

Benchmarking Nursing Practice for Clients with Extended Spectrum Beta-lactamases Bacteria

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<p>Abstract:</p> <p>The prevalence of multi-resistant ESBL-producing bacteria in nursing homes is a problem not only in Finland but worldwide. It presents a major challenge for nurses and healthcare workers in providing quality care to residents. The ESBL-producing bacteria might reside in a carrier without any infection but it severely limits the treatment choices if the carrier becomes ill. In a nursing home, where most residents stay for long periods, nurses have an important role in preventing the spread of ESBL from carriers to other residents and staff. The aim of this study is to provide nurses with evidence-based guidelines to care for ESBL carriers residing in nursing homes. Furthermore, the current situation of evidence-based practices regarding care of ESBL carriers in nursing homes and the situation of ESBL in Finland is investigated. The study is conducted through a review of literature. Nineteen topic-relevant articles have been selected using different academic search databases. The Health Promotion Model by Nola Pender provides the theoretical framework. This study found that the lack of implementation of infection prevention measures was associated with the spread of ESBL in nursing homes. Despite having knowledge, nurses did not implement the proper procedures in practice due to lack of time, resources and proper guidelines. Additionally, inappropriate use of antibiotics was one of the main risk factor in ESBL carriers. In conclusion, healthcare workers must have proper knowledge and implement proper infection control practices in order to restrict the spread of ESBL. Continued education for nurses in the form of training and educational programs could affect the spread of this disease along with proper use of antibiotics. Further study about isolation precaution in nursing homes could shed light on the sources of cross-transmission so that good nursing practice could be developed, impacting the safety of clients and staff.</p>	
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CONTENTS

1	INTRODUCTION.....	7
2	BACKGROUND.....	9
2.1	An Overview of Evidence-Based Practice	9
2.2	Implications for Nurses regarding Evidence Based Practice	10
2.2.1	<i>Barriers to Adopting Evidence-Based Practice for Nurses.....</i>	11
2.3	Infection Control and Prevention.....	13
2.4	The Essentials of Extended Spectrum Beta-Lactamases	14
2.4.1	<i>Risk Factors and Symptoms of Extended Spectrum Beta-Lactamases.....</i>	15
2.4.2	<i>Transmission of Extended Spectrum Beta-Lactamases</i>	16
2.4.3	<i>Nursing Interventions for Carriers of ESBL.....</i>	16
2.5	Current Situation of Extended Spectrum Beta-Lactamases in Finland	18
2.6	Relationship between Evidence-Based Practice and Infection Control	21
3	THEORETICAL FRAMEWORK.....	23
3.1	Elements of Health Promotion Model	23
4	AIMS AND RESEARCH QUESTIONS	27
5	METHODOLOGY	28
5.1	Data Collection.....	28
5.2	Data Analysis	31
5.3	Ethical Considerations	32
6	FINDINGS	34
6.1	Evidence Based Guidelines for ESBL Carrier Residents in the Nursing Home setting	34
6.2	Dynamics of Antibiotic Use in Nursing Homes to Treat Residents Carrying ESBLs.....	36
6.3	Role of Education in Nursing.....	39
6.4	Prevalence of ESBL in Nursing Homes	40
7	DISCUSSION	42
8	CONCLUSION.....	47
8.1	Critical Analysis.....	47
9	REFERENCES	49
10	APPENDICES	56

FIGURES

Figure 1. The Health Promotion Model (Pender et a.. 2002)	25
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TABLES

Table 1. E. coli findings with reduced susceptibility to third-generation cephalosporin (possible ESBL) in male and female population and Incidence of E. coli findings (cases/100,000 population).....	19
Table 2. K. pneumoniae findings with reduced susceptibility to third-generation cephalosporin (possible ESBL) in male and female population and Incidence of K. pneumonia findings (cases/100,000 population).....	20
Table 3. The data collection and retrieval process.....	29
Table 4. Steps of data analysis	32

LIST OF APPENDICES

Appendix 1. List of the articles selected for the study	56
Appendix 2. Standard Precaution.....	63
Appendix 3. Contact Isolation Precaution	65
Appendix 4. Illustration of theme and sub-themes	66
Appendix 5. Guidebook for taking care of ESBL carriers	67

List of Abbreviations

EBM	Evidence-Based Medicine
EBP	Evidence-Based Practice
ESBLs	Extended Spectrum Beta-Lactamases
ESBL-EC	Extended Spectrum Beta-Lactamase- <i>Escherichia Coli</i>
HAIs	Healthcare-Associated Infections
HUCH	Helsinki University Central Hospital
HPM	Health Promotion Model
LTCFs	Long-Term Care Facilities
NIDR	National Infectious Diseases Register
PPE	Personal Protective Equipment
RNs	Registered Nurses
THL	National Institute for Health and Welfare
UK	United Kingdom
WHO	World Health Organization



FOREWORD

Firstly, we are sincerely thankful to Hopeakuu Palvelutalo, Espoo, Finland for commissioning our thesis. Our gratitude goes out to our supervisor Denise Villikka for her continuous guidance, correction and suggestions during the thesis writing process and Pamela Gray for reviewing our thesis. We would like to thank all the teachers from the department of health and welfare at Arcada University of Applied Sciences for their constant support during our time of studies. We would like to thank our families and friends for their emotional support. Lastly, our heart-felt thanks go to Bhabishya Gurung for his assistance with the English language during the final writing stage of this thesis.

1 INTRODUCTION

This thesis topic arose, when nursing staff, who work with residents with ESBL-producing bacteria asked us to commission a report and guidebook based on the latest evidence-based data on the subject. These nurses will use this thesis to help guide them in examining their practices and initiating any new nursing interventions needed during care activities at their nursing home facility located in Espoo, Finland.

Infectious diseases were the primary cause of mortality among humankind before the discovery of antimicrobials. However, it is still among the leading causes of death in countries where quality healthcare is scarce especially in under-developed countries. However, in developed countries, poor clinical outcomes are still a major issue despite the advanced facilities and education of staff. Infections due to resistant microorganism are a major cause for poor clinical outcomes, which influence quality of life and in some cases, result in death (World Health Organization 2016).

According to a list of antibiotic resistant *priority pathogens* published by WHO (2017), these resistant bacteria continue to pose the greatest threat to humanity. The list particularly highlighted the threat from gram-negative bacteria, which includes Enterobacteriaceae. The report highlighted the urgency for the development of a new antibiotic to fight against these bacteria. They believe it is “critical” as the bacteria are becoming resistant to the best existing antibiotics (World Health Organization 2016). One example of this is seen in a study conducted to investigate a citywide outbreak of infections caused by ESBL producing gram-negative bacilli in Chicago nursing homes. The study suggested how nursing home patients might be reservoirs of ESBLs due to constant exposure to broad-spectrum oral antibiotics and lapses in infection control practice (Wiener *et al.* 1999).

Other residents residing in nursing homes have an added risk of acquiring an ESBL infection, if any of the residents are carriers of ESBLs. This is due to immediate proximity and potential exposure to the ESBL microbial. This is especially true for resident with severe limitations who require frequent contact with healthcare providers (See Paterson

& Robert 2005 p. 664). The resistance of ESBLs towards commonly used antibiotics presents a challenge as it severely limits the range of therapeutic options available during the treatment of infections such as pneumonia, urinary tract infections and treatment of more serious infections such as bloodstream infections (Brolund 2014). ESBLs have worldwide prevalence but their distribution varies across different regions. However, this is changing rapidly due to the rise in the number of cases reported annually. It is a worrisome prospect as an increase in ESBL cases often correlates to an increase in morbidity and mortality among the carriers with infection (Dhillon & Clark 2012).

The main cause for the spread of these type of diseases mentioned above is cross-transmission. Therefore, it falls upon the nurses to be competent during care activities by implementing safe practices in order to promote the health and wellbeing of clients while protecting them from harm. Among numerous responsibilities nurses hold, they should be aware and continually seek to develop their competencies in order to provide quality care for clients (Ballard 2003). According to Smith and Lokhorst (2009), since nurses are in day-to-day contact with their clients, safe infection control based on evidence-based practices are necessary for effective and quality care.

This thesis brings forward evidence based nursing practices that nurses can implement when caring for clients who are ESBLs carriers within the context of the nursing home setting. Moreover, the authors try to bring clarity concerning the nurse's role in prevention and containment of the ESBL pathogens. Though healthcare professionals commissioned this thesis, the writers attempted to communicate to a wider audience. Thus, the concepts and processes found throughout this report begin from a wide perspective and then narrow to assist those outside the healthcare profession in understanding the report.

