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Review

Background information on the current status of South African HIV/AIDS hospices in the context of hygiene and quality of life: A review

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Human immunodeficiency virus (HIV) and the resulting acquired immunodeficiency syndrome (AIDS) continues to be a major epidemic that is ravaging the South African population at large. Hospices are non-governmental organisations that provide care to terminally ill patients, including those suffering from HIV/AIDS and cancer. This paper aims to describe the role of South African hospices in the context of the provision of palliative care, safe cooked meal and quality of life to the immune compromised patients. The role of facility design and the influence thereof on bio-aerosol level and proper hygienic practices are also elucidated. A domestic environment like a kitchen setting is known to be a source of microbial cross contamination. This article is a review on hospice kitchen layout, food borne pathogens, cross contamination and bio-aerosol prevalence.

Key words: Hospices, kitchen hygiene, HIV, food safety.

INTRODUCTION

South Africa is one of the countries most severely affected by HIV/AIDS. Approximately 1.2 million children younger than 17 years have lost one or both parents due to the epidemic (UNAIDS, 2006). This high prevalence of the HIV in South Africa has led to the establishment of hospices to assist in the care of terminally ill cancer and HIV/AIDS patients. A hospice is a non-governmental organisation that provides care to the terminally ill patients, either in their homes, in hospitals or in a hospice's own in-patients wards. In South Africa, unlike most other African countries, palliative care services can be found in hospital settings countrywide (Clark et al., 2007). A major advantage is the availability and affordability of a full multi-disciplinary team, which can provide services and support to other departments (IAHPC, 2003). Part of the hospice's mission is to offer palliative care without charge to anyone who requires it. The basic elements of hospice care include pain and symptom management, provision of support to the bereaving family and promoting a peaceful and dignified death (Johnson and Slaninka, 1999). At the core of a hospice's work is the concept of "palliative care" which is defined by the WHO (2000) 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. This service is provided without government funding and relies mainly on donations from families, charity organisations and fundraising campaigns. In South Africa, there are currently more than sixty Registered hospices linked to the national association- the Hospice and Palliative Care Association of South Africa (HPCA) which have been established since 1980. In South African health care, the present focus on cure led to health care professions turning away from patients for whom cure

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is no longer possible and abandonment of patients with far advanced illness to their families or compassionate care givers (Gwyther and Fiona, 2007). Some of the hospices are equipped with an in-patient unit as part of a home care programme. Sunflower hospice, which is situated in Bloemfontein in the Free State Province SA, provides palliative care for children only. However, Naledi hospice which is also situated in Bloemfontein only caters for adult patients. End-of-life care is an ethical imperative, which unfortunately has not been well presented in medical schools (MacDonald et al., 2000). One feature that distinguishes the natural history of HIV in non-industrialised countries from that described in rich industrialised societies is dealing with the consequences of progressive ill-health and immuno-suppression on the background of poverty and lack of resources. Abject poverty also influences disease presentation and quality of care. Again due to lack of financial resources in non-industrialised countries, it becomes difficult to implement a comprehensive and rational care packages. This review focuses on typical layout of hospice kitchens and the relationship between the design and distribution of bioaerosols.

TYPICAL LAYOUT OF SOUTH AFRICAN HOSPICES

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 hospice's in-patient care, but is attached to the hospital itself. For instance, both the Naledi and Sunflower hospices in Bloemfontein occupy under-utilised wards of local hospitals in their region. Patients are under the care of community caregivers and volunteer doctors, and their families are encouraged to learn palliative care skills during this time, including good hygiene and nutrition in order to strengthen the patients' resistance in the ongoing battle against opportunistic infections. Presently, there are more than 80 registered hospices in South Africa across all the provinces. Typical layout of 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, hospital kitchen has receiving area, storage area and breakfast preparation area. Patients regard the food they are given as one of the most important factors in determining their quality of life. An inadequate healthcare service in which the facilities and quality of care may be very basic presents an obstacle to the proper treatment and care of HIV/AIDS patients. One important point to note in linking care with prevention is that in non-industrialised countries, the credibility of AIDS programmes will increasingly be judged by the quality of care they offer (WHO, 1992) .Trained staff may not be on hand to deliver even a limited basic package of care, either because they are not paid a living wage or, because HIV/AIDS is itself taking a toll on clinical staff.

