouli and Pourshafie 2014). Gentamicin, one of the most important antibiotics used in combination with other antibiotics worldwide for the treatment of *S. aureus* infections (Yadegar, Sattari, Mozafari and Goudarzi 2009), seemed not to be active against *S. aureus* in this study, since 75% of the organisms were resistant (MIC >16, range ≤0.25 ->16 $mg.ml^{-1}$). This observation is notable, since gentamicin is also used in combination with other antibiotics to treat infections caused by gram-positive organisms (Talei, Mohammadi, Bahmani and Kopaei 2017). Approximately 60% *S. aureus* strains were resistant to tetracycline (MIC range, 32-128 $mg.ml^{-1}$). Hence, the results of this study are slightly higher than those obtained by Martini, Lange, Brito and Ribeiro (2017).

Chloramphenicol showed a MIC range of (4-16 $mg.ml^{-1}$) against *S. aureus* (Table 5.1). This is considered by the Clinical and Laboratory Standards Institute (CLSI) to be in the intermediate range. A study by Fayyaz, Mirza, Ahmed, Abbasi, Hussain and Ali (2013) found chloramphenicol to have good in-vitro activity against MRSA (75.86% susceptible), with MICs of ≤ 8 $mg.ml^{-1}$, and 21.84% had MIC ≥32 $mg.ml^{-1}$, while only 2.30% had an MIC of 16 $mg.ml^{-1}$. Oxacillin, however, showed relatively poor activity against *S. aureus* (MIC_{50} and MIC_{90}, 8 and >16, range (0.25->16 $mg.ml^{-1}$) respectively. Farrel, Castanheira, Mendes, Sade and Jones (2012) obtained lower values (MIC_{50} and $MIC_{90,}$ >2 and >2, range (0.25->2$mg.ml^{-1}$) respectively for oxacillin against *S. aureus*. By definition, methicillin-resistant *Staphylococcus aureus* (MRSA) strains have an oxacillin MIC of ≥4 $mg.ml^{-1}$ or harbour the *mecA* gene, which encodes the low-affinity penicillin-binding protein (PBP), designated PBP2a (CLSI, 2012). Hence, it can be concluded that the isolates tested in this study are also methicillin resistant, since they had oxacillin MIC of >16 $mg.ml^{-1}$. Cefoxitin is a second generation cephamycin broad-spectrum antibiotic that is effective against several gram-positive and gram-negative bacteria. Cefoxitin has been reported as a surrogate marker for the detection of methicillin resistance. The organisms isolated in this study exhibited a resistance pattern to cefoxitin, as is evidenced by the MIC range of 1.5->128 $mg.ml^{-1}$. Nalidixic acid, a synthetic quinolone antimicrobial which acts as a specific inhibitor of bacterial DNA gyrase, is used mainly in the developing countries due to its affordability.

In this study, nalidixic acid demonstrated poor activity (MIC_{90} >32 $mg.ml^{-1}$) against all the microbial strains. A study (Karlsson, Howie, Crump and Whicharda 2014) also showed increased resistance (MIC>32 $mg.ml^{-1}$) of human isolates nontyphi *Salmonella* to nalidixic acid.

5.6 Comparison of the average percentage susceptibilities of foodborne pathogens isolated from the hospices

The average susceptibility percentages of the different micro-organisms are depicted in Figure 5.3. The average responses of *E. faecalis* and *S. aureus* to gentamicin are respectively 10% and 60%. These results are, however, not surprising, since research has shown that *E. faecalis* is intrinsically resistant to most of the prescribed antibiotics. Giraffa (2002) stated that Enterococci may cause food intoxication through the production of biogenic amines, and can be a reservoir for opportunistic infections, and for virulence traits. The gentamicin percentage susceptibility of Enterococcus in this study is lower than that obtained by Schouten, Voss and Hoogkamp-Korstanje (1999). Bertrand, Mulin, Viel, Thouverez and Talon (2000) revealed that strains with high-level resistance to kanamycin and gentamicin were frequently isolated from raw milk cheese and hospitalised patients. Enterococcus have been recently indicated as potential indicators of faecal contamination on hands, as they are present in large numbers in human faeces, and persist in the environment (Santiago-Rodriguez, Toranzos and Arce-Nazario 2016). Thus, in this study, *E. faecalis* could have originated from the food handlers' hands, and subsequently through cross-contamination. In this study, *S. aureus* responded generally well to gentamicin. However, Zanelli, Sansoni, Zanchi, Cresti, Pollini, Rossolini, and Cellesi (2002) obtained much lower resistance rates (9.2%) of *S. aureus* compared to the 40% resistance rate in this study.

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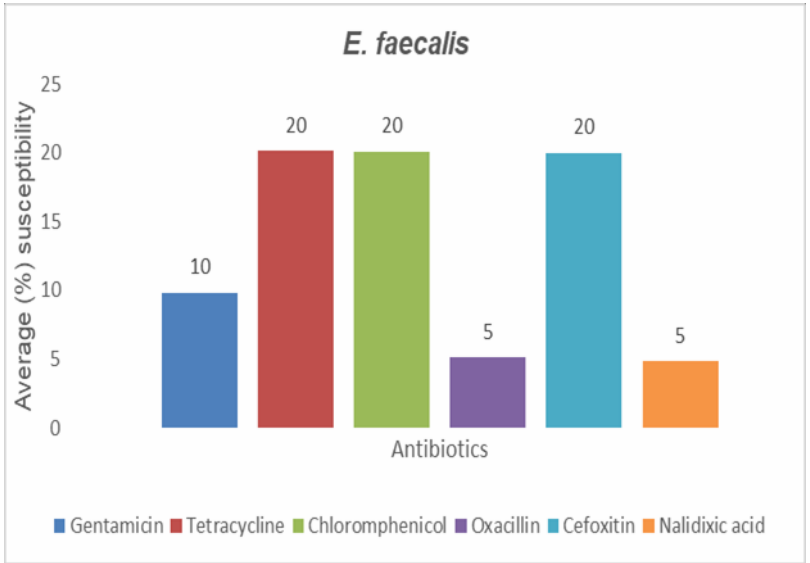

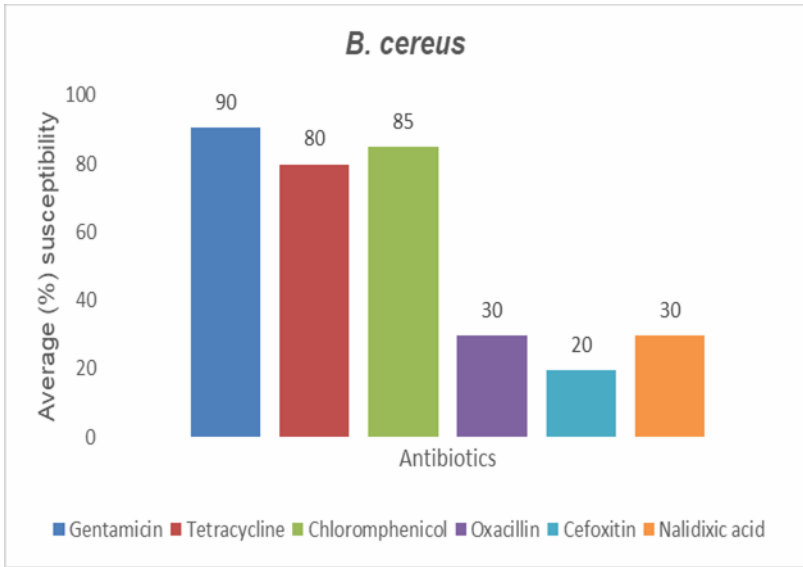

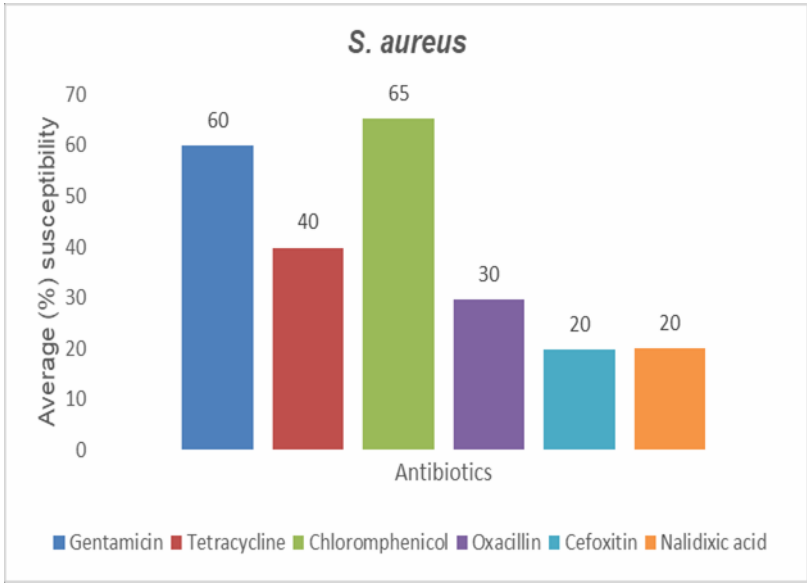

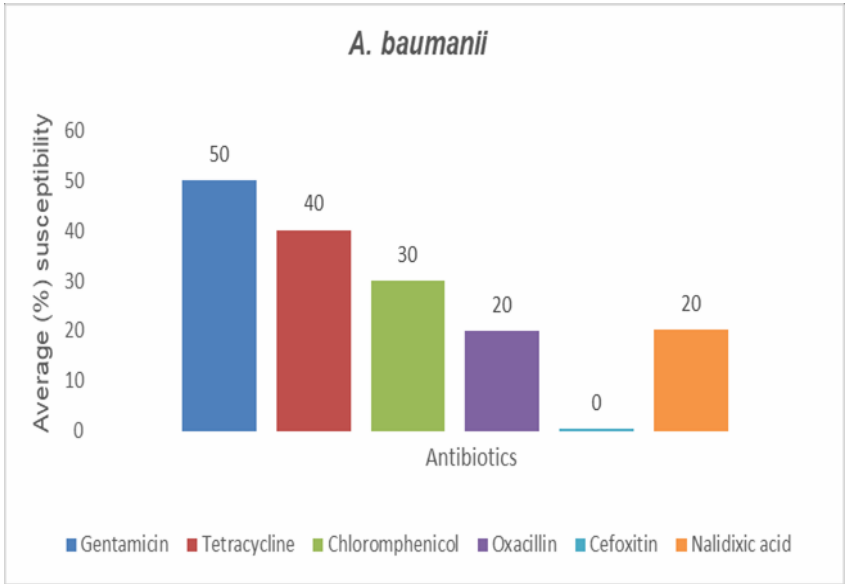

Figure 5.3. Percentage (%) susceptibility of micro-organisms

This again is a cause for concern in the hospice environment, since *S. aureus* cells are destroyed by the gastric juices in an immuno-competent organism, while exposure to the same *S. aureus* cells in immuno-deficient patients risks negative health consequences. Interestingly, both *S. aureus* and *E. faecalis* were noted to have a minimal 20% susceptibility average for cefoxitin. The average oxacillin susceptibility percentages for *E. faecalis* and *S. aureus* were 5% and 30% respectively. Transmission of antibiotic-resistant bacteria in hospices and other healthcare facilities could be facilitated by overcrowding and poor hygiene. It is also interesting to note the 100% resistance of *Acinetobacter baumanii* to cefoxitin in this study. Zhang, Huo, Zhu and Mae (2014) advocate that insufficient attention to hygiene during the production and/or processing of food products can give rise to contamination by pathogenic or spoilage bacteria, including members of the genus *Acinetobacter.* Additionally, multiple drug- resistant Acinetobacter has been detected in raw cow's milk and raw beef, suggesting that food of animal origin could serve as vectors for the dissemination of MDR Acinetobacter in community and hospital settings (Lupo, Vogt, Seiffert, Endimiani and Perreten 2014; Antunes, Visca and Towner 2014). The results of this study agree with findings obtained by Lowings, Ehlers, Dreyer and Kock (2015).

With regard to *Bacillus cereus*, almost all the organisms (90%) were susceptible to gentamicin. The response rate to tetracycline and chloramphenicol was also satisfactory, evidenced by percentage averages of 80% and 85% respectively. Until recently, minimal attention was given to the antimicrobial susceptibility profile of *B. cereus*, due to the low reported ability of this organism to cause infections. However, studies into the role of *B. cereus* in relation to food has now gained significance considering its ability to form endospores, as well as its capacity to grow and produce toxins in a wide variety of foods (Tewari and Abdullah 2015). *B. cereus*-induced gastroenteritis is generally mild, however, in severe cases it can also lead to bloody diarrhoea and emetic poisoning - therefore leading to some fatal cases (Arnesen, Fagerlund and Granum 2008). In this study, the response rate of *B. cereus* to cefoxitin was low (20%), followed by a response rate of 30% for both oxacillin and nalidixic acid. Interestingly, a study (Abraha, Bikila, Alemu and Muktar 2017) showed *B. cereus* isolates to have 80% resistance to cefoxitin.

5.7 CONCLUSIONS

The majority of healthcare-acquired infections are caused by micro-organisms that are resistant to at least one of the antibiotics most commonly used to treat these infections. Therefore, measures that minimise the spread of these resistant organisms are essential. Antibiotic resistance development is not just a local public health issue but includes broader environmental influences which are amplified by international travel and global trade in foodstuffs. Considering the generally challenged environment that HIV hospices find themselves in, the vulnerability and associated risk of microbial infections is considerable. According to the CDC (2013), MRSA is a major public health concern, and is responsible for both hospital and community-associated infections worldwide. This trend is of great concern in these hospices, as there are currently no guidelines in place to control the transmission of MRSA. Even more worrisome are the resource limitations which make it difficult to maintain hospice hygiene measures.