2 BACKGROUND

In this chapter, the writers have attempted to present this topic beginning with the broader concepts relating to evidence-based practice. The authors then narrowed the scope to focus on infection control prevention, followed by reflections on the relationship between infection control prevention as it concerns nursing care duties. The report then introduced the enzymes known as Extended Spectrum Beta-Lactamases (ESBLs) and the *Escherichia coli* (*E. coli*) and *Klebsiella pneumoniae* (*K. pneumoniae*) bacteria. Lastly, the current situation in Finland concerning this issue is brought forward using statistical data.

2.1 An Overview of Evidence-Based Practice

The term “evidence-based practice” is derivation of the term “evidence-based medicine” (EBM) used in the field of medicine. During the 1980s, health professionals used the term “evidence-based” to design clinical practice guidelines (Lockett 1987). A group of researchers at McMaster University, Canada, redefined the term “evidence-based medicine” as an implementation of medicine practice to determine the best practice from the available information (Sackett *et al.* 1996). Later on, in 1992 the Journal of American Medical Association published an article by the Evidence-based Medicine Working Group that discussed the role of EBP in medical education. The article stated that the scientific research findings would boost confidence in physicians to make individual decision-making more structured. The physicians will need to assess the literature in applying the research findings to practice (Evidence-Based Medicine Working Group 1992). In the years after the Medicine Working Group EBP article, healthcare professionals, not just physicians, considered using EBP when providing care.

More recently, the principle of the EBP has continued to evolve and has gained momentum in the delivery of quality care, for which the basis is on evidence rather than tradition (Beyers 2002). Nowadays, the use of evidence-based practice facilitates the provision of safe and efficient care, as it propagates the use of current knowledge into practice to increase the quality of the care process and their outcomes (Stevens 2013).

When implanting care-using EBP, the healthcare team chooses the most appropriate and effective method amongst the scientific evidence that is available to them. Factors such as the characteristics of the patients and the situation affect the selection of evidence-based practice. The best available scientific evidence, clinical expertise and the patient's values are three important elements of the EBP. These three elements should be in balance to achieve scientifically approved clinical practices. EBP is acceptable to use in benefiting patients and to ensure that the patient's care is effective. Various research-based studies have concluded that the patient's outcome has improved remarkably when the care is based on EBP rather than the traditional expertise (Houser & Oman 2011; Heatler *et al.* 1988).

2.2 Implications for Nurses regarding Evidence Based Practice

The use of evidence-based practice facilitates the provision of effective, safe and efficient care, as it propagates the use of current knowledge into practice to increase the quality of the care process and their outcomes (Stevens 2013). The earliest use of an evidence-based framework in the nursing field is in the works of Florence Nightingale's first work after returning from Crimean War (McDonald 2001). However, it was not until the mid-1990s that it was fully incorporated into the nursing profession. From the nursing perspective, nurses use evidence-based practice with the purpose of providing better results through the implementation of nursing interventions that stem from knowledge-based decisions grounded in real evidence (Mackey & Bassendowski 2017). It seems nurses prefer to use EBP in their delivery of care. A study by Majid *et al.* (2011) showed 64.3 % of the nurses "disagreed" or "strongly disagreed" that they prefer traditional practice rather than the new patient care practice. Whereas 52.8 % of the nurses "disagreed" on the statement that they do not like other people questioning their practices when those practices are based on scientific method. Additionally, nurses were positive towards EBP and were open in implementing new healthcare practices.

Evidence-Based Practice not only helps to guide care practices but also relates to the utilization of research, quality improvement and nursing research. For decades, nurses

use the available information in order to improve patient care. The nurses analyze and evaluate the changes' effectiveness by implementing research findings in clinical practice. The focus is to choose the best practice that guarantees quality improvement of patient care. Nelson *et al.* (2002) stated that in recent times, the patients, their families and the healthcare professionals meet often to collaborate as to the needs of the client and to improve the care received. This approach where the client is the center is gaining momentum today in Finland as we see the new mandates handed down from the Finnish government. In addition, an emphasis is placed on multi-professional collaboration with the aim of improving quality and assuring safety during the delivery of care (see Beyea & Slattery 2006 pp. 1-14).

In the end, although the definition of EBP varies, the focus is to improve practice by implementing the best available evidence (Leufer & Cleary-Holdforth 2009). When it comes to professional nurses, the literature suggests they feel confident in their decision if scientific research supports their decision rather than a decision based on habits for the most part (Courtney & McCutcheon 2010 p. 5). In addition, nurses are active in not only gathering research data from other sources but are engaging in their own research to improve care practices. Thus, nurses have an important role in the management of care received by their clients (Sharon 2014).

2.2.1 Barriers to Adopting Evidence-Based Practice for Nurses

Although EBP seems to becoming an accepted practice among healthcare professionals, there are still challenges adopting EBP. In order to achieve the effective quality care, the best evidence-based practice derived from research is important in clinical practice. Determining the best EBP is a challenge in nursing practice. Nurses need skills to understand the questions arising in practice thereby assessing the available information to determine the most appropriate EBP that will help improve patient care (Mohsen *et al.* 2016).

As mentioned earlier in this chapter, there are studies examining the perceptions of the nurses' and the implementation of EBP in clinical practice. In those studies, nurses view

EBP positively and accept the fact that this approach is more effective than that of traditional practice (Upton & Upton 2006). Having said this, though nurses believe EBP provides better care solutions, the motivation to implement this strategy while caring seems low. Some of the nurses described that they were not interested in implementing EBP. The reason for nurses' lack of motivation in implementing EBP seems to be due to the lengthy period required for obtaining the formal training, after which, they are hesitant to engage in further research or scientific reading (Tacia *et al.* 2015).

Even though nurses can have positive attitude towards the EBP, the acceptance and the implementation is slow (Pravikoff & Tanner 2005). According to Apler *et al.* (2005), one of the barriers in adopting EBP in clinical practice is the large number of literature that is available in different sources. This makes adopting EBP more complicated as it is challenging for nurses to keep updated as to the changes in nursing practice (see Majid *et al.* 2011 pp. 229-236).

Funk *et al.* (1991) investigated nurses' perceptions and the barriers in implementing EBP. From the questionnaire called "BARRIERS", the nurses stated two major barriers. First, they do not have power to authorize patient care procedures. Second, they simply lack the time to review the latest news on the subject. Griffiths *et al.* (2001) seems to agree who states, the major barriers for adopting EBP by community nurses are insufficient time, lack of resources and inadequate knowledge to understand the statistical analysis of the research. According to McKenna & Ashton (2004), other barriers for adopting EBP include the lack of skill when searching for information from different sources. The nurses' limited information technology skills and insufficient skills for the searching of information also affect the implementation of EBP. Hagbaghery (2007) stated that the reasons nurses do not adopt EBP in clinical practice are insufficient awareness about the research, lack of skills to determine the quality of research and lack of access in obtaining the information. There is no co-relation associated between the nurses' level of knowledge and skill to implement EBP (see Mohsen *et al.* 2016 pp. 25-33).

2.3 Infection Control and Prevention

It is not just the knowledge about EBP or the ability to identify new ways of providing safe, quality care but nurses also need to implement these standards on a grass-roots level during care encounters. According to the World Health Organization (2017), the infection control and prevention are the practices that help to protect the people who are in danger of obtaining infection. The infection can be obtained in a community or while being cared in a facility. The basic level of infection control and prevention is hand hygiene. All the healthcare workers that help to control the spread of infections should practice infection control practices.

Standard precautions include hand hygiene, personal protective equipment (PPE), respiratory hygiene/cough etiquette, aseptic technique, occupational exposure management, and blood infection prevention. Staff should practice good hand hygiene and should remove all kinds of jewelry while working in the clinical settings. The use of personal protective equipment (PPE) includes gloves, aprons and face/eye/mouth protection. The workers should use PPE when there is risk of contact with blood, body fluid, wounds, non-intact skin and mucus membranes. During care activities, the workers should practice appropriate aseptic technique. For example, performing workflow activities from a clean to dirty area. Furthermore, in order to prevent exposure to infectious agents from blood and body fluids via needles, the facility should properly manage the disposal of sharps, needles and record any sharp needle accidents. In addition, staff should avoid wearing open footwear. Sharp needles should be disposed in a sharp needle container immediately after use. Lastly, the staff should never re-cap the single-use sharp needles after use and discard immediately in a sharp needle container (National Health Service professionals 2010). The authors have illustrated the standard precautions and contact isolation precautions for infection prevention as Appendices 2 and 3, respectively, in the Appendix section of this thesis.

Therefore, the implementation of standard precautions with all encounters helps to ensure that both patients and the workers are safe from harmful microbes as these practices are considered to be the basic interventions for infection control (Tampere University Hospital 2017).