SERIOUS BACTERIAL INFECTIONS AND HIV

Bacterial infections are a major source of morbidity and mortality in HIV-infected children, causing a wide spectrum of diseases which are included in the WHO and CDC staging systems (WHO, 2006). Serious bacterial infections occur more frequently in HIV-infected children than in HIV-uninfected children in resource-rich as well as resource-poor countries. *S. pneumoniae* is the most common pathogen causing invasive bacterial infections in HIV-infected children worldwide (Wilfert, 2000). The spectrum of bacteria associated with pneumonia in HIV-infected children is wide. The pathogens most commonly seen include *S. pneumoniae*, *H. influenzae* type B, *Staphylococcus aureus* and *Escherichia coli*. Other pathogens less commonly observed are *Streptococcus viridans*, *Streptococcus pyogenes*, *Moraxella catarrhalis*, *Bordetella pertussis*, *Klebsiella pneumoniae*, *Salmonella* spp., *Pseudomonas aeruginosa*, *Legionella* spp. and *Nocardia* spp.

During the pre-HAART era serious bacterial infections were the most commonly diagnosed opportunistic infections in HIV-infected children, with an event rate of 15 per 100 child years (Dankner et al., 2001). Pneumonia was also found to be the most common bacterial infection followed by bacteraemia and urinary tract infections. However, with the advent of HAART the rate of pneumonia has decreased to 2.2-3.1 per 100 child-years (Nachman et al., 2005). Recent data from cohort studies and mathematical models in the developed world suggest that treatment outcomes of HIV infected patients improve when antiretroviral therapy (ART) is initiated at CD4 thresholds of 350/µl, and perhaps even 500/µl (Kitahata et al., 2009). Acute lower respiratory tract infection (LRTI), diarrhea and bacteremia accounted for the majority of infections in 108 hospitalized HIV-infected children in Cape Town, South Africa (Westwood et al., 2000). In this study, none of the children received pneumococcal or *H. influenzae* vaccines, intravenous gamma globulin or ART

Food-borne pathogens and compromised immune system

Apart from the provision of quality health care by nurses and doctors in the hospices, there are food-handlers present whose main role is the provision of wholesome cooked or ready to eat meals to the patients on a daily basis. Food-handlers in the hospices play a very important role regarding the provision of safe well cooked, nutritionally balance meal to the patients. In other words, they form an important part of this continuum of care during which strict hygienic measures should be practiced throughout. Food-borne disease caused by microbiological hazards is an important global public health issue (WHO, 2000). One area that is often overlooked in preventative health care and HIV care in general is the importance of food safety. Indeed, during food preparation, pathogens such as *Campylobacter*, *Salmonella*, *E. coli* and *S. aureus* may be spread from infected foods such as raw chicken to hand and food-contact surfaces in the domestic kitchen. Laboratory experiments have shown that both *Campylobacter* and *Salmonella* can be easily transferred from raw chicken products to kitchen surfaces and hands (Gorman et al., 2002). A food-borne illness is generally caused by micro-organisms consumed by eating any type of food. It is estimated that food-borne pathogens (disease-causing agents) are responsible for 76 million cases of illness, some resulting in death, in the United States alone every year (CDC, 2006). Campylobacteriosis is considered to be a greater burden in the developing world, partly because Campylobacter species-associated diarrhoea and bacteraemia occur in HIV/AIDS patients (Scott, 2003). The etiologic agents of food-borne illness are bacteria, viruses, parasites and food toxins with effects ranging from relatively minor discomfort to more serious symptoms and manifestations such as fever, diarrhoea, dehydration and even death (CDD, 2004). Diarrhoea, however, remains a prolific killer of children. The burden of diarrhoeal illness sits firmly in the developing world, both for morbidity (6-7 episodes per child per year when compared with 1 or 2 in the developed world) and mortality (Santosham et al., 1997).