Poor hygiene and a lack of compliance with infection prevention and control measures have been implicated in the contribution to the propagation and spread of resistant bacteria strains. Therefore, improper food handling and kitchen hygiene contribute to potential health hazards due to the identified micro-organisms. Studies have demonstrated that healthcare workers acquire micro-organisms on gloved hands without performing direct patient contact, and when touching surfaces near a colonised patient. Environmental surfaces may serve as potential reservoirs for nosocomial transmission of vancomycin-resistant Enterococci (VRE), and thus need to be considered when formulating institutional infection control policies. There are limited studies that examine the role of the environment, specifically water, sanitation and hygiene factors that contribute to the development of resistant pathogens. Therefore, understanding these elements is necessary to identify any modifiable interactions to interrupt the spread of resistance from the environment into healthcare settings.

This study has shown that resistance to the majority of antibiotics is high, with most of the isolates showing multiple resistance (>or=2 antibiotics). In line with the report, *Bacillus cereus* in this study was resistant to more than two antimicrobial drugs (oxacillin, cefoxitin and nalidixic acid). This is even more alarming, since the occurrence of toxigenic *B. cereus* strains from food preparation surfaces and food handlers' hands could be an indication of a possible high risk of foodborne infections that could occur as a result of cross-contamination.

Acinetobacter baumannii isolates in this study showed generally higher antimicrobial resistance profiles, compared to similar studies. An increase in resistance profiles of *A. baumannii* may be due to the misuse of antibiotics in clinical settings, or because of patients who do not complete the prescribed antibiotic course, including poor infection control practices. *A. baumannii* has emerged as one of the most successful nosocomial pathogens due to its ability to survive in hospital environments. The persistent presence of A. *baumannii* in the hospital sector allowed it to come into contact with antibiotics; therefore, creating a selective pressure that gave rise to the emergence of successful clones with particular antibiotic resistance (Gonzalez-Villoria and Garduno 2016). This particular antibiotic resistance trait also enhanced its capability to become the leading pathogen in intensive care units due to its increasing multi-drug resistance. The fact that it can produce highly resistant biofilms enhances its growth and survival as a nosocomial pathogen in hospital environments for prolonged periods. This is of notable concern for a setting typical of a hospice, where the patients have a compromised immune system. Moreover, it has been suggested by Karageorgopoulos and Falagas (2008) that it is critical to correctly use disinfectants and solutions containing ethanol, because if applied at very low concentrations, *A. baumannii* bacterium can become more pathogenic. Gentamicin had poor activity against *E. faecalis*, and moderate activity against *A. baumanii.* It is well known that gentamicin resistance is a good predictor of resistance to other aminoglycosides, except streptomycin. *Staphylococcus aureus* was found to be resistant to more than four antimicrobial drugs, including tetracycline and oxacillin, thus an indication of methicillin resistance, which is defined as an oxacillin minimum inhibitory concentration (MIC) ≥4 mg/ml.

Since little is known about foodborne MRSA, other than that it is thought to come from food handlers, it is advised that general food safety guidelines should be followed in order to prevent the spread of MRSA bacteria. The guidelines could include the washing of hands with soap and water before handling food. In some countries such as the Netherlands, aggressive infection control campaigns have proved successful at preventing MRSA dissemination (ECDC 2012). A variety of resistance mechanisms and genes complicate the antibiotic resistance issue. Commensals, such as non-pathogenic *E. coli* and *Enterococcus spp*., may serve as reservoirs of potential antimicrobial resistance genes in the environment, from which resistance may be transferred to other commensals or pathogenic bacteria. A critical contribution to the assessment done in this study would be to identify and characterise the contributing resistance genes and other tolerance development strategies. It is vital to identify and characterise healthcare-associated pathogens and their circulating antibiotic resistance genes, as this would benefit the hospice setting. An understanding of the origin of resistance genes can assist in better understanding and implementing improved infection control measures. Barrier precautions (e.g. use of gloves) remain a critical component of infection control. Furthermore, frequent movement of hospice patients in the kitchen is discouraged, since this also contributes to possible transmission of multi-drug-resistant organisms. It is therefore highly recommended that each hospice should have a comprehensive infection control programme that can decrease the transmission of resistant foodborne pathogens from food handlers to the patients. Moreover, it is recommended that policies specific for a hospice setting should be developed in line with the infection control programme. Lastly, the education of food handlers on food safety hygiene is recommended to disrupt the transmission of foodborne infections.

This chapter entailed a detailed discussion of antimicrobial susceptibility amongst microbiota from HIV hospices in Central South Africa, as well as the emerging health risks. In the next chapter, an assessment of the World Health Organization's five keys to safer food is provided. Furthermore, the targeted intervention programme developed for hospices in Central South Africa is discussed in detail.

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CHAPTER 6

AN ASSESSMENT OF THE WORLD HEALTH ORGANIZATION'S FIVE KEYS TO SAFER FOOD AND THE COMPOSITION OF A TARGETED INTERVENTION PROGRAMME FOR HIV/AIDS HOSPICES

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6.1 ABSTRACT

Appropriate food-handling practices are crucial for preventing foodborne diseases during food production and distribution. Training of food handlers is important to ensure the safety of the foodstuffs. Both the developed and developing countries are at an increased risk of foodborne diseases. Studies have shown that foodborne disease prevention requires favourable hygienic conditions during food preparation, which is also considered important in relation to the food handler's role, since he or she may carry pathogens. To effectively manage food safety, there should be adoption of safe food-handling practices. The aim of the study was to evaluate the effectiveness of the WHO's five keys to safer food and targeted intervention programme as a tool for food safety education. The WHO's five keys questionnaire was administered to hospice food handlers using pretest and posttest design. There was a positive significance in the level of knowledge of food handlers after the intervention ($P < 0.01$). The average percentage of correct answers on the knowledge questionnaire was 71%. The knowledge that wiping cloths can spread micro-organisms increased from 84% to 100%. Food safety training increased knowledge and improved attitudes about hand hygiene and food-handling practices.

KEYWORDS: food handler, food hygiene education and food safety.

6.2 INTRODUCTION

As indicated at the end of Chapter 5, Chapter 6 is devoted to a discussion of the factors contributing to foodborne disease. An assessment of the World Health Organization's five keys to safer food is conducted, highlighting the advantages of applying those keys. Finally, the targeted intervention programme that was designed specifically for HIV/AIDS hospices, is explained and discussed, and the results pre- and post-training pertaining to food handlers' knowledge of, attitude towards and food-handling practices applied, are revealed.

6.2.1 Factors contributing to foodborne disease

Foodborne disease caused by microbiological hazards constitutes an important global public health concern. It has been indicated by the World Health Organization that foodborne and waterborne diarrhoeal disease kills an estimated two million people annually (WHO 2015). Reported outbreaks of foodborne illness and the high incidence of diarrhoeal diseases in African children are indications of the magnitude of the problem associated with food as a vehicle for disease transmission. Major contributing factors for the spread of foodborne outbreaks are a lack of knowledge and improper practices by food handlers. Hence, it is important that food handlers should be trained on safe food handling and hygiene. Food handlers play a major role in the passive transmission of foodborne pathogens from contaminated sources, such as cross-contamination from raw meat to ready-to-eat food (Sharif, Obaidat and Al-Dalalah 2013). They may also shed foodborne pathogens such as *E. coli* O157:H7 and non-typhoidal Salmonella during the infection period (Croxen, Law, Scholtz, Keeney, Wlodarska and Finaly 2013).

These pathogens account for the majority of foodborne illnesses and are of great public health concern. Foodborne diseases significantly contribute to mortality from diarrhoea, causing approximately 2.2 million deaths annually, mostly in children in developing countries (WHO 2008). Moreover, the outbreaks are common in South Africa; however, not much information is available on the true incidence of these outbreaks (Benade 1996; Karas, Nicol, Martinson and Heubner 2001; Keddy and Koornhof 2001; Smith, Gouws, Hoyland, Sooka, Keddy, GERMS-SA 2006).

According to Gorman, Bloomfield and Adley (2002), common pathogens that are mainly found in the kitchen include Salmonella, pathogenic *E. coli*, *S. aureus* and Campylobacter. The WHO (2015) indicates that almost one third (30%) of all deaths from foodborne diseases are amongst children under the age of five years, this despite the fact that they make up only 9% of the global population. It has been further stated by the WHO (2006) that the number of foodborne disease outbreaks has increased, and most of them are caused by food mishandling, often due to inappropriate pre-preparation, preparation and distribution of food by food handlers. However, only a small proportion of these illnesses come to the notice of health services, and even fewer are investigated.

In developing countries less cases are counted, primarily because of poverty and lack of resources for food safety management and food control services. It is generally recognised that knowledge related to food safety provides the basis for the development of intervention strategies and initiatives aimed at preventing foodborne illness. Mwamakamba, Mensah, Fontannaz-Aujoulat, Hlabana, Maiga, Bangoura, Mohamed and Ingenbleek (2012) emphasise that food safety education programmes need to particularly target certain segments of the population who either directly have a role in food preparation, and/or have increased vulnerability to foodborne diseases. Additionally, food safety education has the double advantage of having low costs and high potential effectiveness among the strategies of control and prevention of foodborne diseases, provided it is carried out with the active participation of food handlers (Mastrantonio, Dulout, González and Zeinsteger 2014).

An increase in reported cases of foodborne diseases has also been reported in Europe. For example, in 2009 there were 212,064 human cases of campylobacteriosis, compared to 99,020 reported cases of salmonellosis in 2012 (Eurosurveillance Editorial Team 2012). Salmonellosis is one of the most commonly reported enteric illnesses worldwide. *Salmonella spp.* is transmitted by the faecal-oral route through consumption of contaminated food or water, person-to-person contact, or from direct contact with infected animals (Jay, Davos, Dundas, Frankish and Lightfoot 2003).

Table 6.1 shows major outbreaks associated with *Salmonella spp*. Montville and Matthews (2005) indicate that outbreaks attributed to *Salmonella* spp. have predominantly been associated with animal products such as eggs, poultry, raw meat, milk and dairy products, but also include fresh produce, salad dressing, fruit juice, peanut butter and chocolate. Outbreaks involving food have been reported in several food services, e.g. in hospitals (Todd, Greig, Bartleson and Michaels 2007), restaurants (Chan and Chan 2008; Costalunga and Tondo 2002; Xue and Zhang 2013), schools (Johler, Bridy, Huguenin, Robert, Hummerjohann and Stephan 2015) and daycare centers (ESR 2008). Therefore, reduction of these diseases is one of the main goals in national and international food safety programmes.

Table 6.1: Selected major outbreaks associated with *Salmonella* spp. (>50 cases and/or ≥1 fatality)

Year	Total number of cases	Food	Country	Reference
2015	190	Pork	US	CDC 2016
2013	134	Poultry	US	CDC 2013
2010	170	Aioli	Australia	OzFoodNet 2010
2009	272	Salami	US	CDC 2010
2006-2007	628	Peanut butter	US	CDC 2007

Hospice meals have a remarkable associated food safety risk, since they are prepared for vulnerable people with a compromised immune system, and therefore their risk of contracting foodborne illness is high. It is in this context that hospice food handlers play an important role of providing nutritious, wholesome meals to the patients. Therefore, hospice food safety should be a priority at every stage of preparation, including the arrival of food from different suppliers and donors; more especially since hospices receive some of the food that are nearing expiry date from donor organisations. Hence, it is critical that hospice food handlers should always check the expiry date on the food parcels and apply hygienic and sanitation measures in the kitchen during food preparation. Therefore, food handlers' failure to adhere to this practice makes the kitchen to become an important contamination point for food.

It is widely recognised that inadequate food preparation practices in the kitchen, e.g. improper hand washing and food storage, are strongly associated with poor microbiological quality. Even though governments and food safety agencies from all over the world are doing their best to improve the safety of the food supply, the occurrence of foodborne disease remains a significant health issue in both developed and developing countries (Torgerson, Devleesschauwer, Praet, Speybroeck, Willingham, Kasuga, Rokni, Zhou, Fèvre, Sripa, Gargouri, Fürst, Budke and De Silva 2015). Therefore, education of food handlers, including consumers, is recognised as an important strategy to improve food safety, and to reduce the impact of foodborne diseases. For the sake of public health, it is important to understand the epidemiology of foodborne illnesses, as it will assist in prevention and control efforts. Among the behaviours of food handlers that are often associated with outbreaks are inadequate hand hygiene practices; inadequate hygiene of equipment and utensils; maintenance of ready-to-eat food at room temperature; preparation of meals in advance; insufficient cooking temperature and inadequate thawing (Lambrechts, Human, Doughari and Lues 2015; Gould, Rosenblum, Nicholas, Phan and Jones 2013).

It has been emphasised by Batz, Doyle, Morris, Painter, Singh, Tauxe, Taylor, Wong and the Food Attribution Working Group (2005) that one challenge in preventing foodborne illness is determining how to prioritise limited food safety resources across a large number of foods. HIV-infected patients are more vulnerable to foodborne diseases, as their immune systems are compromised. This is of great concern in a hospice environment where HIV-infected patients are hosted. A study by Fleury, Stratton, Tinga, Charron and Aramini (2008) revealed that the high-risk groups for foodborne diseases include infants, young children, the elderly and immune-compromised persons. The population in developing countries is more prone to suffer from foodborne illnesses for multiple reasons, including lack of access to clean water for food preparation; inappropriate transportation and storage of foods, including lack of awareness regarding safe and hygienic food practices (WHO 2011). Moreover, access to safe water is considered to be a basic human need.

It is for this reason that the WHO recommends a minimum of 20 liters of water per person per day, to cover consumption, food preparation, cleaning, laundering and personal hygiene. However, according to Ngwenya and Kgathi (2006), for a person living with HIV the needs can increase significantly to over 100 liters per day. For people living with HIV, foodborne organisms causing diarrhoea include the following: non-typhoidal Salmonella, Giardia and, less commonly, Shigella, Campylobacter, Microsporidium, Cryptosporidium, Isospora, and Cyclospora (Sax 2001). Therefore, it is acknowledged that education in food safety is a well-recognised health intervention, which allows prevention of a wide range of diseases. It is also encouraged that food safety training should be conducted on a regular basis in order to mitigate food contamination risks by improving food handler practices. The effects of food safety training on food handlers' knowledge have been previously described (Martins, Hogg and Otero 2012; Soares, Garcia-Diez, Esteves, Oliveira and Saraiva 2013). However, very few articles specifically relate to food hygiene training of care setting workers (Soares García-Díez, Esteves, Oliveira and Saraiva 2013). 'Care setting' represents premises such as children's nurseries, daycare settings, pre-schools, respite units, and residential homes. It has been stated by several authors that the success of training programmes providing only information is unclear, and changes in improper food practices are not usually achieved (Clayton, Griffith, Price and Peters 2002; Seaman and Eves 2008).