2.4 The Essentials of Extended Spectrum Beta-Lactamases

As stated earlier, there are groupings of microbes that will be in focus in this thesis, the first being ESBLs. Some types of bacteria produce enzymes known as Extended Spectrum Beta-Lactamases (ESBLs). The bacteria that produce these enzymes are mainly *Escherichia coli* (*E. coli*) and *Klebsiella pneumoniae* (*K. pneumoniae*). These are gram-negative bacteria. During the staining technique, the gram-negative bacteria change to pinkish or red (National Institute of Allergy and Infectious Diseases 2016). They belong to the family Enterobacteriaceae also known as coliforms. These bacteria are a part of our normal gastrointestinal flora. The bacteria are usually harmless. However, some of these strains can also cause infections (South Australia Health 2016).

Among all the gram-negative bacteria, *E. coli* and *K. pneumoniae* are the most common cause for serious infections (Behzadi *et al.* 2010). A study conducted by Lautenbach *et al.* (2001), found that there were 33 patients with ESBL-producing *E. coli* or *K. pneumoniae* in a 725-bed hospital. The infection sites were in the urinary tract in 17 patients (51,5 %), 5 in wound (15,2%), 4 in central venous catheter (12,1 %), 3 in blood (9,1%), 3 in the respiratory tract (9,1%) and 1 in the abdominal (3%). Several other bacteria can also produce ESBL; however, this research focuses mainly on *E. coli* and *K. pneumoniae*, as they are the most prevalent bacteria. Kolef *et al.* (2011); Al-Hasan *et al.* (2012) reported that the proportions of *E. coli* and *K. pneumoniae* are up to 75-87 % in community acquired and 62-64 % in healthcare-associated infections (see Holma 2015 p18).

Bacteria that produce ESBL are resistant to commonly used antibiotics, which can make infections caused by it challenging to treat. The infections can sometimes be life threatening (National Institute for Health and Welfare 2015). Beta-lactamases are enzymes produced by the bacteria (Enterobacteriaceae, *Staphylococcus species*). These enzymes have a form of survival mechanism, which gives them their ability to adopt and survive in adverse conditions. They can dislodge the structure of the beta-lactam ring present in antibiotics through the process of hydrolysis, thus nullifying the antibacterial properties. The beta-lactamases can be coded on plasmids or chromosomal DNA, which make them mobile within in a bacterial community allowing them to spread widely. In con-

junction with the above, the same species can produce several strains at any given time (Yewale *et al.* 2010).

Conversely, these ESBL producing bacteria can be present in the intestinal tract, mucous membrane, urine and wounds, without necessarily causing any symptoms (Helsinki University Central Hospital (HUCH) 2012; Health and Social Department, Helsinki 2015). The most common place for ESBL-induced infection is the urinary tract. Other sites of infection are in the intra-abdominal region such as the gallbladder or the appendix and in the lungs (National Institute for Health and Welfare 2015). It may be interesting to note that they have the capability to infect wounds and can be present in the bloodstream as well (Krames StayWell 2000-2016).

An individual is considered to have an ESBL infection when the ESBL producing bacteria infect them. A person carrying the ESBL bacteria but do not show any symptoms of an infection is termed colonized or is called an ESBL carrier. This is also for cases where the ESBL bacteria have infected a person in the past. Although an ESBL colonized person may still be healthy with no apparent symptom, they are still contagious and could spread the bacteria to non-infected patients (HUCH 2012).

The antibiotics used to treat these organisms is Beta-lactam, which belong to the family of broad-spectrum antibiotics characterized by a presence of Beta-lactam ring in their molecular wall. Some well-known examples are penicillin, cephalosporin, clavams (or oxapenam), cephamycins and carbapenems. For decades, healthcare professionals have widely used these groups of antibiotic to treat and prevent bacterial infections (Belgian Biosafety 1999).

2.4.1 Risk Factors and Symptoms of Extended Spectrum Beta-Lactamases

Antimicrobial resistance is not a disease in itself and usually there are no differences in the severity of diseases caused by susceptible strains and resistant ones. Therefore, resistance is generally not a problem of pathology but one that limits the options of thera-

py (World Health Organization 2017). Healthcare professionals should note that a person colonized with ESBL does not typically show any symptoms. However, symptoms vary according to the organs that the ESBL bacteria infect. For example, an infection of urinary tract causes pain and burning while urinating. The patient will urinate more frequently than normal and can have a fever. Conversely, an intestinal infection can cause diarrhea with blood seen in the stool. In this case, the patient may complain of severe pain in the abdomen, stomach cramps, loss of appetite and fever. A skin infection causes wounds that are red in color. Wounds of this nature, if untreated, can produce puss that oozes from the wound resulting in an increased susceptibility to a spread of the infection (Parasakthi 2001).

2.4.2 Transmission of Extended Spectrum Beta-Lactamases

The transmission of ESBL can take place between patients, healthcare staff or visitors. It can be transmitted either as just a carrier without having the bacteria themselves or as an infection where an infection is present. The transmission of ESBL can take place through touching an ESBL infected person or coming in contact with ESBL contaminated items. It is therefore important to take proper precautionary measures in order to ensure the safety of other patients and healthcare workers and to prevent spreading of the infection (Jewell 2017).

The healthcare staff should move ESBL patients having wounds, urinary tract infection or diarrhea to an individual room or in a same room with other ESBL patients. This minimizes the risk of spreading the infection to other patients while treating the patient using proper precaution method with special emphasis to hand hygiene (Health Service Executive 2012).

2.4.3 Nursing Interventions for Carriers of ESBL

With the diagnosis of ESBL in a nursing home, it is of utmost importance to take proper precautionary measures to prevent the spread of ESBL, and to contain it with efficiency. Healthcare workers should perform proper hand hygiene and avoid direct contact with the patient. It is preferable to use a private room for the colonized patient or implement necessary precaution in case of a multi-bedroom facility. During an event of the patient



leaving his/her room for the purpose of mobilization, rehabilitation or tests, healthcare staff should accompany the patient. The patient should put on clean clothes and proper covering of the wound in case of any external wound. The patient should keep themselves away from public areas such as the unit kitchen, cafeteria, study room etc. (Vancouver Island Health Authority 2013).

In addition, the staff should use personalized protective equipment (PPE) when taking care of patients with ESBL. Proper decontamination of the equipment is a must after every use, especially for those meant for common use. This reduces the risk of cross-contamination. This along with proper and timely cleaning of environment helps reduce the prevalence of ESBL causing pathogens in surroundings (Guidelines on infection prevention and control 2012).

As mentioned above, while taking care of a colonized patient, healthcare staff must use Personal Protective Equipment (PPE) such as disposable gloves and aprons. They must perform good hand hygiene before and after the use of PPE. By paying special attention, the risk of spread of ESBL can be lowered (Dorset and Somerset Health Protection Unit 2007). However, control isolation measures alone are not sufficient for prevention and reduction of ESBL spread. A proper use of antibiotics should accompany the isolation measures to create an efficient control strategy (De Cellès *et al.* 2013).

It is necessary for visitors of the clients who are colonized with ESBL, to first talk to the nurse before entering the client's room, so that they receive the necessary information on infection control measures while meeting the client. These includes disinfecting hands with alcohol hand rub before entering and while leaving the room, not visiting other client during the trip, use of protective equipment such as long sleeved gown and gloves when involved in providing direct care to the clients, like bathing, washing, toileting or care for open areas. However, casual contact does not require the use of gloves or gown, for instance holding hands, feeding or pushing wheel chair (Norfolk General Hospital 2010). Furthermore, exposure to ESBL does not lead to infection among healthy visitors, including pregnant women and children. Visitors who have recently undergone surgery or with suppressed immune system are suggested to contact the infection control staff or talk to their general practitioner before making the visit (Sydney

Adventist Hospital 2014). Donning a sign notifying others of special precaution on the door of the colonized patient's room helps to remind healthcare workers and visitors about the need for precaution as they enter the room. ESBLs carrier should also make a conscious attempt at maintaining good personal hygiene at all times (Humber River Hospital 2007).

2.5 Current Situation of Extended Spectrum Beta-Lactamases in Finland

The National Institute for Health and Welfare (THL) in Finland monitors the situation of infectious disease by collecting data on affected people and by studying pathogens through various surveillance systems. THL maintains the data through the National Infectious Diseases Register (NIDR). Since 2008, NIDR started reporting on the resistance of *Escherichia coli* and *Klebsiella pneumoniae* to third-generation cephalosporin. Almost 90 % of the bacteria reported was enzyme-producing ESBL strains. *E. coli* occupied the bigger proportion of the findings while *K. pneumoniae* occupied a smaller proportion. Table 1 and 2 shows the progression of *E. coli* findings and *K. pneumoniae* findings, respectively, from 2008 until 2016 (Jakkola *et al.* 2016). In addition, the tables also depict how the bacteria have mutated in such a way that third-generation antibiotics are not as effective as they were in earlier years. The authors derived the data used in Table 1 and 2 from the NIDR's statistical database.