Within the home and hospice setting, there can be a chain of events that result in the transmission of infection from its source to a new recipient. Certain sectors of the population are especially vulnerable after contracting a food-borne illness, that is, the elderly, pregnant women, young children and those with a compromised immune system (Mootsikapun, 2007). Meer and Misner (2000) have demonstrated that food-borne illness is associated with improper storage or reheating, food stored inappropriately and cross-contamination in the home. Within the hospice and health care settings in general, good hygiene practices including proper hand washing and food handling are essential in the reduction and prevention of the spread of infectious disease (Nkhebenyane et al., 2012). Although, good hygiene dictates that disinfectants should be used to clean food particles from surfaces, any bacteria remaining on these surfaces are not visible to the naked eye and may therefore be left behind. The significance of contaminated surfaces in relation to pathogen transmission to food is apparent in the food-processing, catering and the domestic environment like hospice kitchens. Pathogen exposure on surfaces may occur either by direct contact with contaminated objects or indirectly through airborne particles. Lack of food hygiene awareness and implementation are also contributing factors in this regard.

Comparison of domestic and small-scale kitchens in terms of infrastructure and cross-contamination potential

It is well known that the kitchen is particularly significant in the spread of infectious disease in the domestic environment due to various activities that occur in this particular setting. Many foods brought into the domestic kitchen are frequently contaminated with naturally occurring pathogenic microorganisms. The hospice kitchen has been described as the 'front line in the battle against food-borne disease', however, these kitchens may be inadequately designed, lacking equipment for safe food preparation and may be used for a range of non-food purposes.The food-preparation surfaces are a focal point in the kitchen. According to Nkhebenyane et al. (2011), in any domestic setting, the safety and quality of food served in a hospice depends on the kitchen design, storage conditions and food preparation practices of the food handlers. In this study, the environmental surfaces were found to be contaminated with pathogenic and non-pathogenic microorganisms e.g.*Staphylococcus* spp., *Bacillus* spp. and *Micrococcus* spp. The layout of a hospice kitchen is similar to that of a domestic setting, where the retention of bacteria on food contact surfaces increases the risk of cross-contamination of these micro-organisms to food (Figure 1).

Exposure of surfaces to pathogens may occur either by direct contact with contaminated objects or indirectly through airborne particles. Zhaoet al. (1998) found that during food handling and preparation, micro-organisms on raw foods can be transferred to various surfaces, such as cutting boards and water-tap spigots. The persistence of microorganisms, the presence and density of pathogens and the potential spread of microbial contamination from contaminated food in the household kitchen have been extensively studied and examined. Several studies have indicated that various bacteria, including *E. coli, S. aureus and Salmonella* spp., can survive on human hands, sponges or cloths, utensils and currency for hours or days after initial contact (Scott and Bloomfield, 1990; Kusumaningrum et al., 2002). Other studies have quantified the extent of bacterial survival and cross-contamination between hands and various food items and kitchen surfaces (Zhaoet al., 1998; Chen et al., 2001; Montvilleet al., 2001). It became evident that quantifying the cross-contamination risk associated with various steps in the food preparation process can provide a scientific basis for risk management efforts in both the home and in food service. Hand-washing and effective cleaning of food-preparation surfaces have been recognised as the most effective measures to prevent cross-conta-mination and reduce the transfer of micro-organisms to ready-to-eat foods in modern homes and institutional kitchens (Fendleret al., 2002).

MEASURES FOR PREVENTING CROSS-CONTAMINATION

Many cases of food poisoning originate in the domestic environment and can be associated with improper cleaning and food handling. The primary sources whereby