A major intervention in improving the safety of food, including ready-to-eat food prepared in the hospice kitchens, entails training of food handlers on hygienic food handling. However, this is more effective if it is evidence based, that is, if the training is based on specific data and information obtained from the trainee food handler. Therefore, for the prevention of foodborne outbreaks, training of food handlers regarding appropriate preparation and storage of food is required. The WHO has long recognised the importance of reducing foodborne diseases. After thorough consultation with food safety experts and risk communicators, in the year 2001, the WHO introduced five keys to safer food as an intervention tool to promote safe practices amongst food handlers and consumers. Additionally, the WHO's five keys to safer food messages are based on scientific evidence, and can be promoted in all settings. Through its recommendations, the expert committee emphasised the importance of educating food handlers and consumers regarding proper hygiene. Public education and community participation were identified as essential strategies for intervention. The messages of this intervention are based partly on the Hazard Analysis Critical Control Point (HACCP) studies. The aim of the study was firstly to assess the efficacy of food handler training based on the WHO's five keys to safer foods and the associated training material, and secondly, to develop a hazard characterisation tool specific for hospice settings. The study ultimately endeavours to contribute to the safety and quality of hospice food, and to improve food handlers' knowledge of food safety.

6.3 MATERIALS AND METHODS

6.3.1 Research design

A pre-test and post-test quasi experimental study design was employed. There was no random allocation of participants to training intervention. Training was given to all the participants, and the scores were compared before and after training. The WHO's five keys to safer foods framework underpinned the training intervention, and the training was supplemented with a food safety manual designed by the author and food safety experts. The study was carried out in four hospices located in the FS (Free State) and EC (Eastern Cape) provinces. These are medium-sized hospices with a number of patients ranging between 20 to 60 per hospice. A total of 100 food handlers who are working full time in the hospice kitchens were included in the study.

6.3.2 Data collection

A venue in the precinct of a hospice was selected for food safety training. This venue was kindly made available by the hospice manager. Training per hospice was for the full duration of four hours. Lecture and demonstration techniques were selected as the training method. The WHO's five keys to safer foods training manual and questionnaire were used to facilitate the training (WHO 2006). Over and above the WHO's manual, a food safety manual compiled by the author and food safety experts, specifically for the hospice food handlers, was also used to facilitate training (see Appendix 1A and 1B). The WHO's assessment tool was a multiple-choice questionnaire made up of 31 questions (see Appendix 2 below). The first section was based on knowledge, and it contained 11 questions with the options of True or False as an answer. The second part was on attitude, and it contained 10 questions with the options of agree, not sure, or disagree for an answer.

The last part of the questionnaire was on self-reported behaviour, consisting of ten questions, with the following options as possible answers: always, most times, sometimes, not often and never. The core message of the five keys to safer foods is the following: keep clean; separate raw and cooked food; cook thoroughly; keep food at safe temperatures; and use safe water and raw materials. Prior to the commencement of training, food handlers were assessed on the WHO's pre-assessment test on knowledge, attitude and self-reported behaviour containing multiple-choice questions. Food safety training manuals simplified and modified for the hospice food handlers were then subsequently distributed to all the participants for the purpose of training.

APPENDIX 2

WHO 5 KEYS TO SAFER FOOD

For participants

KNOWLEDGE

KEY 1	Keep clean	TRUE	FALSE
1a	It is important to wash hands before handling food.		
1b	Wiping cloths can spread microorganisms.		

KEY 2	Separate raw and cooked	TRUE	FALSE
2a	The same cutting board can be used for raw and cooked foods provided it looks clean.		
2b	Raw food needs to be stored separately from cooked food.		

KEY 3	Cook thoroughly	TRUE	FALSE
3a	Cooked foods do not need to be thoroughly reheated.		
3b	Proper cooking includes meat cooked to 40 °C.		

KEY 4	Keep food at safe temperatures	TRUE	FALSE
4a	Cooked meat can be left at room temperature overnight to cool before refrigerating.		
4b	Cooked food should be kept very hot before serving.		
4c	Refrigerating food only slows bacterial growth.		

KEY 5	Use safe water and raw materials	TRUE	FALSE
5a	Safe water can be identified by the way it looks.		
5b	Wash fruit and vegetables.		

ATTITUDE

KEY 1	Keep clean	AGREE	NOT SURE	DISAGREE
1a	Frequent hand-washing during food preparation is worth the extra time.			
1b	Keeping kitchen surfaces clean reduces the risk of illness.			

KEY 2	Separate raw and cooked	AGREE	NOT SURE	DISAGREE
2a	Keeping raw and cooked food separate helps to prevent illness.			
2b	Using different knives and cutting boards for raw and cooked foods is worth the extra effort.			

KEY 3	Cook thoroughly	AGREE	NOT SURE	DISAGREE
3a	Meat thermometers are useful for ensuring food is cooked thoroughly.			
3b	Soups and stews should always be boiled to ensure safety.			

KEY 4	Keep food at safe temperatures	AGREE	NOT SURE	DISAGREE
4a	Thawing food in a cool place is safer.			
4b	I think it is unsafe to leave cooked food out of the refrigerator for more than two hours.			

KEY 5	Use safe water and raw materials	AGREE	NOT SURE	DISAGREE
5a	Inspecting food for freshness and wholesomeness is valuable.			
5b	I think it is important to throw away foods that have reached their expiry date.			

SELF-REPORTED BEHAVIOR

KEY 1	Keep clean	ALWAYS	MOST TIMES	SOMETIMES	NOT OFTEN	NEVER
1a	I wash my hands before and during food preparation.					
1b	I clean surfaces and equipment used for food preparation before re-using on other food.					

KEY 2	Separate raw and cooked	ALWAYS	MOST TIMES	SOMETIMES	NOT OFTEN	NEVER
2a	I use separate utensils and cutting-boards when preparing raw and cooked food.					
2b	I separate raw and cooked food during storage.					

KEY 3	Cook thoroughly	ALWAYS	MOST TIMES	SOMETIMES	NOT OFTEN	NEVER
3a	I check that meats are cooked thoroughly by ensuring that the juices are clear or by using a thermometer.					
3b	I reheat cooked food until it is piping hot throughout.					

KEY 4	Keep food at safe temperatures	ALWAYS	MOST TIMES	SOMETIMES	NOT OFTEN	NEVER
4a	I thaw frozen food in the refrigerator or other cool place.					
4b	After I have cooked a meal I store any left-overs in a cool place within two hours.					

KEY 5	Use safe water and raw materials	ALWAYS	MOST TIMES	SOMETIMES	NOT OFTEN	NEVER
5a	I check and throw away food beyond its expiry date.					
5b	I wash fruit and vegetables with safe water before eating them.					

KNOWLEDGE:	ATTITUDE:	SELF-REPORTED BEHAVIOR:
1a) True, 1b) True	1a) Agree, 1b) Agree	1a) Always, 1b) Always
2a) False, 2b) True	2a) Agree, 2b) Agree	2a) Always, 2b) Always
3a) False, 3b) False	3a) Agree, 3b) Agree	3a) Always, 3b) Always,
4a) False, 4b) True, 4c) True	4a) Agree, 4b) Agree	4a) Always, 4b) Always

Manual simplification and modification were applied to accommodate the food handlers given their education level, and it did not contain technical aspects. Over and above, audiovisual resources (slides and posters) were also designed to elaborate on the theory presented in the food safety manual, and to show the food handlers the nature of bacteria under the microscope, as stipulated by the WHO. During presentation, the food handlers were offered lessons and training on different food safety related subjects, including food and personal hygiene, environment and food safety, transmission and control of foodborne infections, and the economic importance of food safety. There was also an interactive session that provided food handlers with the opportunity to ask pertinent questions related to food safety.

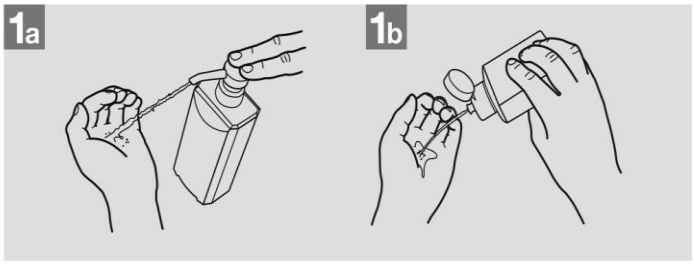
Lastly, there was a demonstration on correct hand washing procedure using the WHO's hand wash poster (see Appendix 3 below). Subsequently, food handlers had to wash their hands, and they were then subjected to a UV light to demonstrate the effectiveness of proper hand washing procedures. This was done so that food handlers could visualise areas missed during hand washing. Approximately a month after training, the very same WHO assessment tool was re-administered to the food handlers. Statistical analysis was done in terms of mean and standard deviation (SD). SPSS version 18 was used for all the analyses.

APPENDIX 3

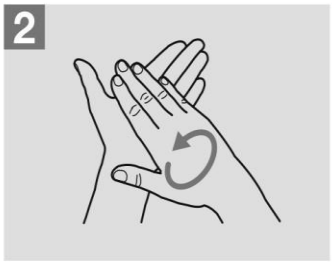
How to Handrub?

RUB HANDS FOR HAND HYGIENE! WASH HANDS WHEN VISIBLY SOILED

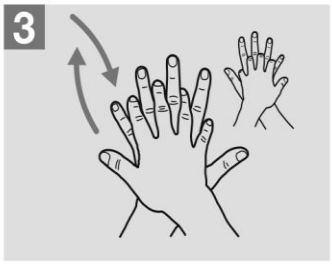
Duration of the entire procedure: 20-30 seconds



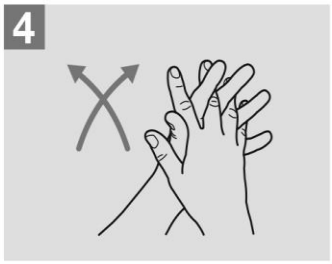
Apply a palmful of the product in a cupped hand, covering all surfaces;



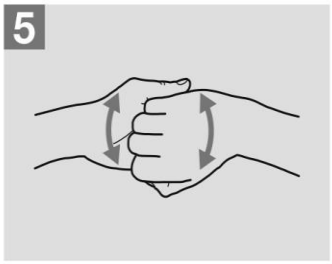
Rub hands palm to palm;



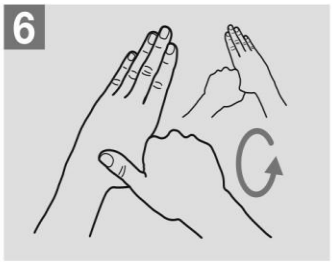
Right palm over left dorsum with interlaced fingers and vice versa;



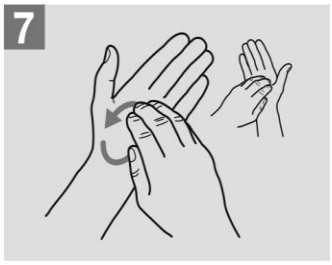
Palm to palm with fingers interlaced;



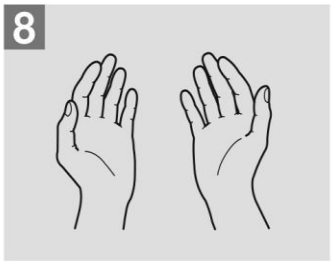
Backs of fingers to opposing palms with fingers interlocked;



Rotational rubbing of left thumb clasped in right palm and vice versa;



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



Once dry, your hands are safe.

World Health Organization | Patient Safety — A World Alliance for Safer Health Care | SAVE LIVES Clean Your Hands

WHO acknowledges the Hôpitaux Universitaires de Genève (HUG), in particular the members of the Infection Control Programme, for their active participation in developing this material.

May 2009

6.3.3 Hazard categorisation via a novel audit system

In South Africa, the number of people being cared for at hospices is increasing, due to the scourge of HIV/AIDS. This, in spite of the fact that some hospices struggle with proper infrastructure and are financially constrained. It was observed during the study that some of the hospices do not have proper kitchens with separate food storage facilities. The in-patient wards were also problematic since they represent the potential source of the risk of acquiring an infection during the healthcare delivery. There are biological as well as chemical hazards associated with this type of setting. Biological hazards are living organisms that can cause infectious diseases and allergy. Therefore, the hospice can be a potential environment for proliferation of harmful micro-organisms. Montella, Triassi, Bellopede, Reis, Palladino and Silverio (2014) emphasise that healthcare-associated infections (HAI) are the most serious complication associated with medical care. However, biological agents capable of creating a hazard to human health are not limited to micro-organisms, plants and fungi. The biological hazards associated with hospices include pathogens, human bodily matter, biohazard waste, sewerage and rubbish. Chemical exposures can occur from sterilants, disinfectants, and cleaning compounds. Hence, it is important that these should be properly labelled. The different mode of transport for these biological agents are heating ventilation and air conditioning (HVAC) systems, doors, windows, attachment to people and objects, water infrastructure and via infected individuals and animals (Nasir, Campos, Christie and Colbeck 2016). Additionally, it has been recognised that overcrowding in small enclosed spaces, inadequate ventilation, recirculation of contaminated air, increased duration of exposure and susceptibility of exposed people increase the prospect of airborne disease transmission (Nardell 2016). Cross contamination routes have also been explained in detail in the preceding chapters. These hazards can be eliminated or reduced by a variety of exposure control methods, including design elimination, administrative controls, and personal protective equipment.

The present study proposes the development of a hospice hazard categorisation tool via a novel audit system (see Appendix 4 at the end of this chapter).