Table 1 E. coli findings with reduced susceptibility to third-generation cephalosporin (possible ESBL) in male and female population and Incidence of E. coli findings (cases/100,000 population)

Year	ESBL- <i>E. Coli</i> findings			Incidence per 100,000
	Male	Female	Total	
2008	368	1306	1674	31
2009	512	1665	2177	41
2010	596	1965	2561	48
2011	713	2425	3138	58
2012	907	2782	3689	68
2013	1076	3390	4466	84
2014	1021	3172	4193	77
2015	1114	3050	4164	77
2016	1254	3448	4702	86

According to Table 1, ESBL-EC findings have almost tripled between 2008 and 2016. There was a rapid increase in the number of findings until 2013, after which, the number of findings decreased for the next 2 years. However, we can see that there is again an increase significantly in 2016 equaling 4702 cases. The number of findings was higher in females than in males across all years. In 2016, almost three-quarter (73%) of the diagnoses were in female.

According to the NIDR's statistical database, in 2016, diagnosis of ESBL-EC was in all age groups; more than half of them in patients aged 65 or older. The number of findings was largest in the Hospital District of Helsinki and Uusimaa. However, the incidence was higher in the Hospital District of Kymenlakso, which had 263 cases reported. The average incidence within the whole of Finland in 2016 was 86/100,000. Additionally, there was a significant increase in number of blood culture findings. The Hospital Dis-

trict of Helsinki and Uusimaa alone had almost one-third (97) of the blood culture findings. However, the incidence of blood culture findings was highest in Hospital District of Etelä-Savo.

Table 2 K. pneumoniae findings with reduced susceptibility to third-generation cephalosporin (possible ESBL) in male and female population and Incidence of K. pneumoniae findings (cases/100,000 population)

Year	ESBL- <i>K. pneumoniae</i> findings			Incidence per 100,000
	Male	Female	Total	
2008	48	68	116	2.1
2009	64	91	155	2,9
2010	81	109	190	3.5
2011	91	152	243	4.5
2012	90	152	242	4.4
2013	81	157	238	4.4
2014	105	206	311	5.7
2015	107	182	289	5.2
2016	160	250	410	7.5

According to Table 2, ESBL-*K. pneumoniae* findings have increased 3.5 fold between the year 2008 and 2016. The number of findings have increased significantly throughout the years with a slight decrease in 2015 equaling 289. However, there was a large increase in the number of findings in 2016 equaling 410. As in ESBL-EC, the number of findings in females was higher than in males throughout the years. However, the female proportion of diagnoses was 60% in ESBL-*K. pneumoniae*.

According to the NIDR's statistical database, in 2016, diagnosis of ESBL-*K. pneumoniae* was in all age groups; almost one-half in patients aged 65 or more. The number of findings was largest in the Hospital District of Helsinki and Uusimaa. However, the in-

idence was higher in the Hospital District of Lapland, which recorded 25 cases. The average incidence in the whole of Finland in 2016 was 7.5/100,000. The number of blood culture findings in 2016 was 27 (2015:16). The Hospital District of Helsinki and Uusimaa had the largest number of blood culture findings equaling 7. However, the highest incidence of blood culture findings was in the Hospital District of Vaasa.

2.6 Relationship between Evidence-Based Practice and Infection Control

With the increase in cases as seen in the last chapter along with the challenges for nurses and the acceptance of EBP, ensuring the safety of society when it comes to infection control is challenging. Therefore, by linking EBP with the prevention and control of infection could be a way to combat the spread of infection. By tracking the spread of infection through reporting, health providers can continually evaluate their level of performance. For the past several decades, literatures on healthcare have reported incidents related to healthcare-associated infections (HAIs). HAIs are the undesirable outcomes that question the quality of a patient's care. Haley *et al.* (1985) reported that since the early 1980s, healthcare facilities are monitoring HAIs and this continues now (see Collins 2008 pp. 547-575). The Centre for Disease control and prevention (2000) stated that in certain intensive care units, implementation of evidence based infection control strategies decreased the occurrence of HAIs. Over the last 10 years, there has been an increase in antibiotic resistant microorganism. The factors for that alarming increase can be related to the increase in severity of illness due to abuse of antibiotics. This began during the 1980's, when the use of third-generation cephalosporins was used to treat Beta-lactamase-mediated bacterial resistant organisms. The use of this antibiotic was regarded as a success; however, it was short lived with the emergence of plasmid-encoded Beta-lactamases, which developed resistance to cephalosporin's thus cutting short the success. This resulted in having to face-off with an unfavorable consequence. Soon afterwards, several others Beta-lactamase showed resistance to extended spectrum cephalosporins. Owing to these factors, the renewed β -lactamases were grouped together as Extended-Spectrum Beta-Lactamases (Paterson & Robert 2005). ESBLs are a diverse and rapidly evolving group of plasmid-mediated enzymes. They significantly restrict the range of therapeutics options available during treatment of infection amongst

carriers. Infections caused by ESBL producers include urinary tract infection to life threatening sepsis (Rawat & Nair 2010).

Resistance to antibiotics is not the only factor to influence EBP and infection control. Stein *et al.* (2003) observed the attitude of doctors and nurses towards infection control guidelines in a Birmingham Teaching Hospital located in the United Kingdom. In order to improve the infection control practices in this hospital, the authors recommended educational training for healthcare professionals. As a result, the monitoring of adherence to infection control guidelines and improvement in quality resources were highly recommended. Picheansathien *et al.* (2008) conducted a survey that included the implementation of hand hygiene practice and its effect on HAIs among 26 nurses for a duration of 7 months. The result showed the adherence of hand hygiene improved from 6.2 % to 81.2 %. All of the nurses agreed on the fact that the hand hygiene promotion program motivated them to implement improved hand hygiene practices (Fashafsheh *et al.* 2015 pp. 79-90). Thus, despite the challenges listed above and the low staff to patient ratio due to limited resources, healthcare professionals continue their mission to improve the quality of patient's care (see Collins 2008 pp. 547-575).

In this chapter, EBP was outlined along with the implication it has on nursing practices. Also discussed were the barriers in terms of challenges nurses face while adopting EBP, such as keeping up-to-date with the latest literature and evidence-based practices. Furthermore, elaborated were the characteristics of ESBL, risk factors, symptoms and nursing interventions aimed at combating the spread of this disease. Lastly presented, was current data on ESBLs in Finland and the impact of evidence-based practice on infection control measures.

3 THEORETICAL FRAMEWORK

Brought forward in this chapter is nursing theory along with the theoretical framework that the authors selected for this investigation. Nursing theory is a set of ideas and concepts that guide nurses in the treatment of the patients. It explains the illness and predicts the etiology. It encompasses the actions of both patients and nurses with the goal of treating illnesses (University of Wisconsin 2017). Indeed, Brown (1964) stated that nursing theory should be the foundation of practice that helps to create knowledge. It also helps to determine which direction nursing practice should head taking into consideration the needs of society in the future. Lastly, the theoretical framework describes the theory and research problems of the research study (Abend 2008).

For this research study, the authors chose The Health Promotion Model (HPM). Nola Pender first introduced the model in 1982. Pender later revised the model in 1987 and yet again in 1996 (McEwen & Wills 2011). The HPM helps nurses to achieve health-by-health promoting behaviors that increase the wellbeing of a person (Pender, Murdaugh & Parsons 2011). The authors chose this particular model because the writers are nursing students who are familiar with nursing practice. This model illustrates the aspects that can affect the behaviors of nurses concerning health promotion (Alligood & Tomey 2010). While searching for a theory related to the health promotion, the authors happened upon the HPM. This is not a new model; other researchers have used this model to communicate concepts and considered positive as it aids in validating this model.

3.1 Elements of Health Promotion Model

The philosophical base of the HPM is to view the human being holistically. The theory states, in order to achieve the desired result of an action, the human interacts with their surroundings creating a type of framework. This theory hypothesizes that an individual acts in order to achieve a goal to produce a desired outcome. Additionally, it states that people interact with their environment and have thoughts, which drives behavior. The person's ability to make a decision depends on how he/she thinks. Furthermore, the Health Promotion Model postulates that the background of the individual has an effect

on health behavior. The model consists of three aspects that are considered critical aspects in nursing intervention. The theoretical framework of the model can be seen in Figure 1 below.