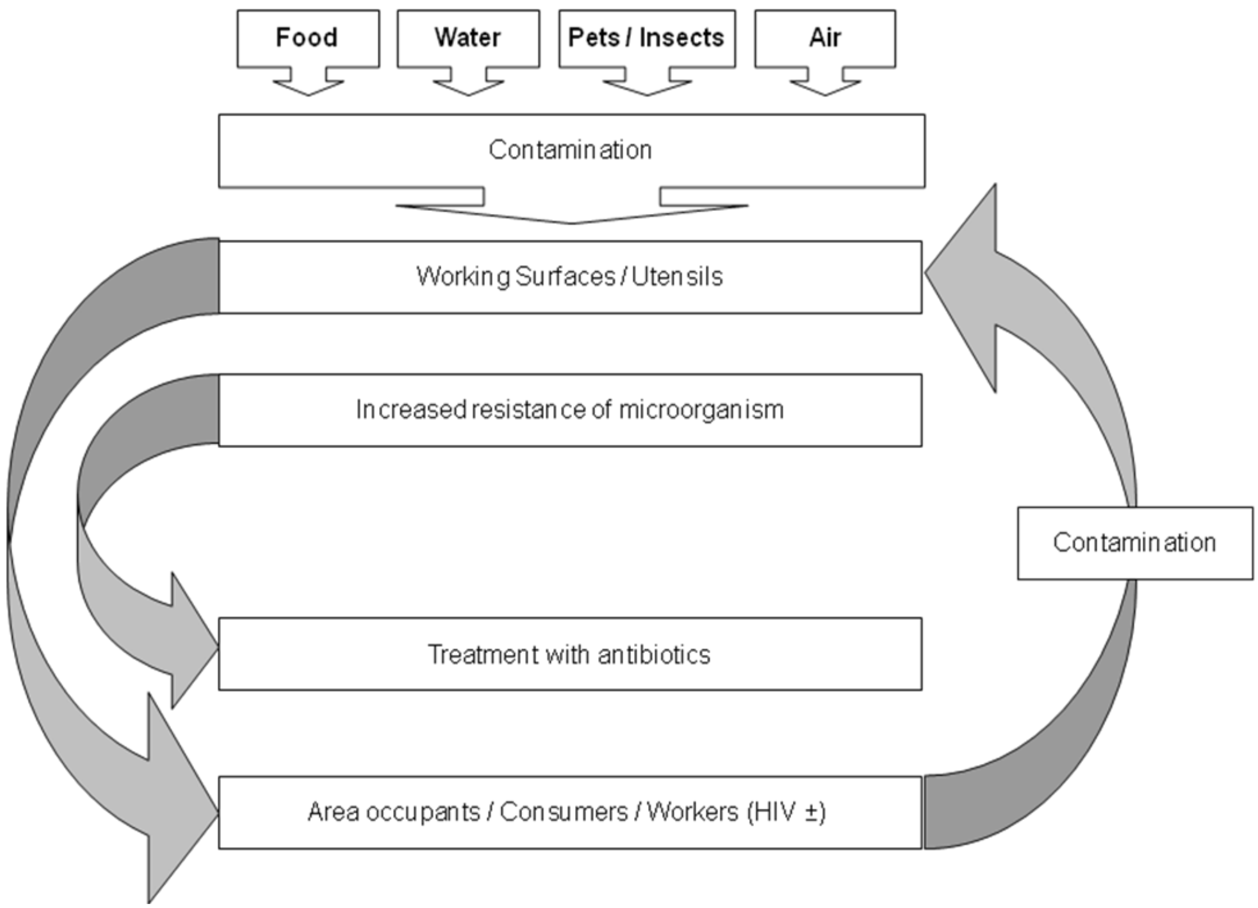

Figure 1. Chain of transmission of infection within a hospice kitchen.

pathogenic micro-organisms are introduced into the home are people, food, pets, water, insects and air (Beumeret al., 1999). Within a hospice kitchen, there is a chain of events which results in transmission of infection from its source to a new recipient. Additionally, sites where water accumulates such as sinks, toilets, waste pipes, or items such as cleaning cloths readily support microbial growth and can become primary reservoirs of infection; although species are mostly those that represent a risk to vulnerable groups. *Campylobacter* and *Salmonella* can persist on food-contact surfaces for significant period of time, which may lead to increased risks of cross-contamination between household members, ready-to-eat (RTE) foods and other food-contact surfaces (De Cesare et al., 2003). Ideally, to prevent cross-contamination in the kitchen, raw and cooked foods have to be handled separately. However, the strict separation of raw poultry, raw meat and RTE foods is not always possible in the hospice kitchen due to inadequate infrastructure.The spread of infection can be interrupted by good hygiene practices, which include good hand hygiene and the cleaning and disinfecting of surfaces. Cross-contamination of bacterial and viral pathogens in the home and in food service establishments is a major contributing factor for sporadic and epidemic food-borne illness (Knabel, 1995). Cross-contamination simulations by De Boer and Hanne (1990) demonstrated the ease with which *Campylobacter jejuni and Salmonella* are transferred from raw chicken products to chopping boards, plates and hands during food preparation. According to Kaplan (2005), the hands of food handler may also serve as a community reservoir for antimicrobial resistant strains of clinical importance, thus further emphasising the crucial role of the human hand as a vehicle for the transfer of food-borne pathogens. Simple personal hygiene coupled with soap utilisation has therefore been hailed as the most successful public health measure in the pre-disinfectant era (Greene, 2001), hence the recommendation by International Forum on Home Hygiene (IFH, 2007) that organisms be physically removed from hands and other surfaces by means of washing with soap or detergent-based cleansers, and that microbes be killed *in situ* by the application of a disinfectant or sanitizer.