The conceptualisation was aligned with current literature and the WHO's five keys to safer foods. The rationale for the tool development emanates from the gaps identified during surveys in the hospices. It is envisaged that the tool will assist in the reduction of the prevalence of common pathogens associated with healthcare settings, and therefore in keeping the hospices safe and improving the health outcome of patients. The effective pillars of palliative care will assist with the optimal holistic hospice function. The tool also has the potential to fast-track accreditation of hospices with COHSASA (Council for Health Service Accreditation of Southern Africa) accreditation, as outlined in palliative care standards.

The tool is comprised of the following constructs/focus areas, based on gaps identified during the study as previously mentioned:

- Infrastructure
- Food preparation and storage facilities
- Sanitation
- Food handler training
- Hospice management including pillars to effective palliative care

6.3.4 The rationale for the focus areas of the hazard categorisation tool

It was observed during study fieldwork that hospice infrastructure still remains a problem, and that government can do more to modify the existing healthcare facilities, and to invest in infrastructure. It should, however, be pointed out that some of the hospices do boast a well-resourced infrastructure. To highlight an example, the hospice kitchen should be well equipped with different food preparation areas and hand wash stations, not forgetting well ventilated rooms for exchange of fresh air. Over and above, there should be a dedicated area for receipt and inspection of raw materials as they are coming in from various donor organisations and suppliers. WASH - defined as improved water quantity and quality, sanitation, and hygiene, can prevent or limit the transmission of disease through multiple routes.

There are various forms of WASH interventions such as campaigns to promote hygiene and sanitation behavior, and water/sanitation infrastructure, all with the capacity to improve quality of care, and to reduce healthcare-related infections. Another critical aspect of palliative care is food handler training. During the survey in all the participating hospices it became apparent that only a small percentage of food handlers are trained on safe food handling. It is therefore in light of these observations that hospice supervisors/managers are encouraged to emphasise the importance of food safety training, and to provide relevant training to hospice food handlers. This is even more important in the hospice context due to the job profile of the food handlers; the majority do not only cook and handle food, but they are also responsible for the care of the children who are hospice in-patients.

It is also encouraged that there should be regular communication between hospice management and food handlers, irrespective of the nature of their job contract i.e. voluntary or with a specified job contract. It has been mentioned before that hospices operate under budgetary constraints. This is creating some difficulties to management on the hiring aspect, hence some food handlers are appointed on a voluntary basis. However, during the focus group discussion, it became apparent that managers communicate differently with contracted food handlers and volunteers. There are constant meetings with the contracted food handlers, whilst voluntary workers have to rely on secondary information from the contracted workers. The voluntary workers expressed the need to be valued and appreciated by the managers. Therefore, hospice managers are encouraged to have inclusive discussions/communication that does not exclude the voluntary workers to maintain harmony, and to uphold the quality of service provision.

6.3.5 The design process and the reasoning behind the use of colour and graphics

The manual (hazard categorisation tool) was developed by the author, and the design was conceptualised by Mrs Miralde Kotze from Central University of Technology, Free State's Product Development and Technology Station (PDTS). The ultimate goal for the design was to redefine food safety and palliative care. Subsequently, this should be a valuable tool that the hospices can use to obtain Council for Health Service Accreditation of Southern Africa (COHSASA) accreditation, as outlined in palliative care standards.

The accreditation will mean that the hospices are compliant in terms of safety, and that they provide most needed, high quality care to patients. The purpose behind the tool manual with its visual graphics, is to give anyone (moderately literate or fully literate) the ability or tools to perform a review of a hospice, and to determine which aspects are in place, and where attention is needed to improve food safety and food handling. The core focus areas of the tool are: infrastructure, food preparation and storage facilities, sanitation, food handler training and hospice management/supervision.

The complete manual consists of 12 pages, of which 2 pages are the front and back cover. The first section contains the **formal audit review**, with questions and a colour-coded number scoring structure. The second section contains the **visual audit review**, with pictures and graphics, so that the inspector can mark the sections or areas that are in place (good), or not in place (bad).

The reason behind the use of colour for the graphic design of the manual, was to conform to Central University of Technology, Free State (CUT) corporate branding guidelines. The corporate branding guideline is a document that specifies the design elements and colours of the corporate entity. CUT has an extended colour pallet that represents its four faculties (light blue for Engineering and Information Technology, red for Management Sciences, yellow for Humanities, and green for Health and Environmental Sciences). The main colour pallet for the Hospice Food Safety Audit manual consists of dark blue and green, representing CUT's Faculty of Health and Environmental Sciences.

The colour pallet for the scoring structures was referenced with a gradual colour change from green to red. Gradual tone from green to red, as referenced, is linked to the use of colour in traffic light systems, with emphasis on red which indicates danger, or which functions as a sign to stop orange represents the transition from green to red, indicating a warning, and green represents safety (being good to go or to proceed).

The scoring structure uses two applied methods to rate/score a question, and these are: (1) the use of colour, and (2) the use of a number. When food safety and health is concerned, there normally are no 'in-between' when something needs to be done correctly or needs to be in order, therefore, having a narrow scoring structure, one is able to rate the hospice section as either good (green) or bad (red), but with the additional option to give comments, and to rate the level of improvement that must take place. Below each question, a space is made available for comments or recommendations. As with any report, this will give the management of the hospice that is being audited, reasons for a failed audit or a passed audit, as well as highlighting areas requiring improvement.

In drawing a parallel with similar audit manuals or reports, reference is made in this case to the WHO manual used in Switzerland. It is a manual that is designed in a visually uncluttered and simple way, easy to understand, but where one must be fairly literate to comprehend its contents. Therefore, in the structure and design of the visual hospice kitchen food safety audit, a further step was embarked upon. This included colour coding and graphic imagery for improved comprehension of terms and sections, and lastly, the creation of a visual 'check list' to determine if the necessary concepts are in place for a healthy hospice kitchen.

At the end of the hospice kitchen food safety audit manual, the 12 Pillars of Effective Palliative Care are outlined in words and sentences, accompanied by graphic illustration. The colour pallet for the 12 Pillars for Effective Palliative Care has its reference from the Tertiary colour pallet of CUT's corporate branding manual. Each of the 12 individual pillars is represented with an icon. The design of the infographic goes hand-in-hand with the keywords describing each of the 12 pillars. Additionally, the infographic can also be used as a tool for memorising the 12 important pillars of effective palliative care.

6.4 RESULTS AND DISCUSSION

6.4.1 Overall knowledge, attitude and practice

The food handlers in the hospices expressed high levels of knowledge, positive attitudes and good practice in food safety post training. Figure 6.1 shows the mean and standard deviation (SD) of knowledge, attitude and behaviour score on food safety before and after training.

The mean (SD) score of knowledge was 6.1 (1.11) for pre-training, and 7.81 (1.25) post-training. The mean (SD) score of attitude was 5.85 (1.02) pre-training and 7.40 (1.30) post-training. The mean (SD) score of self-reported behaviour was 5.63 (1.18) pre-training, and 7.01 (1.56) post-training. In this study the knowledge, attitude and self-reported behaviour of food handlers were found to be significantly different pre-training and post-training ($P<0.01$).

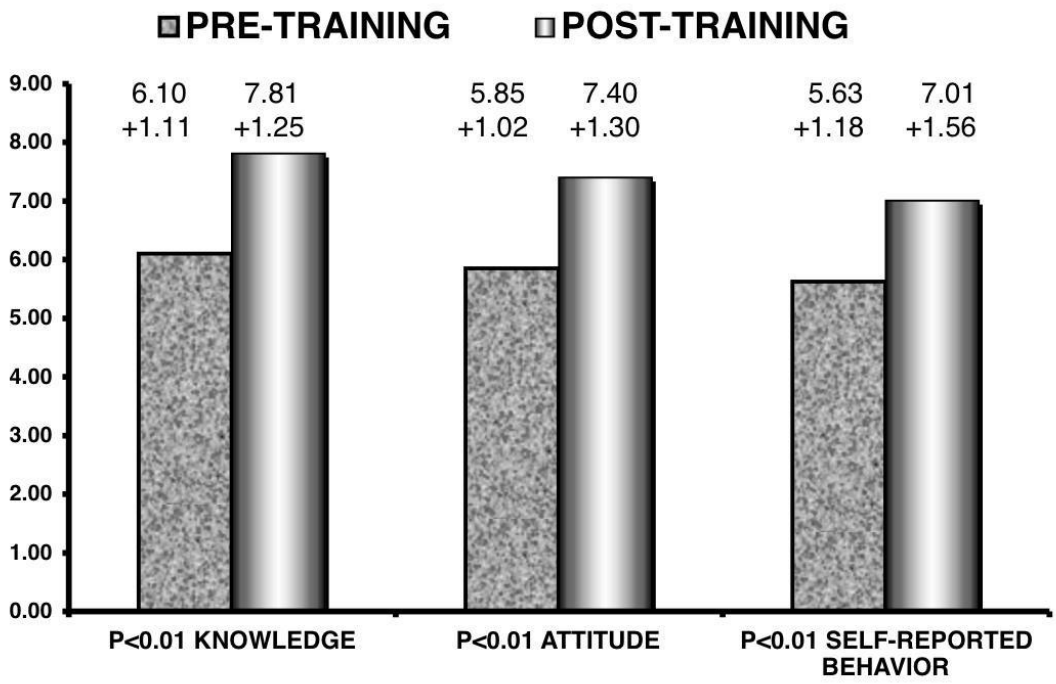


Figure 6.1: The mean and standard deviation of food safety KAP score pre-training and post-training

6.4.2 Food handlers' knowledge on food safety

The food safety knowledge assessment pre-training and post-training is shown in Table 6.2. The importance of always washing hands before handling food was consistently scored at 100% before and after training. The results of this study regarding hand washing are different from those obtained by Donkor, Kayang, Jonathan and Moses (2009), wherein the rate improved from 57% pre-training to 100% post-training.

This was indeed a good indication, since it is common knowledge that strict adherence to hand hygiene reduces the risk of cross-transmission of infections (Chouhan, Chouhan, Khan and Chouhan 2017). The knowledge that wiping cloths can spread micro-organisms increased from 84% pre-training to 100% post-training. The role of wiping cloth in microbial cross-contamination in the kitchen should never be underestimated. According to Beumer and Kusumaningrum (2003), micro-organisms can also be transmitted from wet cloths used to clean surfaces, where they are able to survive and subsequently be transferred from these surfaces to food. Additionally, another study (Gerba, Tamimi, Maxwell, Sifuentes, Hoffman and Koenig 2014) demonstrated that significant numbers of coliforms and *E. coli* commonly occur in kitchen cloths.

Cross-contamination can cause food poisoning when bacteria are transferred from raw food to food that is ready to eat. It is also one of the main factors related to foodborne outbreaks. An increased risk of cross-contamination is facilitated by the adherence of bacteria on food contact surfaces (Khelissa, Abdallah, Jama, Faille and Chibib 2017). A study (Dantas, Bruna, Bonsaglia, Castilho, Hernandes, Fernandes and Vera 2018), concluded that the cutting boards represent a critical point in cross-contamination, particularly in the presence of biofilm. In this study, pre-training, 32% of food handlers believed that the same cutting board can be used for raw and cooked foods, provided that it looks clean. However, post-training, 73% knew that this assumption is incorrect.

Table 6.2: WHO food safety knowledge questionnaire before and after training

Knowledge question	Pre-training (%)	Post-training (%)
Is it important to wash hands before handling food	100	100
Wiping cloths can spread micro-organisms	84	100
The same cutting board can be used to for raw and cooked foods provided it looks clean	32	73
Raw food needs to be stored separately from cooked food	50	100
Cooked food needs to be thoroughly reheated	37	80
Proper cooking includes meat cooked at 40 °C	12	71
Cooked meat should be left at room temperature	19	79
Cooked food should be kept very hot before serving	24	84
Refrigerating food only shows bacterial growth	32	100
Safe water can be identified by the way it looks	18	77
Wash fruit and vegetables	100	100

Additionally, before training, only about 50% of the food handlers knew that raw food needs to be stored separately from cooked food. After training this score improved to 100%. This was a good indication, considering that some studies have attributed inappropriate food storage to be responsible for about 50% of foodborne diseases (Gomes, Franco and De Martinis 2013). The knowledge that cooked foods need to be thoroughly reheated increased from 37% before training to 80% after training. It is important that food should be thoroughly cooked and reheated to kill micro-organisms. Studies recommend that the heating time should not be too short, and reheating should ideally be at a temperature of 74°C (USDA 2011).

Moreover, cooking food properly at the correct temperature has been shown to kill any harmful bacteria that may be present in the food. Many studies have revealed that food handlers are less familiar with time and temperature abuse and the effect thereof on food safety. For example, Anon (2003) reported that improper handling of food includes abuse of time and temperature, and that this accounts for most foodborne disease outbreaks. Additionally, a study (Akbanda, Hlortsi and Kwarteng 2017) showed that food handlers had insufficient knowledge of time and temperature controls. In this study, food handlers also had minimal knowledge of time and temperature control. There was, however, an improvement in the knowledge that cooked food should be kept very hot before serving. This is demonstrated by a score of 24% before training, and 84% after training. There was also a marked improvement in the knowledge that food should be thoroughly cooked at temperatures above 40ºC, and this is evidenced by a score of 12% pre-training and 71% post training. Pre- training, only about 19% of the food handlers knew that is it wrong to leave cooked meat at room temperature overnight to cool; however, this score changed to 79% post-training. The knowledge that refrigerating food only slows bacterial growth increased from 32% to 100% respectively before and after training. Also, pre-training, about 18% of the participants knew that one could not distinguish safe water from unsafe water just by merely looking at the water. This score improved to 77% post-training. Washing of fruit and vegetables scores remained consistent at 100% before and after training. It was indeed encouraging to note the consistent pattern of washing fruits and vegetables with water, as this is a preventative measure of foodborne illnesses, and for the elimination of harmful pesticide residue.

6.4.3 Food handlers' attitude towards food safety

The results of the attitude of the food handlers are depicted in Table 6.3.