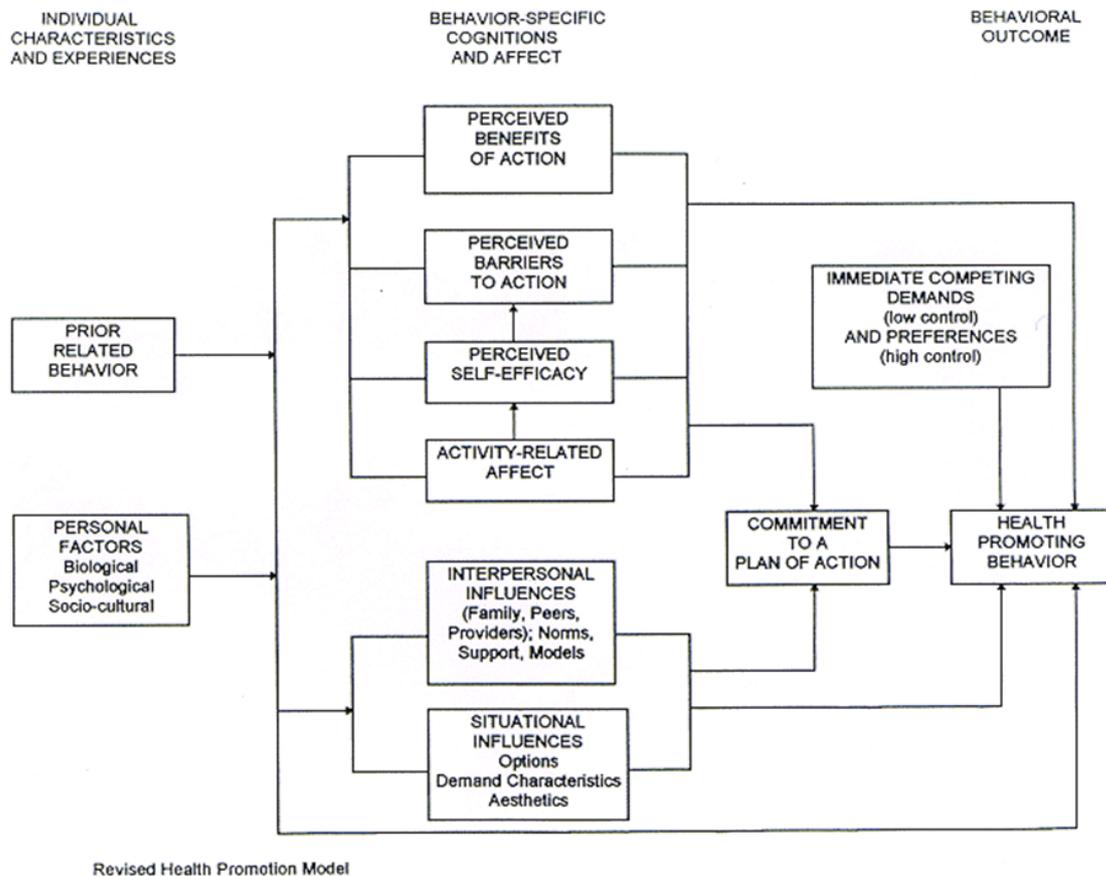


Figure 1 The Health Promotion Model (Pender et al. 2002)

The first aspect of HPM as seen in Figure 1 is the *individual characteristics and experience* followed by two sub-aspects. The first subcategory is *prior related behavior* and it relates to the background or past behavior of a person. The behaviors that the person is practicing based on their past naturally influence the current behavior. Therefore, it is important to consider this factor when formulating a plan to assist the client's health promoting behavior. *Personal factors* relates to the biological, psychological and sociocultural factors that affect the individual's behavior. Age and gender are a few examples of biological factors. Additionally, self-motivation, self-esteem and psychological factors also influence the way a person acts. Some examples of the sociocultural factors that affect behavior consist of race, education and socioeconomic status.



The second aspect of this model is *Behavior-specific cognitions and effect* with the subcategories being: *perceived benefits of action*, *Perceived barriers to action*, *Perceived self-efficacy*, *Activity related affect*, *interpersonal influences* and *situational influences*.

The first subcategory focuses on our thoughts. It suggests that by having positive thoughts we can drive healthy behaviors; this is called *perceived benefits of action*. If practiced over time, the model suggests that the person will begin to understand that through the practice of healthy behavior come benefits. The next subcategory, *perceived barriers to action* explains that while implementing healthy behavior a person may perceive barriers in implementing the actions such as lack of time, financial limitations. These perceived barriers must be addressed and a plan formulated that will support the client in overcoming these challenges. Next subcategory is *perceived self-efficacy*, which suggests that the degree in which a person is confident in their ability to organize and implement certain healthy behaviors relates to long-term sustainability. In other words, self-confidence helps in performing health behavior successfully over time. *Activity-related affect* is described as the negative or positive feelings that occur before, during or after a person's behavior or action. It states that the action performed largely motivates the person if the person has self-confidence while doing something. Thus, feelings are taken into consideration. Next comes, *interpersonal influences*, which consist of behaviors influenced by others. Some examples are families, peers and even healthcare providers. The last aspect of this category is *situational influences*. This suggests that the understanding of any situation or problem can also influence the behavior of the person. Some of the factors that influence the health promoting behaviors are available options/opportunities to develop and the environment.

The third and final aspect covered in this model is *behavioral outcomes*. The first of three subcategories is *health promoting behaviors*. The model considers this as the final action of the person in gaining desired, positive, healthy outcomes. Through healthy behavior, such as a healthy diet and exercise, the person can benefit from a healthy lifestyle. Next comes, *commitment to a plan of action*. The aim being the identification of a planned action supports implementation of the healthy behavior. This enables a person to maintain their commitment to an action until it is completed. Finally, we have *immediate competing demands and preferences*. The behaviors affect the course of action just



prior to the planned health behaviors. The preference of one behavior affects the implementation of a plan or action.

All of these aspects listed work together to form a holistic picture to aid individuals in modifying their behavior to reflect a healthy lifestyle. It is also worth mentioning that prior to implementing this model, nurses should first assess their own beliefs and aim at achieving a healthy lifestyle so that they can care for others. When it comes to care activities, this model focuses on ways of nurturing healthy behaviors through relationships creating a lifestyle that is beneficial to the patient as a whole (Pender 2011).

4 AIMS AND RESEARCH QUESTIONS

This thesis builds on the knowledge that nurses should practice aseptic measures for preventing the spread of infection. However, there seems to be gaps in nurses' practices and evidence-based guidelines. Hence, this paper intends to present guidelines for the nurses in the form of a guidebook that will support nurses when caring for ESBL carriers in the nursing home setting.

From this study, the authors are trying to find the answers of the following research questions:

1. What are the current evidence-based practices regarding infection control while taking care of ESBL carriers in the nursing home setting?
2. How can the nurses prevent the spread of ESBL infection in nursing homes?
3. What is the current situation of ESBL in Finland?

5 METHODOLOGY

In this chapter, the authors present with the methodology used for the study beginning with a brief overview of what a literature review entails followed by the data collection process and analysis. Finally come some of the ethical considerations made during the writing of this thesis. The authors used literature review as the method for this research study and the approach was inductive.

A Literature review allows one to provide a comprehensive picture about the research question through searching and analyzing relevant literature systematically. Through this type of investigation, one hopes to discover new insight as the relevant pieces of information that come together in context. The results could provide a better understanding of the topic chosen for investigation (Aveyard 2010). Additionally, a review of literature can be viewed as a process of surveying, gathering and critically evaluating information through the work of literature available on the selected topic of interest. Depending on the scope of the investigation, a more saturated and refined work on the subject may be possible, adding to the already prevailing body of knowledge (Royal Literary Fund 2017).

5.1 Data Collection

Data collection is the process of searching, reading and analyzing the information from different sources during the literature review. The purpose of data collection is to help researchers get the appropriate answers for the research questions. It helps the researchers to evaluate the outcomes and validate their study. It also aids in identifying the questions for further probabilities and future investigations. To assure the quality of the study, the data collection should be accurate with the use of the scientific search tools (Rouse & McLaughlin 2016).

The process of the data collection includes use of electronic tools in searching keywords related to the research questions. The search tools used in this research were Academic Search Elite (EBSCO), PubMed, Science Direct and Google-scholar. Additionally, the authors used an inclusion and exclusion criteria while collecting the information. The

inclusion criteria used to select the articles for this study were as follows: articles published between 2006-2017, freely accessible articles, articles in the English language and the articles related to the topic. The exclusion criteria for data collection were as follows: the articles published before 2006, articles that were not free, articles other than in the English language, and articles thought not related to the topic. The authors have illustrated the data collection and retrieval process in Table 3 below.