However, it was demonstrated by Scott and Bloomfield (1990) that drying alone is insufficient to prevent the transfer of infectious micro-organisms between household surfaces and food handlers, and that cleaning with detergents is only a temporary measure when cloths are kept moist. Although heat is an effective form of disinfection, Beumer et al*.* (1999) conceded that it may not be a possibility when it comes to large surface areas and might be unreliable in unskilled hands. In order to reduce the risk of sponges and cloths being contaminated with microorganisms, it is recommended that these items be soaked in a bleach solution or be heated for one minute in a microwave oven, or alternatively be immersed in boiling water for five minutes (IFH, 2000).

The influence of bioaerosols in a hospice setting

Exposures to bioaerosols in the occupational environment are associated with a wide range of health effects with major public health impact. According to Zuckeret al. (2000), bio-aerosols consist of all airborne particles of biological origin, that is, bacteria, fungi, fungal spores, viruses and pollen fragments, including various antigens. The transport and ultimate settling of bio-aerosol are affected by their physical properties (size, density and shape of droplets) and environmental factors which include, air current magnitude, relative humidity and temperature (Stetzenbach et al., 2004). Airborne bacteria and fungi can be the cause of a variety of infectious diseases as well as allergic and toxic effects. Healthcare facilities are complex settings, especially in developing countries, where factors such as overcrowding, improper design and ventilation can impact the growth and/or survival of microorganisms. Exposure of surfaces to pathogens may take place either by direct contact with contaminated objects or indirectly through airborne particles (Kusumaningrumet al., 2002). Pathogens are continually introduced into the home by people (who may have an infection or may be asymptomatic carriers of infectious organisms), contaminated food and domestic animals, and sometimes in water or via the air. A typical example of such a disease is tuberculosis (TB) which is caused by aerosolized *Mycobacterium tuberculosis*, which is spread from person to person through airborne particles released through a cough or sneeze by an infected person (Kumar et al., 2007).

One of the most important routes for transmission of infection is via the hands. Person-to-person and food-to-person spread via hands or surfaces, via an infected food handler or by air-borne spread can also occur. Inadequate cooking and storage of food is considered to be the main cause of food-borne infection, but poor hand and surface hygiene is also a significant contributory factor. One of the major health problems in the hospices are the episodes of diarrheal infections which are caused by a variety of bacteria, viruses and protozoa. The organisms are shed in large numbers in the faeces of an infected person. All of these organisms are transmitted via the faecal-oral route (from the faeces of an infected person or animal, to the mouth of another person). For bacterial diseases, faecal-oral routes with longer transmission cycles are also possible, such as contamination of crops or water sources with faecal material. Therefore hand hygiene is a critical component of infection control in the hospices. The following bacteria, *S. aureu*s and meticillin-resistant *S. aureus* (MRSA), *Acinetobacter* spp., *Aspergillus* spp., *Pseudomonas* spp. and *Legionella* spp. were identified as the main cause of nosocomial infection through airborne transmission in health care setting (Srinivan et al., 2002). Preventing the spread of pathogens that are transmitted by the airborne route requires the use of special air handling and ventilation systems to contain and then safely remove the infectious agent (CDC, 2005). However, these remains a challenge for the hospice kitchens since most of them rely on natural ventilation to dilute the airborne pathogens.