Frequent hand washing during food preparation, and keeping kitchen surfaces clean to reduce the risk of illness was scored 100% for both sessions. Before training, 69% of food handlers agreed that keeping raw and cooked food separate helps to prevent illness, whilst this score post-training was 100%.

The majority (79%) agreed before training that using different knives and cutting boards for raw and cooked meat is worth the extra effort. After training there was 100% agreement on this. The overall score regarding meat thermometers being useful to ensure that food is cooked thoroughly increased from 70% before training to 100% after training. It is very important to cook food thoroughly in order to kill micro-organisms that may be present. It is for this reason that one of the basic food messages is ensuring that food reaches a proper internal temperature during cooking (WHO 2006). The agreement that soups and stews should always be boiled to ensure safety remained constant at 100% for both training sessions.

Table 6.3: Self-reported food-handling attitude of food handlers pre- and post-training

Attitude questions	Pre-training (%)	Post-training (%)
Frequent hand washing during food preparation is worth the extra time	100	100
Keeping kitchen surfaces clean reduces the risk of illness	100	100
Keeping raw and cooked food separate helps to prevent illness	69	100
Using different knives and cutting boards for raw and cooked foods is worth the extra effort	79	100
Meat thermometers are useful for ensuring food is cooked thoroughly	70	100
Soups and stews should always be boiled to ensure safety	100	100
Thawing food in a cool place is safer	42	100
I think it is unsafe to leave cooked food out of the refrigerator for more than two hours	64	100
Inspecting food for freshness and wholesomeness is valuable	100	100
I think it is important to throw away foods that have reached their expiry date	79	100

There was also a marked increase in the agreement that it is unsafe to leave cooked food out of the refrigerator for more than two hours. This is evidenced by a score of 64% before training, and 100% post-training. Before training, 42% of food handlers agreed that thawing food in a cool place is safer; however, after training there was 100% agreement. The agreement that it is important to throw away foods that have reached their expiry date increased from 79% before training to 100% after training. It has been mentioned that hospices operate with minimal budgets, and they also receive donated foods from retail stores. For these reasons, there is a tendency of reserving the food supply - even foods that have reached their expiry date. Overall there was 100% agreement for both sessions that inspecting food for freshness and wholesomeness is valuable.

6.4.4 Food handlers' self-reported behaviour

The results for self-reported behaviour are depicted in Table 6.4. In assessing the food safety behaviour of food handlers, 100% reported for both sessions that they always wash their hands before and during food preparation. The importance of washing hands with soap to reduce enteric disease has been well documented. For instance, Brown, Calmcross and Ensink (2013) state that transmission of faecal oral microbes in the domestic environment can be interrupted by washing hands with soap before feeding children and after cleaning them. Additionally, food contact with unwashed hands is one of the main sources of diarrhoea pathogens (Mattioli, Pickering, Gildsdorf, Davis and Boehm 2013). Pre-training, about 75% of the participants reported that they always clean surfaces and equipment used for food preparation before re-using them on other food. However, post-training the percentage increased to 100%. Also, the usage of separate utensils and cutting boards when preparing raw and cooked food increased from 81% pre-training to 100% post-training. Separation of raw and cooked food during storage only increased slightly from 86% to 87%. Also, the checking of meat for thorough cooking by ensuring that the juices are clear, or by using a thermometer, increased from 75% to 82%. The storing of leftovers in a cool place within two hours after cooking improved from 55% to 100%. Both the thawing of frozen food in the refrigerator or other cool place, checking, and throwing away of food beyond its expiry date increased from 27% to 100%. The washing of fruit and vegetables with safe water prior to consumption remained constant at 100% for both sessions.

Table 6.4: Self-reported food-handling behaviour of food handlers pre- and post-training

Self-reported behaviour questions	Pre-training (%)	Post-training (%)
I wash my hands before and during food preparation	100	100
I clean surfaces and equipment used for food preparation before re-using them on other food	75	100
I use separate utensils and cutting boards when preparing raw and cooked food	81	100
I separate raw and cooked food during storage	86	87
I check that meats are cooked thoroughly by ensuring that the juices are clear or by using a thermometer	75	82
I reheat cooked food until it is piping hot throughout	41	100
I thaw frozen food in the refrigerator or other cool place	27	86
After I have cooked a meal I store any leftovers in a cool place within two hours	55	100
I check and throw away food beyond its expiry date	27	86
I wash fruit and vegetables with safe water before eating them	100	100

6.5 CONCLUSION

The development and provision of food safety training courses are important to achieve behavioural changes, coupled with an improvement in skills and knowledge. To reduce the incidence of foodborne diseases, public health interventions must focus on general hygiene measures and appropriate food-handling procedures. In this study, the efficacy of food safety training was evaluated with the aim of utilising the information to implement corrective measures through an evidence-based training programme. Preventing the spread of infectious diseases is undoubtedly a serious global concern. It is now well known that most foodborne illnesses can be tracked to an infected food handler. Latana (2003) states that basic food safety interventions are also recognised as important in disrupting gastrointestinal pathogen transmission and subsequent growth in food. Hence, it remains important that greater food safety should incorporate the development of efficient tools and training programmes (WHO 2002). Indeed, it has been stated by the WHO that food safety education is an essential tool to prevent workers from contaminating food and reducing food contaminants.

Disease reduction is considered as the gold standard in the healthcare system for assessing the effectiveness of clinical and other health interventions. In developing countries, infections such as AIDS and SARS, coupled with the huge burden of hygiene and sanitation-related infectious diseases, continue to be the most critical public health threat. Regular food safety training is thus encouraged to prevent food contamination risks by adjusting the practices of food handlers and improving their skills. According to the WHO, South Africa is having the largest ever listeriosis outbreak in the year 2018. This is an infection caused by the bacterium *Listeria monocytogenes*. Transmission generally occurs by eating contaminated foods, in particular dairy products, meat and fresh produce. As of 16 January 2018, a total of 767 laboratory-confirmed listeriosis cases have been reported to the National Institute of Communicable Disease (NICD) since 01 January 2017. Most cases have been reported from Gauteng Province (60%, 462/767) followed by Western Cape (13%, 101/767) and KwaZulu Natal (7%, 55/767). It has now become a notifiable disease in SA, and the WHO is once again encouraging the public to practice the five keys to safer foods, which includes washing hands before and during food preparation.

This serves to highlight the importance of food safety campaigns. It has been argued, however, that, although positive responses towards food safety and knowledge of good hygiene practices have been indicated, these do not necessarily translate into positive behaviours (Redmond and Griffith 2003). In this study, however, there was a positive significant difference in the level of knowledge of food handlers after training. Over and above, it has been argued by Mitchell, Fraser and Bearon (2007) that food handler training usually conveys basic knowledge about the factors causing foodborne diseases, coupled with specific contents emphasising individual behaviour. Research has shown that establishments that provide food safety training to their employees have less risk of causing foodborne diseases. For example, Green, Radke, Mason, Bushnell, Reimann, Mack, Motsinger, Stigger and Selman (2007) observed that the employees in establishments with training programmes tend to wash their hands correctly. In this study, the washing of hands before and after food preparation has been a consistent practice, since all the food handlers (100%) reported that they do wash their hands before and after food preparation.

Of main concern though, was the common perception among food handlers that cooked meat could be left overnight to cool, as this creates an ideal environment for micro-organisms to grow and multiply. In addition, it has been recommended by the Federal/Provincial/Territorial Food-safety Committee (FPTFSC) (2016) that food items should not remain for more than two hours in the ‘danger zone’ temperature, which is considered to be a range between 4°C and 60°C, during which pathogenic micro-organisms grow best. There also seemed not to be a notable difference in the practice of separating raw and cooked food during storage. This is worrisome, since foodborne illnesses typically involve cross-contamination of raw and cooked foodstuff and storage at inappropriate temperatures.

The post-training, self-reported behaviour of food handlers also improved. However, it has been cautioned by Cairncross, Shordt, Zacharia and Govindan (2005) that, even though persistent changes in behaviour may be possible following interventions, more research is needed to monitor the longer-term effects of behaviour change campaigns. Furthermore, Guatam, Mills, Chitty and Curtis (2015) state that in reality, more emphasis regarding food hygiene practices should be focused on low-income settings, and these should also include critical actions that can reduce or eliminate foodborne pathogens, and effective

interventions that could mitigate risks. However, it was encouraging to note the knowledge improvement on the proper cooking temperature of meat, which is considered to be a high-risk food item - more especially since food handlers believe that visible indicators, such as color changes, can be used to determine if foods are cooked to a point where pathogens are killed. Finally, it can be concluded that, although there are different school of thoughts on the impact of food safety training, the general consensus is that food safety training improves knowledge, and food handlers should be trained according to their need and food risk categorisation in terms of food poisoning.

In the next chapter, the final conclusions and recommendations based on the outcome of this study, are discussed.

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Adobe Acrobat Document

Double click to open Annexure 4.

Central University of Technology, Free State

HOSPICE KITCHEN FOOD SAFETY AUDIT

FACULTY OF HEALTH AND ENVIRONMENTAL SCIENCES
DEPARTMENT OF HEALTH SCIENCES

CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE

HOSPICE KITCHEN FOOD SAFETY AUDIT

Food borne illnesses constitute a public health issue. The provision of safe nutritious food to vulnerable patients in the hospice remains one of the critical components towards improved quality of life. It is very important that food is prepared and served in accordance with recognized food safety procedures and legislation. Hence it is important that food handlers should be trained on safe food handling and proper hand washing facilities should be supplied. Physical facilities in the kitchen (e.g. proper illumination of food preparation areas and ventilation system) should be in good working order. Moreover, food should be cooked and kept at correct temperatures. Chemicals should be properly labelled and stored away from food and food supplies. The role of management and good communication with staff members regarding safe food aspects is very important.

SCORING STRUCTURE

5	4	3	2	1	-1	-2	-3	-4	-5
GOOD					BAD				

The scoring structure uses both numbers and colours, representing the food safety level that ranges between GOOD and BAD. The goal of the scoring structure, is to establish a value-rated number to each section that is audited. It will highlight areas that need improvement, and also areas that are in place and in good order.

CONTENT

Central University of Technology, Free State

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

HOSPICE KITCHEN HYGIENE AND SAFETY AUDIT

STANDARD HOSPICE REVIEW

GOOD	BAD

INFRASTRUCTURE

GOOD					BAD				
5	4	3	2	1	-1	-2	-3	-4	-5

The kitchen should be well ventilated with proper windows to allow for exchange of fresh air

Not enough ventilation for exchange of fresh air

Q1

Comments:

There should be proper drainage section to remove waste water

No drainage section in the kitchen. The workers even use buckets to discard or get rid of used water

Q2

Comments:

Natural or artificial lighting of sufficient intensity e.g. 500 lux for the kitchen and air quality is crisp fresh and pleasing aroma with no flies doing rounds

Light level or illuminance low, less than 500 lux. Constant presence of flies in the kitchen, which is a risk of foodborne infection

Q3

Comments:

Door/door frame is made up of corrosion resistant material and water impermeable

Door material not suitable and not water resistant, prone to rust

Q4

Comments:

Dedicated area to receive, inspect and store raw material until further handling and processing

No such area, materials that are received are just haphazardly stored all over and there is no inspection taking place

Q5

Comments:

Handwashing station allocated in the kitchen and there is a notice reminding employees to wash hands with soap

There is no dedicated area for handwashing and no reminder to wash hands

Q6

Comments:

Food is distributed to patients using trolley/isothermal trolley

No trolley available to distribute food to patients

Q7

Comments:

There is a patient waiting section/ward and no movement of patients from the ward to the kitchen

There is no dedicated area for patients to wait and there is frequent movement of patients in the kitchen

Q8

Comments:

GOOD					BAD				
5	4	3	2	1	-1	-2	-3	-4	-5

INFRASTRUCTURE (continued)

GOOD	BAD
There is a dedicated section to store harmful chemicals and detergents and they are properly labelled	Chemicals and detergents share the same cupboard with other food stuffs and there is no proper labelling

5	4	3	2	1	-1	-2	-3	-4	-5

Q9
Comments:

GOOD	BAD
Area just outside the door is covered with by lawn and not liable to produce dust, thus discouraging the spread of microorganisms	Area immediately outside the door is not covered by lawn and prone to dust formation therefore contributing to the distribution of microorganisms

5	4	3	2	1	-1	-2	-3	-4	-5

Q10
Comments:

GOOD	BAD
Toilet facilities are available and within practical distance from food preparation area. There are handwashing facilities and ample supply of toilet paper/hand cleaning detergent and refuse bins of hygienic construction	Toilet facilities are inconveniently located from the food preparation area and there is no provision for hand washing facilities

5	4	3	2	1	-1	-2	-3	-4	-5

Q11
Comments:

FOOD PREPARATION / STORAGE FACILITIES

GOOD	BAD
There are separate storage facilities for different food materials received, in-process materials and finished food product so as to prevent cross contamination Separate cutting boards are used to prepare meat and vegetables. Refrigeration in good working order and service documents available. Kitchen thermometer present to test food doneness	Storage facilities for different food material not separated. Cross contamination risk is high. One cutting board is used to prepare meat and vegetables. Refrigeration not in good working condition and no documented service schedule available. Food doneness is conducted through visual inspection

5	4	3	2	1	-1	-2	-3	-4	-5

Q12
Comments:

SANITATION

GOOD	BAD
The sink area is divided into two separate sections for hot and cold water to wash the dishes and there is a space allocated in between to put soap. Documented cleaning and disinfection programme available	There is only 1 sink available to wash the dishes and there is no provision of dedicated area to put soap There is no documented cleaning and disinfection programme available

5	4	3	2	1	-1	-2	-3	-4	-5

Q13
Comments:

GOOD	BAD
Separate suitable waste disposal facilities are available on the premise and at appropriate locations. No rat infestation	Only one container is used to dispose waste. Rats are regularly seen

5	4	3	2	1	-1	-2	-3	-4	-5

Q14
Comments:

GOOD	BAD

FOOD HANDLER TRAINING IN FOOD SAFETY

Hospice manager regularly send food handlers to a food safety training course and there is documentation There is periodic training assessment in place					Food handlers are not encouraged to attend food safety training and are mostly not trained				
5	4	3	2	1	-1	-2	-3	-4	-5

Q15 Comments:

Food handlers use aprons/glove and head nets when preparing food					Food handlers are not provided with aprons and some even wear jewelry during food preparation				
5	4	3	2	1	-1	-2	-3	-4	-5

Q16 Comments:

HOSPICE MANAGEMENT / SUPERVISION

There are regular meetings between management and food handlers irrespective of their employment contract.					Meetings are not held on regular basis and it is often with food handlers who have an employment contract.				
5	4	3	2	1	-1	-2	-3	-4	-5

Q17 Comments:

There are records of meetings held.					There are little or no records of meetings held.				
5	4	3	2	1	-1	-2	-3	-4	-5

Q18 Comments:

OVERALL SCORING

INFRASTRUCTURE

Q1	Q5	Q9
Q2	Q6	Q10
Q3	Q7	Q11
Q4	Q8	TOTAL

FOOD PREPARATION STORAGE FACILITY

Q12

TOTAL

SANITATION

Q13

Q14

TOTAL

FOOD HANDLER TRAINING FOOD SAFETY

Q15

Q16

TOTAL

HOSPICE MANAGEMENT SUPERVISION

Q17

Q18

TOTAL

GOOD	
CAN IMPROVE	
BAD	

GOOD

INFRASTRUCTURE

Proper Ventilation

Illuminance 520

Crisp, clean and fresh air with no flies in the vicinity

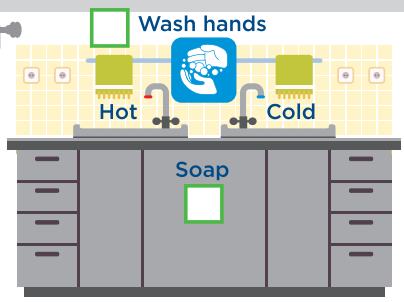
SANITAITON

FOOD PREPARATION / STORAGE FACILITIES

Food storage area

Vegetable storage

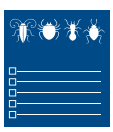
Dry ingredients



Food trolley

Towelling paper

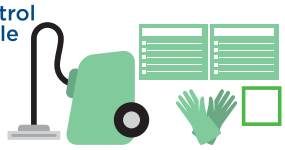
Refrigerator



Pest control schedule

Chemical and disinfectant storage

Labelled properly



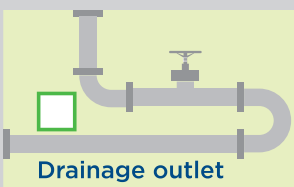
Disinfection programme
Cleaning schedule

Kitchen Thermometer

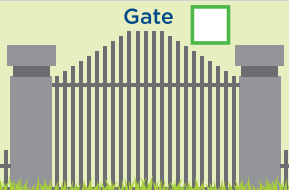
Well maintained Floor

Patient Bedroom Section

Door



Drainage outlet



Gate

Waste disposal

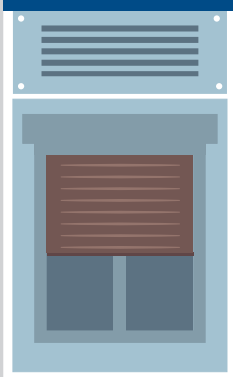
Lawn/Grass

HOSPICE KITCHEN FOOD SAFETY AUDIT

VISUAL HOSPICE REVIEW

BAD

INFRASTRUCTURE



No proper Ventilation

Illuminance less than 520

Little fresh air, with flies in the air

SANITAITON

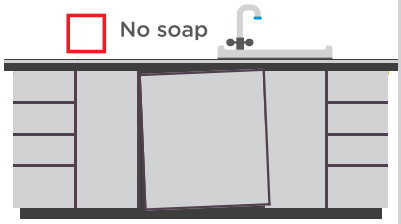
No toilet paper

No handwash facility

FOOD PREPARATION / STORAGE FACILITIES

Combined storage of foodstuff

Chemical and disinfectants (not labelled properly)



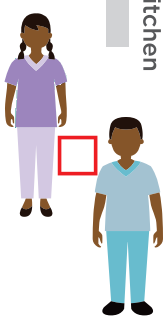
No soap

No food trolley

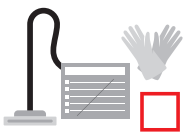
No towelling paper

Little or no refrigeration

No kitchen thermometer

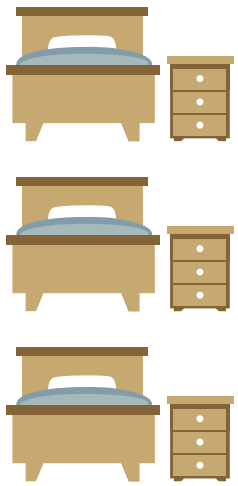


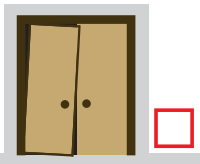
No pest control schedule



No disinfection programme or cleaning schedule

Patient movement in the kitchen





Door

Cracks on the floor

No proper drainage outlet

No gate

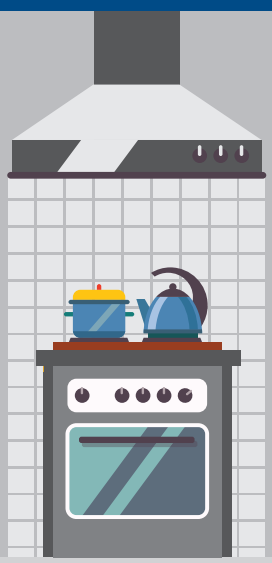
soil and dust

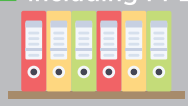
Waste bin

Rats and mice

GOOD

FOOD HANDLER TRAINING IN FOOD SAFETY





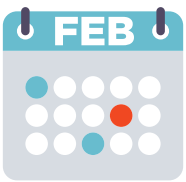
☐ Food handler training in food safety including PPE

Head net ☐

Gloves ☐

Apron ☐

HOSPICE MANAGEMENT / SUPERVISION



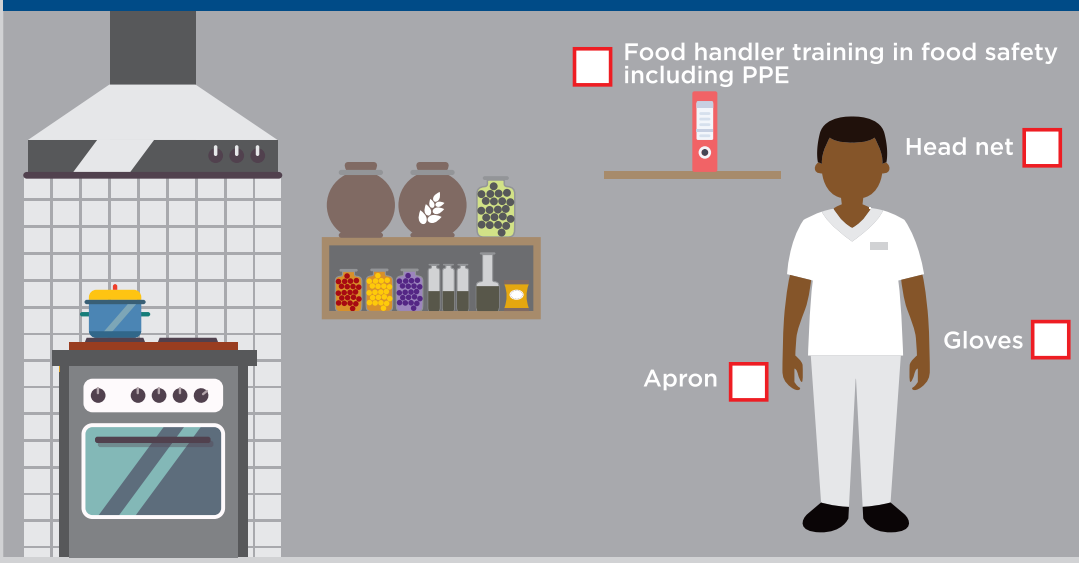
☐ Records of meetings held

☐ Meeting Schedule

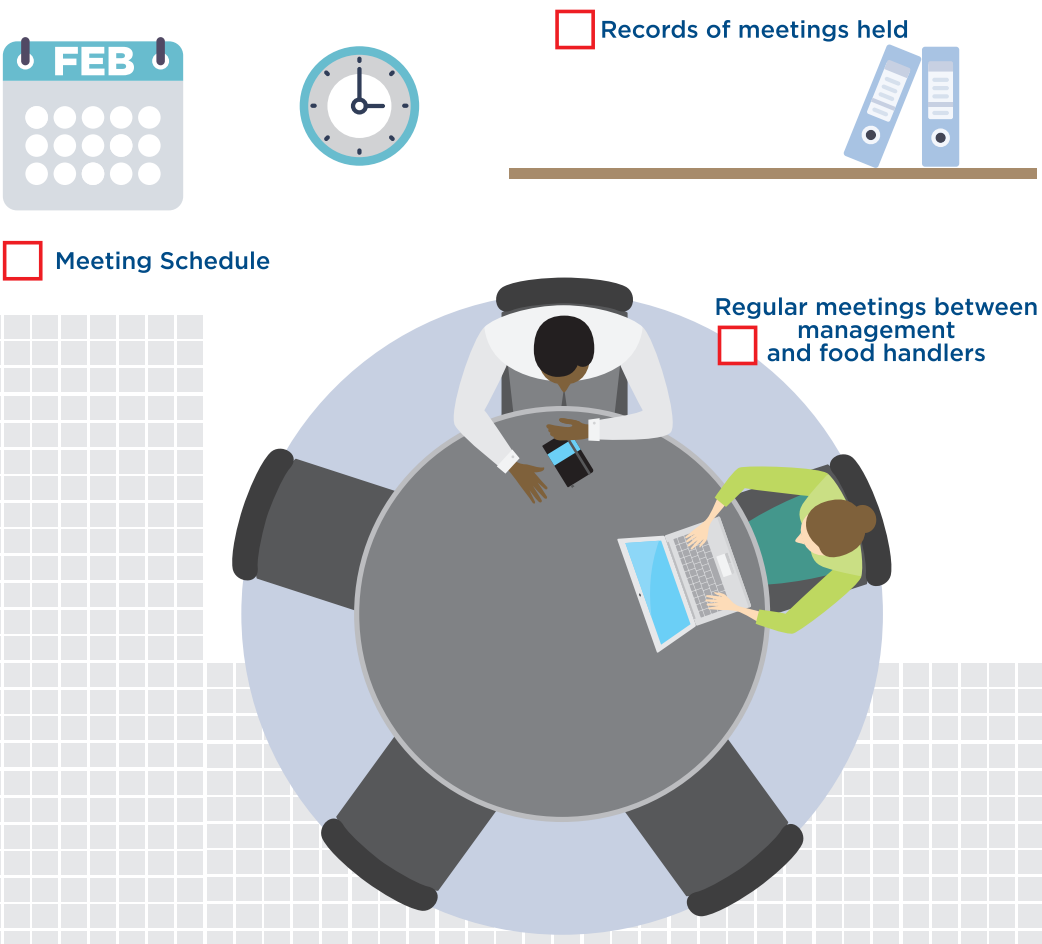
Regular meetings between management and food handlers ☐

BAD

FOOD HANDLER TRAINING IN FOOD SAFETY



HOSPICE MANAGEMENT / SUPERVISION



Central University of Technology, Free State

Effective Palliative Care

TB is the major cause of death in people infected with HIV in the developing world, this in the face of poverty and malnourishment. South Africa is faced with the highest TB incidence and prevalence, this being the second highest number of diagnosed MDR-TB cases and the largest number of HIV associated TB cases (Churchyard et al., 2014). According to (WHO, 2014), In 2013 there were 9 million new tuberculosis (TB) cases, and 1.5 million deaths. To make matters worse, 20.5% of previously treated TB cases had multidrug-resistant tuberculosis (MDR-TB). It is in this context that the philosophy of palliative care plays an important role to alleviate the suffering of patients. The goal of palliative care is to improve the quality of life for people with life threatening illness and their family members. Initially there was resistance from the government to roll out antiretroviral treatment, however things have now changed and ARVs are now officially available. Sadly, poverty and lack of infrastructure mean treatment remains beyond the reach of the majority who need it.

Therefore based on the above, the following 12 pillars to effective palliative care in the hospices are proposed.

Pillars to Effective Palliative care

Mentorship programme: training of caregivers on hygiene/infection control, food hygiene and nutritional programme

Proper infrastructure: to enhance safe food handling

Quality of life: pain and symptom management

Communication skills: effective communication between managers and hospice care workers regardless of their contract status

Community developer: trains volunteer caregivers/approaches gov for resources

Community care: based on partnerships with government (health, welfare and development)

Collaborative care: gov hosp and clinics

Risk management: infection control and opportunistic infection control

Social development and poverty alleviation: income generation projects

Person oriented vs disease oriented: provide holistic care to the patient

Day care programmes: as an adjunct to home care and in-patient care

Stress management: due to burnout

HOSPICE KITCHEN FOOD SAFETY AUDIT

FACULTY OF HEALTH AND ENVIRONMENTAL SCIENCES
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CHAPTER 7

GENERAL CONCLUSIONS AND FUTURE RECOMMENDATIONS

7.1 INTRODUCTION

As mentioned in the preceding chapters, HIV/AIDS has had a devastating impact among the SA population. HIV/AIDS remains a disease with severe social consequences, and it primarily affects those who are already socially disadvantaged and marginalised. During the year 2009, an estimated 5.7million South Africans were living with HIV/AIDS. One of the most significant damages caused by this disease is the number of children orphaned as a result. This has placed an immense economic burden on the health care system, resulting in the shortage of hospital beds to accommodate HIV/AIDS patients.