Table 3 The data collection and retrieval process

Databases	Keywords	Number of Hits	Relevant articles	Selected articles
EBSCO	ESBL AND nursing homes	37	5	3
Science Direct	ESBL AND nursing homes	520	9	3
	ESBL carriers AND nurses role	147	3	1
Google Scholar	Evidence based practice AND ESBL carriers AND nursing homes	794	8	2
	ESBL AND infection prevention AND long term care facilities	385	30	7
PubMed	ESBL AND nursing homes	59	8	3

In the first phase of data collection, the authors used “Academic Search Elite (EBSCO)” to search for literature. The search words used were “ESBL AND nursing homes”. The search resulted in 37 hits. The authors filtered the result after selecting the articles pub-

lished between 2006 and 2017, availability of full text and peer-reviewed journals. The search resulted in 10 hits after the filtration. The authors selected 5 articles on the basis of relevancy to the topic.

Next, “Science Direct” search database was selected using the phrase “ESBL” AND “nursing homes” from the “Journal and All” section. Also the search period of “2006-present” was selected resulting in 520 hits. Upon applying the “open access articles” option, the result decreased to 74 hits. Ultimately, 9 articles were selected based on relevancy toward the topic. Using the same database, the authors used a new set of words. They were “ESBL carriers AND nurses role” from the “Journal and All” section. Again selecting the search period “2006-present”. There were 147 hits. The authors selected 3 articles on the basis of relevancy to the topic of this thesis.

For the next search database, the authors used “Google-Scholar”. The search words used were “evidence based practice AND ESBL carriers AND nursing homes”. The search resulted in 794 hits. By selecting the time range “2006-2017”, the result decreased to 667 hits. The number of articles selected for the further study was 8 in total. From the same search database, the authors used the keywords “ESBL” AND “infection prevention” AND “long term care facilities”. The result from the search was 385 hits. After selecting the time range of “2006-2017”, the search recorded 339 hits. From this result, the authors selected 30 articles based again on relevancy to the topic.

The fourth database used was “PubMed”, as the writers felt there was still not enough data for this study. The keywords for the search were “ESBL” AND “nursing homes”, which resulted in 59 hits. After using the criteria of ten years and full text, there were 47 hits. The authors selected 8 relevant articles for this study.

From the aforementioned search databases, the authors selected altogether 63 articles for the further study. Because of the scope of this thesis, authors had to lower the number of articles. Thus, the authors used inclusion and exclusion criteria to identify the articles that they will use further for this study. The authors have already described the inclusion and exclusion criteria used in this chapter. Furthermore, the research questions helped in ensuring the quality of the data selected and helped to guide and to stay fo-

cused on the relevant literature. After following these criteria, the authors selected 19 articles for data analysis. The authors have listed the selected articles as Appendix 1 in in hopes of facilitating readability.

5.2 Data Analysis

The data analysis process consists of answering the research questions from the collected data. The purpose of the data analysis is to summarize the findings of literature review, even though the main aim of the data analysis is to interpret the findings. The interpretation of the data helps the authors to explain the reason for differences and similarities with other findings concerning the same study (Aveyard 2010).

As mentioned earlier, the authors used an inductive approach to analysis the data for this study. Hsiu-Fang & Shannon (2005) identified three approaches to interpret the content from the collected data. The three approaches are conventional content analysis, directed content analysis and summative content analysis. The conventional content analysis emphasizes avoiding precoding and shares similarity with grounded theory. It follows the inductive approach. Where as, a directed content analysis follows a deductive approach. It shows the relationship of outcome to the theory of the study. Summative content analysis interprets the use of words or phrases and finds their meaning.

The authors used the qualitative content analysis during the data analysis process. According to content analysis of Graneheim & Lundman (2004), in the first step, the investigator reads the selected articles texts several times thoroughly to facilitate understanding the content and highlighting relevant data. In the second step, the researcher divides the notes, in accordance to the content of the study, into meaning units. The findings from the articles should be trustworthy and the evaluation is done with the intention of the bringing to light the findings. The authors have presented the steps of data analysis below in Table 4.

Table 4 Steps of data analysis

Step 1: reading and coding

- After collecting the data, 19 articles were selected that were relevant to the re-search questions.
- Thoroughly reading the articles several times, relevant and interesting data was selected and noted.
- The relevant information collected was marked with different colors.

Step 2: listing and categorizing the codes

- In the second steps of content analysis, the notes taken were read thoroughly several times and the information was listed.
- According to the relevancy of the codes, the information was then categorized and formed a group.

The author chose Graneheim & Lundman (2004) content analysis method because of its familiarity with nursing research. In the first step of the data analysis, the authors thoroughly read the selected 19 articles. Then, the authors picked and noted the interesting data with different color markers. In the second step, the authors read the notes thoroughly several times and listed the information. The authors then categorized the information and formed groups according to the relevancy of the codes.

5.3 Ethical Considerations

Ethics refers to a concept that distinguishes between right and wrong. It is a method used to lead actions while analyzing complex issues. While conducting research, the investigator should be responsible and meet the ethical norms of good scientific practice. Thus, the authors attempted to follow the guidelines for writing scientific research obtained from the Thesis Guide 2014 Version 2.1 of Arcada University of Applied Sciences, Finland. One of the purposes of ethical conduct is to prohibit the falsifying of data or alter the findings for minimizing errors in the research. Intentional fabrication of the results is therefore considered unethical. For derived data or information, the author



must give credit to the owner of the data through proper referencing. Lastly, the authors should avoid any sort of plagiarism (Resnik 2013).

It is also worth noting that during the data collection process, for the data and information used from the selected articles, the authors used proper referencing and provided proper credit to the articles' original authors. The authors have not knowingly violated copyright issues and have avoided plagiarism while conducting this investigation. During the writing phase, the authors did not perform any action of copy and paste from the articles. However, the standard and contact isolation precautions guidelines while taking care of ESBL residents in nursing homes in Finland listed as Appendices 2 and 3 was translated into English from its original language. The authors did this, as they could not find any guidelines for Finnish nursing homes regarding ESBL in the English language. The authors attempted to maintain a neutral position during this thesis process with the intention of limiting biasness. Lastly, the results presented in this work directly reflect what the collected data showed, and were not fabricated.

6 FINDINGS

This chapter presents the findings that the authors made after going through each of the articles selected in the data collection process. The authors analyzed the information acquired from 19 different articles. During the course of analyzing the articles, some major underlying themes emerged across the study. Some of the themes are as follows: Adequate use of infection prevention method by healthcare staff, correlation between antibiotic use and ESBL in nursing homes, and the need for increased awareness and knowledge regarding ESBL while taking care of residents with ESBL in nursing homes. The authors have further elaborated these themes alongside other sub-themes as Appendix 4 in the Appendices of this thesis.

6.1 Evidence Based Guidelines for ESBL Carrier Residents in the Nursing Home setting

The first theme identified through the literature review was *evidence-based guidelines for ESBL carrier residents in the nursing home setting*. Articles (1, 2, 4, 5, 8, 9, 15 and 18) mentioned practices of infection control performed by nurses in different nursing homes. Based on the similarities of the content, the authors have grouped the findings from the articles together in the respective subgroups and themes. The first being the *need for implementation of infection prevention*. Articles (2, 5, 8 and 18) emphasized the importance of infection control guidelines. Article (2) reported that in one of the three nursing homes, the fecal carriage of CTX-M-type ESBL producers was the lowest equaling (6.1 %). The evidence from this article suggests that the nursing home with fewer residents (51 beds) had better implementation of infection control measures. Therefore, it is important to note that the prevention and transmission of ESBL producers can only be managed through close monitoring. According to article (5), another factor for high prevalence of beta-lactamase-producing Enterobacteriaceae among nursing homes is cross transmission. It also stated that 35.5 % of the residents who were at least one time a carrier had no history of antibiotic treatment recently. Article (8) stated that in order to improve the better management of the infection, it is necessary to implement proper hand hygiene along with necessary use of gloves and gowns.

Article (18) measured the quality of infection control in nine nursing homes in the Netherlands. It reported that on average 24 % (ranging from 19 % to 50 %) of infection control guidelines were not made readily available to staff. Therefore, infection prevention was not available in all of these nursing homes. As a result, environmental contamination was high in all but one nursing home. After the report was prepared, the managers of the nursing homes developed the missing guidelines and infection prevention protocols.