A South African study (Nkhebenyane et al., 2011) on the prevalence of bioaerosols in the hospice kitchens revealed the following micro biota to be mainly present: *Bacillus cereus, S. aureus, Pseudomonas* spp and coliforms*.* Nosocomial infections transmitted by the airborne route, especially fungal infections such as aspergillosis, have been reported by Dykewicz (2001) to be the major source of morbidity and mortality in immuno-compromised patients. Therefore, optimal hand hygiene behavior is considered the cornerstone of healthcare associated infection (HCAI) prevention (Pittet et al., 2006). According to Goodman et al. (2008), hand hygiene, together with other specific prevention measures, environmental cleaning is another essential measure to prevent the spread of some pathogens, particularly *Clostridium difficile*, vancomycin-resistant enterococci (VRE), norovirus, *Acinetobacter* spp. and methicillin resistant *S. aureus* (MRSA). Chlorhexidine is a broad spectrum antiseptic agent active against both Gram-positive and negative bacteria, and has been successfully assessed as an effective skin antiseptic since the early 1980s (Edmiston et al., 2007).Chlorhexidine, as an active antiseptic can be used directly as solution, or as an ingredient in soaps, gels or impregnated in cloths. Published studies suggest that the routine use ofchlorhexidine-gluconate (CHG) is associated with a reduction in VRE acquisition in patients in intensive care units (Climo et al., 2009). Therefore, this can also be used in the hospice by both the patients and food-handlers as an intervention strategy for improved hand hygiene and microbial load reduction.

Antimicrobial resistance and its impact on HIV treatment

Antimicrobial resistance has emerged as a major public health concern globally. For more than half a century, antibiotic drugs have made it possible to treat potentially life-threatening bacterial infections. They have turned bacterial infections into treatable conditions rather than the life-threatening compounds they once were. Schlundt (2002) identified *Campylobacter, Salmonella, Yersnia,* pathogenic *E. coli and Listeria* as the major food-borne bacterial pathogens. Infection with any one of these bacterial strains, if resistant to antibiotics, will cause delays in the administration of appropriate therapy and may affect the outcome negatively (Molbak, 2005). The increasing prevalence of antibiotic resistance poses a serious threat to healthcare, and people living with HIV/AIDS are at particular risk (Manges, 2001). Furthermore, the emergence of multi-drug resistance bacteria has created a situation where there are few treatment options available for certain infections (WHO, 2002). One of the major disadvantages of antimicrobial use in animals is the potential development of antimicrobial-resistant zoonotic food-borne bacterial pathogens and the subsequent transmission thereof to humans as food contaminants. Lately, the effectiveness of many antibiotics is diminishing dramatically in the face of increasing resistance amongst various types of bacteria. Antibiotic resistance in food-borne pathogens has become a reality, although substantial qualitative and quantitative differences do exist (Teuber, 1999). A study (Nkhebenyane et al., 2012) in a hospice revealed a decrease in susceptibility for cefoxitin in approximately 80% of all *S. aureus* isolates and coliforms, while 95% of the *Staphylococcus* spp. and 93% of the *B. cereus* isolates were found to be resistant. These pathogens were isolated from the food preparation surfaces (e.g. cutting board, food handler's hands and table). *S. aureus* isolates from a tertiary hospital were reported to be 100% resistant to cefoxitin according to published results (Vysakh and Jeya, 2013). Infections caused by resistant bacteria have been shown to be more frequently associated with increased morbidity and mortality than those caused by susceptible pathogens, which poses a serious public health concern (Helmset al., 2002; Travers and Barza, 2002; Varmaet al., 2005). It is now collectively accepted that the use of antimicrobials in both animals and humans can select for resistant bacterial populations. Thus, addressing the issue of antimicrobial resistance is one of the most urgent priorities in the field of infectious disease today.

CONCLUSIONS

Hospices have been established to improve the quality of life for terminally ill patients, including those infected with HIV/AIDS. In an era of antiretroviral use as a means of reducing the viral load, food safety may relate to HIV mortality, keeping in mind the compromised immune status of the patients. Microorganisms are ubiquitous in nature, some are responsible for food-borne illnesses others posing as opportunistic pathogens- hence the importance of hygiene interventions within the hospice setting. Hospice kitchens operate on a similar basis to traditional home-based kitchens with regard to infrastructure. Although, the occupants of these settings exemplify hospital patients, this brings forth the question of whether a typical hospice kitchen will host different kinds of micro-organisms at different levels than home-based kitchens and whether the patients are contributing as a source.

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