In response to the scourge of the disease, hospices were established by various non-governmental organisations, with minimal support from government. Unlike hospitals, hospice infrastructure is not well designed, especially with regard to patient wards and kitchens used for meal preparation. Furthermore, the majority of hospice food handlers are not trained on safe food-handling aspects. Moreover, regarding the supply of food, hospitals are usually contracted to a reputable supplier with a good track record; however, the business of food supply in hospices is totally different. It was mentioned in Chapter 2 that hospices rely mostly on donor funding, including donation of foods from the local retailers that are nearing the expiry date. In terms of HACCP, this represents a critical control point that warrants attention from all the stakeholders involved in food supply and meal preparation in hospices.

Thus, the overarching aim of the study, as previously mentioned, was to analyse the hygienic quality of the food contact surfaces, including food handlers' hands, and to compose interventions to discourage microbial proliferation in the hospice environment, towards improved food safety awareness and practices. Part of the study's aim was to assess the susceptibility profile of microbiota isolated from the hospices. All of these aims were accomplished, and discussed in chapters one to six of this research. This final chapter is devoted to the general conclusions and recommendations made, based on the outcome of the study.

7.2 GENERAL CONCLUSIONS

It is imperative that food safety and hygiene procedures are strictly adhered to in a healthcare setting in order to reduce the incidence of food poisoning. The failure of food handlers in hospices to adhere to safe practices during preparation can have severe consequences on the health of patients. It has been reported by the WHO (2015) that there are approximately two million fatal cases of food poisoning occurring every year globally, especially in developing countries. Moreover, the role of hand hygiene cannot be over-emphasised as a critical component of personal hygiene, since this has been identified as a significant risk factor of food contamination that leads to food contamination. The kitchen is the focal point of food contamination and during food preparation, handling and storage, food can be mishandled at many places.

The development and provision of food safety training courses are therefore important to achieve behavioural changes, coupled with an improvement in skills and knowledge. However, it has been argued (Sheppard, Kipps and Thomson 1990) that undesirable hygiene practices are often deeply rooted in kitchen culture, and they are not easily overturned, even by the most imaginative training programme. Therefore, food hygiene and food safety are of paramount importance in a hospice setting in order to minimise the hazard of foodborne illnesses. Hence, it remains critical that correct handling of food during all stages of its preparation and storage is applied, in order to reduce the incidence of foodborne diseases. Food handlers in the hospices should always be encouraged to adhere to good personal hygiene, since this is considered to be a key measure in the prevention of food contamination and the spread of enteric diseases. In this study, food handlers had a moderate knowledge (68%) of food safety aspects.

The knowledge area of concern was a generalised lack of sufficient knowledge of the correct responses for refrigeration temperature, including the correct temperature for hot and cold ready-to-eat foods. Similar studies also revealed this to be a general problem across the board. Therefore, it is encouraged that future safety training courses should elaborate on this important aspect of food safety and the correct storage temperature.

It has also been suggested by Clayton, Griffith, Price, and Peters (2002) that a comprehensive understanding of all the factors underlying food hygiene behaviour in the workplace should be attained, in order to design effective training for food handlers. In turn, the evaluation of food hygiene training initiatives should then be conducted to attribute value to an intervention. In this study, the efficacy of food safety training was evaluated, with the aim of utilising the information to implement corrective measures through an evidence-based training programme. Indeed, by adjusting the practices of food handlers and improving their skills and knowledge, it is possible to prevent food contamination risks through regular provision of food safety training.

Moreover, it has been suggested by MacAuslan (2001) and Worsfold, Griffith and Worsfold (2004) that food hygiene courses should be shorter and more focused on the needs of the participant. In this study, food training session was designed such that the duration did not exceed four hours per hospice. The knowledge acquisition (the extent to which trainees know more after training than before) was evident in this study. What then remains to be seen is the sustained behaviour and practice of safe food handling. Over and above the food safety hurdle that the hospices are facing, there is also an antimicrobial resistance problem facing the hospices. Antimicrobial-resistant bacteria are biological hazards resulting in increased human morbidity and mortality. Thus, they are of public health concern. Transfer of antimicrobial resistance can involve different kinds of micro-organisms. Human bacterial pathogens can be acquired directly by person-to- person spread and from the environment, or as foodborne pathogens directly from food. It has been stated (Thanner, Drissner and Walsh 2016), that the two most important factors influencing the emergence and spread of AMR are the use of antimicrobial agents in different hosts, and the spread of resistant bacteria and resistance genes between hosts of the same, or of different species. Antibiotics are frequently administered to hospice patients due to the accompanying common bacterial infections and opportunistic pathogens.

This is of concern, since it presents a risk factor for infection with antimicrobial resistant pathogens. Moreover, cross-contamination with antimicrobial-resistant bacteria resulting from improper handling of food is a well-known phenomenon that has been researched in detail (Kusumaningrum, Van Asselt, Beumer and Zwietering 2004; Mylius, Nauta and Havelaar 2007). In this study, the bacterial strains were resistant to the majority of antibiotics, with most isolates showing multiple resistance (resistance to >or=2 antibiotics). A typical example is *Bacillus cereus* strains, which displayed resistance to the following antibiotics: oxacillin, cefoxitin and nalidixic acid. These strains were isolated from food preparation surfaces and food handlers' hands; therefore, this could be a possible indication of cross-contamination. Again, this is a cause for concern, given the fact that these strains are multi-drug resistant, and *Bacillus cereus* toxins are responsible for diarrhoea, which can be fatal in immune-compromised patients. Furthermore, in this study, *Staphylococcus aureus* was found to be resistant to more than four antimicrobial drugs, including tetracycline and oxacillin, thus an indication of methicillin-resistance, which is defined as an oxacillin minimum inhibitory concentration (MIC) ≥4 mg/ml. Not much is known about foodborne methicillin-resistant *Staphylococcus aureus,* except the speculation that it could have originated from food handlers. MRSA frequently contains the genes associated with enterotoxins (Yarood, McCormick, Paustian, Orwin, Kapur and Schlievert 2002; Fey, Saïd-Salim, Rupp, Hinrichs, Boxrud, Davis, Kreiswirth and Schlievert 2003), which are the proteins that cause staphylococcal food poisoning.

Therefore, increased prevalence of MRSA amongst *S. aureus* strains could lead to a higher prevalence of toxinogenic *S. aureus*. In comparison with the hospitals, the hospices face more challenges with respect to infection prevention strategies. The isolation of colonised or infected residents with MDR organisms is often unrealistic in this type of setting. Moreover, interactions via group activities are common among the hospice patients, more especially among the children who also share many of the functional rooms, such as the dining room, facilities, bathrooms and play area. Many of the potential contamination problems in the kitchen can be minimised by thorough cleaning of the kitchen, sanitation, and by altering food consumption patterns. Hospices are therefore encouraged to implement effective strategic prevention and control measures. This can be achieved through better understanding of the ecology, epidemiology and extent of such resistance among foodborne pathogens.

In light of the above-mentioned, it is also important to note that the hospice environment is much more vulnerable to food safety mishaps and the occurrence of foodborne illnesses, as most of the food handlers are typically untrained and not aware of the potential hazards. The confined kitchen space in which the food handlers are preparing food also creates a conducive environment for the growth and survival of micro-organisms. Among the top causes of foodborne illness identified by the WHO, five directly relate to food handler behaviour. The pressure to prepare meals in a short period of time, often above the designed capacity of the establishments, may negatively influence the attitude toward safe practices, creating an evident gap between knowledge and practices (Clayton, Griffith, Price, and Peters 2002). It was in this context that a part of the study was to conduct a focus group discussion to explore the food handlers' perception of safe food handling, and to explore their food safety management system.

Food handlers expressed the need to have a voice in the operational aspects of food safety and preparation in the kitchen. There was a general feeling of discontentment from the food handlers regarding failure of management to give them due recognition and incentive as a motivation for safe food handling. Moreover, it was expressed that factors such as time pressure, unavailability of resources and substandard infrastructure negatively affect compliance to hygiene practices. Food handlers' perception of training was positive, and the majority indicated that they would enrol for such training on a continuous basis. The majority of the participants also declared that they do not prefer wearing gloves while preparing food, due to a generalised conception that gloves cause skin damage. Of course, this is of great concern, since research has shown that gloves can prevent hands from becoming contaminated with micro-organisms - both from patients and the inanimate environment.

7.3 RECOMMENDATIONS

7.3.1 Recommendations for hospices, the health sector and policy makers

Flowing from the outcome of this research, the following recommendations are made for hospices, the health sector and policy makers:

- Contaminated water, poor sanitation, and poor personal hygiene are the main causes of enteric diseases. Since the link between HIV and water/food and sanitation is unavoidable, hospices are encouraged to implement safe water systems so as to reduce infection control. This is also in line with the need for advocating and promoting improved hand washing practices.
- Furthermore, given the fact that hospices are high-risk environments, there should be adequate food storage infrastructure in place, as well as adequate regulatory standards.
- The urgent need to develop HACCP policy and food safety guidelines for hospices, since it was revealed during the study that the majority of the hospices do not have an HACCP policy in place.
- Antimicrobial stewardship programme should be implemented in all the hospices to help minimize the spread of MDR.
- More collaboration with government sectors towards the integrated implementation of services for tuberculosis and HIV would result in much broader health outcomes for people living with HIV/AIDS.
- Ideally, the hospices that are struggling should have mentor hospices, which will tutor and guide them as exemplar hospices, and also in making the best use of their limited resources to guide priority setting.
- Collaboration with academics is encouraged, as they are well suited to address methodological challenges in relation to needs assessments and programme evaluations.
- Hospice managers are encouraged to have regular all team meetings in order to provide a valuable forum to explore how disagreements can be resolved. Equal treatment, appreciation and respect should be demonstrated towards all food handlers, through regular engagement and performance appraisal, regardless of whether they are contracted, or service as volunteers.

- Finally, measures should be put in place to offer continuous refresher training for food handlers and their supervisors and hospice manager are encouraged to use ISO 22000:2005, which is a food safety standard that specifies requirements to enable an organization to plan, implement, operate, maintain and update a food safety management system aimed at providing products that, according to their intended use, are safe for the consumer

7.3.2 Recommendations for industry

The outcome of this research also led to the following recommendations for industry:

- A major obstacle to adequately addressing food safety concerns is the lack of accurate data on the full extent and cost of foodborne diseases, which would enable policymakers to set public health priorities and allocate resources - more especially since in SA, the existing legislation promoting food safety is not enforced. Therefore, government and policy-makers need to be transformative in trusting and investing more in palliative care and community systems to improve the quality of life.
- In SA, there is a paucity of updated information on the diversity of potential bacterial pathogens that could cause diarrhoea among HIV-infected people. Hence, there should be proper surveillance of foodborne outbreaks and strategies to ensure that food safety decision-making is based on solid epidemiological evidence. This will also help to address the frequently observed research policy and practice gap. Lastly, palliative care must be included in all UHC (universal health coverage) schemes.

7.4 LIMITATIONS OF THE STUDY

Due to financial constraints and feasibility reasons, not all hospices in South Africa were included in the study. Hence, the conclusions should not be generalised as a reflection of all South African hospices, although they may apply universally.

7.5 FINAL SYNTHESIS AND CONCLUSION

As indicated throughout this thesis, foodborne illness is a significant and growing global problem, with over 200 different diseases currently known to be transmitted by food. In 2005, it was reported that 1.8 million people died from diarrheal diseases largely attributable to contaminated food and drinking water. Worldwide, an estimated one billion episodes of diarrhea are caused by foodborne pathogens annually. The findings of this study will contribute to the reduction of diarrheal foodborne outbreaks in the hospices through improved sanitation and hygiene practices - more especially during the current prevailing climate of listeriosis in SA. The incidence of systemic listeriosis is much higher in susceptible populations, including pregnant women, the elderly and individuals with compromised immune systems.

Additionally, this study has the potential to contribute to food handler skills through improved knowledge, attitude and behaviours on a sustainable basis. Interventions to limit the emergence and spread of resistant bacteria in the healthcare setting may include reducing the dissemination of multidrug-resistant bacteria through the food chain by improving food handling practices and developing alternative treatment strategies. Therefore, through the implementation of this antimicrobial stewardship programme, it is envisaged that hospices will use antibiotics more prudently.

Finally, the study made a significant contribution to the auditing of South African hospices through the development of the hazard characterisation tool, to be used for auditing purposes. Thus, beyond the study, this tool will assist the hospices during their accreditation processes.

7.6 REFERENCES

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APPENDICES

Adobe Acrobat Document

Double click to open Annexure 1 A.

Adobe Acrobat Document

Double click to open Annexure 1 B.

Five keys to safer food

Keep clean

- ✔ Wash your hands before handling food and often during food preparation
- ✔ Wash your hands after going to the toilet
- ✔ Wash and sanitize all surfaces and equipment used for food preparation
- ✔ Protect kitchen areas and food from insects, pests and other animals

Why?

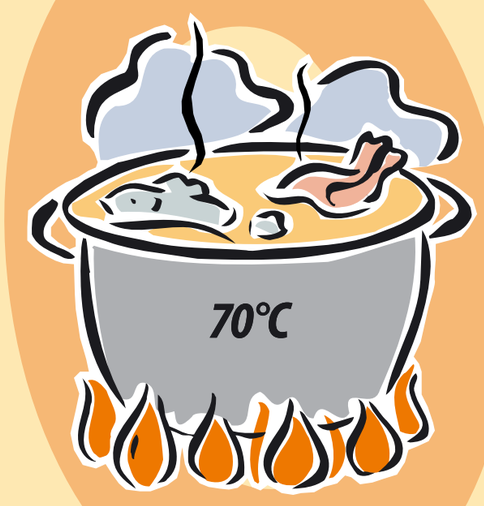
While most microorganisms do not cause disease, dangerous microorganisms are widely found in soil, water, animals and people. These microorganisms are carried on hands, wiping cloths and utensils, especially cutting boards and the slightest contact can transfer them to food and cause foodborne diseases.