The following articles identified the next subtheme *lack of implementation of infection prevention measures*. Article (1, 4 and 9) mentioned the lack of implementation of infection prevention measures in nursing homes. In article (1), the staff interviewed about infection control, had good knowledge but lacked the implementation of the practice. The staffs from five nursing homes (n=172) were asked in which situations would they wear gloves and apron. They had a general knowledge to wear aprons and gloves during “dirty procedures” but admitted they do not follow the practice all the time. During the study period, the staff sometimes failed to remove their gloves and clean their hands before leaving the resident’s room. Article (4) highlighted the association between ESBL carriage and the Facility A (nursing home). In facility A, the percentage of residents colonized with ESBL-producing organisms was 27 % in Wing X and 10 % in Wing Y. It further reported that the reason for the presence of the strain in both wings might be because same nursing staffs and cleaner were working in both wings. It stated poor infection control practice might be the reason for spread of the organisms. Article (9) conducted a qualitative study on the staff experiences while caring for patients with extended spectrum beta lactamase. The study interviewed five registered nurses (RNs) and five assistant nurses from a nursing home. Nurses reported that there were no guidelines or other routines at the time of the first ESBL admission. The situation resulted in wearing long sleeved gowns and double gloving, which may have caused discomfort to the resident and caregivers. Thus, infection control guidelines are important but the correct way of implementation is equally important.

The next sub them is *isolation precautions*. Article (4) highlighted that nursing homes implement contact isolation for the patients with multi-resistant gram-negative bacteria. It is difficult to implement this in residential aged care facilities as the residents share

common rooms such as dining rooms and recreational areas. As a result, this increases risk factor for resident-to-resident contamination. Another article (8) stated that the infection control guidelines are unrealistic as residents also live in the nursing home and it is their home too. It was thought that the employees working in this facility could benefit from additional educational programs. Article (14) was a long-term survey conducted by the microbial laboratories of the Assistance Publique Hopitaux de Paris that consisted of 7000 beds in long-term care facilities (LTCFs). It indicated an increase of ESBL producing isolates per 1000 hospitalization days in LTCFs from 0.07 in 1996 to 0.28 in 2005. It further stated that implementation of isolation precaution was difficult in LTCFs which might be the reason for the spread of ESBL strains in LTCFs. In article (15), the long-term care facility used contact precautions measures for three of the residents who had urinary tract infection with ESBL due to unavailability of proper isolation rooms.

6.2 Dynamics of Antibiotic Use in Nursing Homes to Treat Residents Carrying ESBLs

The next theme identified through the literature review is entitled, *Dynamics of Antibiotic Use in Nursing Homes to Treat Residents carrying ESBLs*. Unsurprising enough, out of the 19 articles used in the study, 16 articles (1,2,3,4,5,6,9,11,12,13,14,15,16,17,18,19) talked about the relationship between ESBLs carriers and the use of antibiotics for treatment in nursing homes. The authors have sub-grouped the findings from the articles and explained below.

The first subtheme is *Correlation between use of antibiotic and Extended Spectrum Beta-lactamase*. Findings from 8 of the articles (1, 5, 9, 11, 12, 16, 18 and 19) have shed light on the co-relation between the use of antibiotics and Extended Spectrum Beta-Lactamases. Article (1) reported that 42 % of ESBL positive residents had antibiotic treatment more significantly than 28 % of residents with no ESBL positive, 6 months prior to sampling. The increase in risk factors for carriers of ESBL-producing Enterobacteriaceae was high due to the use of antibiotics. Article (5) conducted a cross-sectional study in two major nursing homes in North Lebanon. The percentage of residents who had been on an antibiotic recently was 59.6% (31/52) among the ‘at least one time’ carriers and 18.8% (3/16) among the ‘never’ carriers. The final analysis of the re-

port was that the only risk factor associated with multi-drug resistant Enterobacteriaceae was the recent intake of the antibiotic. Another article (9) interviewed nurses concerning their experience while caring for patients with ESBL producing bacteria. Generally, the nurses were aware of the avoidance of the use of antibiotics. The participants also expressed the fear of antibiotic resistance that might be a great threat to humankind, and in the future, possibly the greatest of all because antibiotics will not be strong enough to combat infections leading to deaths on a massive scale. Article (11) conducted a study at a long-term care facility with 88 residents in Ireland. They looked into the molecular characteristic of ESBL producing Enterobacteriaceae isolates and antimicrobial susceptibility among other things. The study found that out of the 64 residents, who participated in the study, ESBL-EC isolates recovered from rectal and urine samples were resistant to ciprofloxacin as well as to co-amoxiclav. In addition, the residents who received antimicrobial three months prior to the sampling had 2.4 fold higher odds of ESBL colonization. The study also goes as far as to suggest that the use of antimicrobial are an added risk factor for carriage of ESBL-EC as the ESBL-Enterobacteriaceae are resistant to commonly given antimicrobials in the long-term care facilities. Article (12) also made the similar conclusion. Given the high prevalence of ESBL, it concluded that nursing homes should limit the use of antimicrobial drugs amongst the residents and avoid unnecessary use of antibiotic treatment.

A study conducted by article (16) in Northern Ireland that collected fecal samples from 294 residents showed that over 40% of the samples tested positive for Multidrug-resistant *E. coli*, suggesting the increase in spread among nursing homes. Interestingly enough, residents who had high exposure to antibiotics were significantly higher among carriers having received more days of treatment of trimethoprim and fluoroquinolones. The article suggested that the treatment should be appropriate and limited use of antibiotics with close supervision of the outcome is essential. Article (18) conducted a study in 9 nursing homes in the Netherlands. A total of 643 residents were tested for rectal ESBL carrier out of which 70(10.9%) tested positive. Although, there were major shortcomings on the part of the nursing homes, one of the significant bits was prescription of antibiotics without screening for the pathogen. This resulted in infections and indiscriminate use of antibiotics.

The next theme identified through the literature review is *Antibiotic treatment for patient with Extended Spectrum Beta-lactamase*. Ten of the selected articles (2, 3, 4, 6, 13, 14, 15, 16, 17, 18 and 19) mentioned themes concerning antibiotic treatment for patient with Extended Spectrum Beta-lactamase. Article (2) found 44 CTX-M-type ESBL producers' multidrug resistant from 3 nursing homes. This showed a high level of co-resistance to quinolone antibiotics. Besides quinolone antibiotics, more than half (25 out of 42) isotopes also showed resistance to tetracycline. All of the 44 CTX-M-type ESBL producers were susceptible to carbapenem and amikacin. Article (3) showed that infections derived from ESBL producing Enterobacteriaceae caused inadequate initial empirical antibiotic treatment, potentially leading to rise in mortality in cases with severe infections. As seen during the analysis of resistance patterns of ESBL found in patients, it displayed widespread resistance to trimethoprim-sulfamethoxazole and ciprofloxacin, which are antibiotics widely used for treating infections such as UTI. Similarly, article (4) also found that beside β -lactamase, ESBL producing strains. They were also resistant to commonly used antibiotics among elderly. This relayed the need for careful selection of antibiotics. The study also found that the physicians were prescribing antibiotics without proper measures such as collecting clinical samples for a treatment course. In about 44% of the cases, physicians made antibiotic prescription without fulfilling the criteria for clinical infection. The reduction in unnecessary prescription of antibiotics helps to decrease the selection pressure that drives ESBL dissemination. Prescriptions of antibiotics should be limited to only clear suspicion of bacterial infection and the duration of the course should not be prolonged (6).

Article (13) conducted a yearlong study between 2013 and 2014 at a long-term care facility with 296 residents in the Netherlands. The study showed that of all the positive ESBL ST131 isolates detected, 69 residents displayed resistant to ciprofloxacin as compared to just 25 of the 57 from other ESBL-EC. While only 9 of the 69 resident were resistant to co-trimoxazole as compared to 43 of 57 other ESBL EC isolates obtained from 26 of 32 (81%) colonized residents. However, there was no resistant towards colistin, meropenem or imipenem among any of the isolates. The microbial laboratories of the Assistance Publique Hopitaux de Paris carried out one of the earliest long-term surveys on ESBL-producing isolates from samples collected of residents at long-term care facilities in Paris from 1993 onwards. The study showed that there was a fourfold in-

crease in ESBL producing Enterobacteriaceae between 1996 and 2005. The strain of ESBL found during the study was resistant to amoxicillin, ceftriaxone and fluoroquinolones, which are among the widely used antibiotics to treat infections among elderly (14). Article (15) studied 104 residents over the period of seven months in a long-term care facility in the Kingdom of Bahrain. The study found 8 of the residents to be ESBL carriers. The facility later used meropenem for treatment of the ESBL carrier residents with successful results. Article (16) suggests the use of Nitrofurantoin and fosfomycin to treat infection, as they are active against ESBL producing *E. coli*. Of all the fecal samples collected from the residents in a nursing home in Bavaria, Germany (2017), 14.7 % of them tested positive as ESBL carriers. Although the study found that ESBL *E. coli* was resistant to most antibiotics group, they showed no resistance against carbapenems (17).