Separate raw and cooked

- ✔ Separate raw meat, poultry and seafood from other foods
- ✔ Use separate equipment and utensils such as knives and cutting boards for handling raw foods
- ✔ Store food in containers to avoid contact between raw and prepared foods

Why?

Raw food, especially meat, poultry and seafood, and their juices, can contain dangerous microorganisms which may be transferred onto other foods during food preparation and storage.

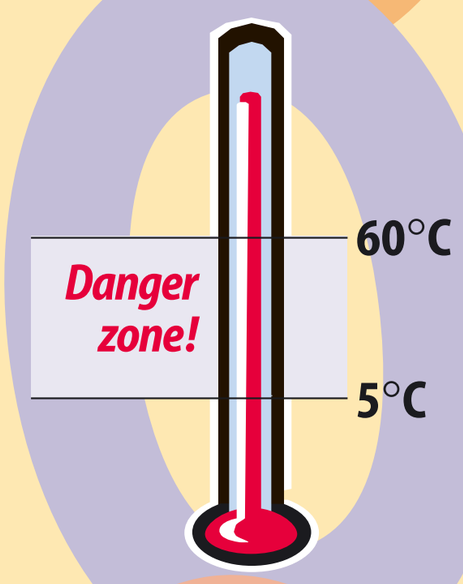


Cook thoroughly

- ✔ Cook food thoroughly, especially meat, poultry, eggs and seafood
- ✔ Bring foods like soups and stews to boiling to make sure that they have reached 70°C. For meat and poultry, make sure that juices are clear, not pink. Ideally, use a thermometer
- ✔ Reheat cooked food thoroughly

Why?

Proper cooking kills almost all dangerous microorganisms. Studies have shown that cooking food to a temperature of 70°C can help ensure it is safe for consumption. Foods that require special attention include minced meats, rolled roasts, large joints of meat and whole poultry.



Keep food at safe temperatures

- ✔ Do not leave cooked food at room temperature for more than 2 hours
- ✔ Refrigerate promptly all cooked and perishable food (preferably below 5°C)
- ✔ Keep cooked food piping hot (more than 60°C) prior to serving
- ✔ Do not store food too long even in the refrigerator
- ✔ Do not thaw frozen food at room temperature

Why?

Microorganisms can multiply very quickly if food is stored at room temperature. By holding at temperatures below 5°C or above 60°C, the growth of microorganisms is slowed down or stopped. Some dangerous microorganisms still grow below 5°C.

Use safe water and raw materials

- ✔ Use safe water or treat it to make it safe
- ✔ Select fresh and wholesome foods
- ✔ Choose foods processed for safety, such as pasteurized milk
- ✔ Wash fruits and vegetables, especially if eaten raw
- ✔ Do not use food beyond its expiry date

Why?

Raw materials, including water and ice, may be contaminated with dangerous microorganisms and chemicals. Toxic chemicals may be formed in damaged and mouldy foods. Care in selection of raw materials and simple measures such as washing and peeling may reduce the risk.

Design: Marilyn Langfeld. Illustration: Janet Petitpierre

Food Safety
World Health Organization

Knowledge = Prevention

WHO/SDE/PHE/FOS/01.1
Distribution: General
Original: English

Food handler training

Jane Nkhebenyane

Central University of Technology,
Free State

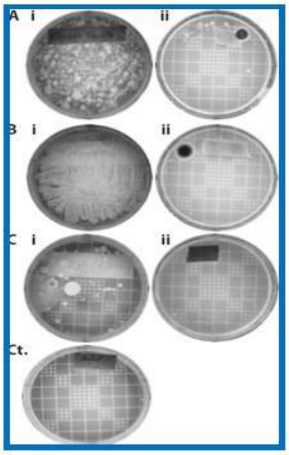
FOOD SAFETY

Personal Hygiene

TRAINING

Manual

Hazards



Microorganisms

Food Handlers hands

STORAGE CONDITIONS

Pesticides

Food Safety Training Manual

Table of contents

EDUCATIONAL OBJECTIVES

Participant evaluation

On completion of this training course the participant must be able to:

- **List key health and safety concepts and briefly describe the relations between them.**
- **Establish the factors responsible for the risk of food poisoning.**
- **Know how to prevent contamination and spread of foodborne diseases.**

Key Concepts

Definitions

Cleaning: The removal of soil, food residue, dirt, grease or other objectionable matter.

Disinfection: The reduction, by means of chemical agents and/or physical methods, of the number of micro-organisms in the environment, to a level that does not compromise food safety or suitability.

Bacteria/germs: A germ is a microbe that causes a disease.

Infection: The entry and multiplication of an infectious agent in the tissues of the host.

Hygiene: The things that you do to keep yourself and your surroundings clean in order to maintain good health.

Hazard: Biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse effect to human, animal or vegetable health.

Food hygiene: Food hygiene is the conditions and measures necessary to ensure the safety of food from production to consumption.

Food safety: Assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.

Pathogen: Dangerous microorganisms that make people sick and can even kill.

Contamination: Occurrence or introduction in a food product of biological, chemical or physical substances, in a quantity sufficient to endanger health or to render this food product unfit for human consumption.

Cross contamination: Occurs when pathogenic bacteria are passed from one food or object to another. Pathogens can be transferred from one surface or food to another.

Chemical disinfectants: Products that kill germs (bacteria, fungi and virus).

HACCP: A system which identifies, evaluates, and controls hazards which are significant for food safety.

Background information

What is the problem?

Every day people all over the world get sick from the food they eat. This sickness is called foodborne disease and is caused by dangerous microorganisms and/or toxic chemicals. Most foodborne disease is preventable with proper food handling. The vast majority of food-borne illnesses occur because food was not handled or cooked properly.

Foods are safely cooked when they are heated for long enough and at a high enough temperature to kill any harmful micro-organisms. If food isn't cooked properly micro-organisms such as Salmonella, *E. coli* and Listeria may cause food poisoning. Coupled with this, foods stored incorrectly can also increase the risk of contamination and disease spread. Ideally, all food, particularly cooked food, should be stored in a refrigerator.

Module 1: Food Safety

What are microorganisms/germs?

Microorganisms are very small living things, so small that they cannot be seen with the naked eye. There are three different types of microorganisms: the good, the bad and the dangerous.

1. Good microorganisms are useful. They are used to:
- Make food and drinks (e.g. cheese, yoghurt, beer and wine);
- Make medicine (e.g. penicillin); and help digest food in the gut.

2. Bad microorganisms, or spoilage microorganisms, do not usually make people sick, but they cause our food to smell bad, taste horrible and look disgusting. Examples are:
    - Lactic acid formation: Lactobacillus, Leuconostoc (Bacteria).
    - Gas formation: Leuconostoc, Lactobacillus, Proteus (Bacteria).
    - Slime or rope formation: Enterobacter, Streptococcus (Bacteria).
    - Aspergillus produces aflatoxin, ochrtoxin, citrinin and patulin (Moulds).

3. Dangerous microorganisms make people sick and can even kill. These are called "pathogens". Most of these microorganisms do not change the appearance of the food.

Bacteria, viruses, yeasts, moulds and parasites are all microorganisms. Examples of common dangerous foodborne microorganisms include:
Bacteria - *Salmonella, Shigella, Campylobacter* and *E. coli*.

Common pathogens found in the hospice Bacillus, Enterobacteriaceae, *Staphylococcus aureus, E.coli*.

Where do microorganisms live?

Microorganisms are everywhere, but are mostly found in:

- Faeces;
- Soil and water;
- Rats, mice, insects and pests;

- Domestic, marine and farm animals (e.g. dogs, fish, cows, chickens and pigs); and
- People (bowel, mouth, nose, intestines, hands, fingernails and skin).

Human and animal faeces contain disease-causing microorganisms.

A single teaspoon of soil contains more than 1 billion microorganisms. All living things have microorganisms associated with them.

How do microorganisms move?

- Microorganisms rely on someone or something to move them around. The transfer of microorganisms from one surface to another is called “cross contamination”.
- Hands are one of the most common means of moving microorganisms from one place to another.
- Microorganisms can be spread through contaminated food and water.
- Pets and domestic animals can also be a source of contamination.

How are foodborne illnesses spread?

The micro-organisms that cause food-borne illness can be spread from raw meat and vegetables during food preparation, directly on to chopping boards, utensils, worktops, and other foods. These micro-organisms can then spread to other surfaces around the home through your hands. Once one person is infected with food-borne micro-organisms, it’s highly likely that they will pass this on to others in your home and community, particularly if hygiene practice is poor.

If a food handler is infected with a virus and continues to prepare food, some viruses may be passed on to the consumer via the food. Hepatitis A and Norovirus are examples of viruses which can be transmitted in this way.

How do microorganisms grow?

Most microorganisms “grow” by multiplication. To multiply, microorganisms need:

- Food;

- Water;
- Time; and
- Warmth.

Meat, seafood, cooked rice, cooked pasta, milk, cheese and eggs are foods that provide ideal conditions for microorganisms to grow.

One bacterium can become 2 in just 15 minutes. This means that within 6 hours, 1 bacterium can multiply to over 16 million. To be harmful, some bacteria need to grow to high levels. Other bacteria can cause illness when they are present in very low numbers. Viruses are many times smaller than bacteria. They do not grow in food or water, but these are vehicles for transmission.

What are the symptoms of foodborne disease?

Every year, billions of people experience one or more episodes of foodborne disease, without ever knowing that their illness was caused by food.

The most common symptoms of foodborne disease are:

- Stomach pains;
- Vomiting; and
- Diarrhoea.

The symptoms depend on the cause of the disease. Symptoms may occur very quickly after eating the food, or may take days or even weeks to appear. For most foodborne diseases, symptoms occur 24 -72 hours after the food has been eaten.

For infants, the sick, pregnant women and the elderly, the consequences of foodborne disease are usually more severe and more often fatal. Drinking plenty of fluids will maintain hydration during diarrhoea. Mouth masks are recommended for people who may cough or sneeze while handling food. Gloves can be used to cover any cuts or lesions and should be changed frequently.

Module 2: Personal hygiene

The importance of hand washing.

Good personal hygiene practices are an essential part of providing safe food to our customers. Among these hygiene practices, the most important is hand washing.

Employees must wash their hands and forearms using the following steps:

STEP 1: Moisten hands with hot water and apply hand soap;

STEP 2: Vigorously rub hands together scrubbing between your fingers, under your fingernails, your forearms, and the back of your hands. You must continue scrubbing for at least 20 seconds. It is the hand soap combined with the scrubbing action that removes the dirt and germs from your hands; and

STEP 3: Completely rinse your hands under running water and dry them with a disposable paper towel.

You must be aware of what your hands are touching at all times. You should recognize when your hands become contaminated and wash them to keep from passing the contamination on to the food you are preparing and serving.

It is always necessary to wash your hands when you first arrive at work;

- Before eating
- After changing diapers, coughing and sneezing or blowing your nose
- Prior to handling food, utensils, and single service articles;
- Before putting on gloves to handle ready-to-eat foods and between glove changes.
- Before and after handling or touching any raw foods such as raw meats, chicken, and eggs.
- After using the bathroom;
- After touching any part of your body or uniform;
- After handling dirty equipment, dishes or utensils;
- After taking a break or taking out garbage
- After any other activity that may contaminate your hands such as washing dishes, sweeping the floor, taking out the trash, eating or drinking, coughing, or sneezing.

Common foodborne diseases spread by poor hygiene:

- **Hepatitis A.**
- **E. coli O157:H7.**
- ***Salmonella typhi*.**
- **Shigella.**
- ***Staphylococcus aureus*.**
- **Norwalk virus.**

Module 3: Temperature

Temperature matters/Best practice for food hygiene

- Store and prepare raw meat, poultry, and seafood away from other foods.
- Store food in the fridge at 5°C, do not overfill and not allow cold air to circulate.
- Where refrigeration is not possible use food preservatives such as salt or freshly prepare food each day.
- Prevent food juices from dripping onto other foods.
- Wash hands after each stage of food preparation and particularly after touching raw meat and poultry.
- Cut meat and vegetables with separate knives and cutting boards.
- Don't forget to clean all contaminated items including utensils, cutting boards, and kitchen worktops after using.
- Soak, scrape, brush, scald, or wash all fruit, salad and vegetables.
- Always cook all meat products thoroughly at 70°C.
- Don't leave cooked food sitting at room temperature for longer than two hours.
- Remember to reheat (at 70°C or above) and re-serve leftovers only once.
- Wash hands before and after eating.

Module 4: Hazards

What about chemicals?

Microorganisms are not the only cause of foodborne illness. People also get sick from poisonous chemicals, which include:

- **Natural toxins;**
- **Metals and environmental pollutants;**
- **Chemicals used for treating animals;**
- **Improperly used pesticides;**
- **Chemicals used for cleaning; and**
- **Improperly used food additives.**

Simple measures such as washing and peeling may reduce the risk from chemicals that are found on the surface of foods. Appropriate storage can avoid or reduce the formation of some natural toxins.

Module 5: Five Keys to safer food

You can make a difference.

Stop microorganisms from making you and other people sick by following the 5 Keys to Safer Foods, which are:

- **KEY 1: Keep clean.**
- **KEY 2: Separate raw and cooked.**
- **KEY 3: Cook thoroughly.**
- **KEY 4: Keep food at safe temperatures.**
- **KEY 5: Use safe water and raw materials.**

Additional information:

Foodborne Disease

Foodborne Disease is a problem in both developing and developed countries; it is a strain on health care systems; it severely affects infants, young children, elderly and the sick; and it creates a vicious cycle of diarrhoea and malnutrition.

Key Messages

The food health and safety situation

Food poisoning is a major public health problem. The cost in human suffering is far too high, in particular for the most vulnerable population groups (infants, children, the elderly, etc.).

Cases of food poisoning are constantly rising, and new hazards are discovered each year. This increase in the number of cases is the result of various interacting factors, including insufficient food hygiene and presence of contaminants, which can be toxic for the consumer.

These risks can be reduced when simple and efficient hygiene rules are applied and all operators implement food safety management systems based on an analysis of hazards.

A very big THANK YOU for participation and completion of this course!!!