Article (18) measured the quality of infection control in Dutch nursing homes. It stated that eighteen residents equaling 45 % of all the residents on antimicrobial therapy were receiving treatment with antibiotics without any healthcare associated infections. Article (19) did not find any carbapenemases resistant strain of ESBLs, however the resistance rates in *E.coli* collected through urine samples of the residents towards urinary tract infection were, for ampicillin 31%/21%, mecilli-nam 4.6%/7.7%, cefadroxil 3.5%/72.6%, nitrofurantoin 1.1%/0.85, trimethoprim 19%/12% and ciprofloxacin 7.6%/3.4% accordingly.

6.3 Role of Education in Nursing

Next theme that emerged during the literature review is *the role of education in nursing*. Articles (1, 9, 10 and 18) stated the need for the implementation of educational activities for nurses. Article (1), after the interview and observation that concerned the guidelines and principles of infection prevention, found out that the staff had knowledge about the guidelines but lacked implementing them in practice. Thus, there was a shortcoming in evaluating whether or not the infection control guidelines were not only implemented but also here adhered to over a longer period of time. Furthermore, it emphasized a need

for continuous work to improve shortcomings. In article (9), nurses from the nursing homes confessed their lack of knowledge about ESBL and the guidelines for care and antibiotic resistance. The nurses also expressed a lack of adequate level of knowledge about the antibiotic resistance bacteria and transmission. The low level of knowledge resulted in fear among the nurses. Education is therefore, considered essential as registered nurses play an important role in educational activities and care activities.

Continuing with this theme, Article (10) reported that after there one program that promote hand hygiene. The use of hand rub increased by 70 % between September 2004 and October 2005 in Finnish LTCFs. It highlighted a lack of hand hygiene programs in the LTCFs. A study conducted in the Netherlands among different nursing homes found significant shortcomings on the part of nursing homes in terms of infection control. The shortcomings included lack of one hand washing station per 15 residents, absence of gowns and hand alcohol and significant lapses related to containing environmental contamination. After the report, the nursing homes started educational programs (18).

The final subcategory for this theme is *Education for patients and relatives*. Article (9) reported that the residents might not know that they have ESBL because of dementia. Relatives of the resident fear contracting ESBL and are afraid that the patient will bring ESBL back home with them during visitations. Therefore, it is also important to raise awareness among relatives about ESBL.

6.4 Prevalence of ESBL in Nursing Homes

The last theme identified in this review of literature is *prevalence of ESBL in Nursing Homes*. Article (1) conducted a study on the prevalence of Methicillin-Resistant Staphylococcus Aureus (MRSA), Vancomycin-Resistant Enterococci (VRE) and Extended Spectrum Beta-Lactamase (ESBL) producing bacteria in 9 nursing homes. The study reported 15 of the residents to be ESBL positive. However, the study did not find any MRSA or VRE in the study group. Results from the study in article (4) showed the colonization rates of VRE (2%), *C. difficile* (1%) and ESBL isolates (12 %). Article (7) reported high prevalence of ESBL producing Enterobacteriaceae in 2 nursing homes. According to the study, 75 % of residents had the bacteria in their stool. Article (8) re-

ported that 64 % of the residents from LTCF ESBL colonization producer among carriage of resistant bacteria.

Presented in this chapter, were the results of the literature review. In summary, the 19 articles selected for the analysis revealed that ESBL producing bacteria is prevalent in nursing homes. The residents in the nursing homes are dependent on the nurses for most of their daily activities. This means there are many encounters where direct contact between the residents and the nurses happens on daily basis. If nurses do not implement infection prevention when caring for the residents, there is a possibility for transmission of infections from the nurses to the residents and vice versa. The articles highlighted that nurses should follow evidence-based standard precautions when caring all the residents. Additionally, nurses should implement contact precautions for the residents colonized or infected with ESBL. They further stated that nurses should have adequate knowledge about the antibiotics and raise questions if the physicians are prescribing antibiotics unnecessarily or without fulfilling the required criteria. Next, nursing homes should provide further educational programs regarding antimicrobial stewardship and evidence-based guidelines in order to prevent the spread of the ESBL. In the next chapter, the reader will find the discussion where the authors will further delineate the evidence gained through this investigation.

7 DISCUSSION

In this chapter, the authors attempt to discuss further the questions raised in this thesis. The authors have already discussed the third question regarding the current situation of ESBL in Finland in the background section. Firstly, the authors will discuss the implementation of evidence-based guidelines to aid in infection prevention and control. Next, management of prescription antibiotics is covered. Additionally, the authors again present and discuss education among nurses followed by the health promotion model first outlined in chapter 3.

As stated earlier, infection prevention and control practices are important factors in the field of caring. They guide healthcare professionals in preventing the spread of infection and provide quality care to clients. As there are many research activities in the field of nursing practice, the guidelines are constantly evolving which helps to guide nurses in the latest evidence-based guidelines. At the same time, there is a large amount of information, which can create confusion and perhaps be overwhelming. The information found may not be correct or may have biases. Thus, in order to obtain accurate evidence-based guidelines, the nurses should use recognized professional sources. Some examples of reliable sources are World Health Information, European Centre for Disease Prevention and Control, and International Federation of Infection Control (Infection prevention and control 2014). According to Wilson *et al.* (2015), nurses should apply standard precautions for all the residents. It stated that the healthcare workers should implement standard precautions with contact precautions for residents with colonized or infected with multi-drug resistant bacteria.

When it comes to infection control, according to the articles, nursing home staff had general knowledge about the hygiene guidelines but failed to implement the knowledge in practice. Some of the reasons for lack of implementation of hygiene practices might be the lengthy time duration when applying and removing protective gear, lack of resources and for some, lack of hygiene guidelines in nursing homes. Moro *et al.* (2013) supported this idea in that the spread of ESBL producing bacteria results from the fact that staffs simply do not implement infection prevention measures. Additionally, nurs-

ing home staff do not clean and decontaminate the environment on a regular basis, and waste is not disposed of properly. Efstathiou *et al.* (2011) reported that nurses regarded the reasons for not following standard precautions as being too busy due to the shortage of staff in the nursing home. As mentioned earlier in this work, the authors produced a guidebook for the nurses of Hopeakuu Palvelutalo. The authors prepared a guidebook according to the findings during the study. The English version of the guidebook is located in Appendix 5. However, the authors will give a Finnish version of the guidebook directly to the Hopeakuu Palvelutalo, as Finnish is the primary language of the nursing home.

It is interesting to note that the National Board of Health and Welfare (2007) highlighted that the standard precautions are the principles of infection prevention that healthcare professionals need to implement at all times. These principles include alcohol-based hand rub before and after direct contact with the patients, use of gloves and aprons if there's risk of body fluids, daily change of work clothes, no use of watches and jewelry, no use of nail polish and shortening of the nails. Some of the articles touched on the topic concerned with implementation of isolation precautions in LTCFs. It is thought to be difficult to implement isolation precautions in some nursing homes. As mentioned earlier, for the residents, the nursing home is their home and they share the common rooms such as dining rooms and recreational activities. The residents in the nursing homes are dependent on nurses. Dr. Jump (2017) reported the challenges considering isolation precautions. According to him, the residents live in the nursing home, and there is a question concerning the personal rights of residents and patient safety. The difficulty is that the nurses cannot ask the residents to be isolated for several weeks. Thus, with these residents, nurses should implement proper hand hygiene before and after contact with residents, use of gowns and gloves before entry to resident's room, remove gowns and gloves before exiting resident's room along with hand hygiene. Healthcare workers should clean and disinfect equipment after use. Additionally, the residents should also implement hand hygiene. They should maintain personal hygiene, and cover any wounds properly before leaving their room (Anwar 2017). According to HUCH (2012), in nursing homes, the nurses should implement standard precautions when caring the carrier of ESBL-*E. Coli*. If the resident is not able to keep up with the hygiene instructions, then the nursing home should offer them a private room. The car-

riers of ESBL-*K. pneumoniae* should be in a separate room with their own toilet and shower. The nurses should implement standard precautions along with contact precaution for the carrier of ESBL-*K. pneumoniae*. When the residents are out of their room, implementation of standard precaution is enough but healthcare professionals should implement contact precautions in any therapeutic measures such as during physiotherapy. The authors have illustrated the standard and contact precautions as Appendix 2 and Appendix 3 respectively in the Appendices section of this thesis.

It was also discussed earlier, when preventing the spread of ESBL in nursing homes, all healthcare workers should implement infection prevention to prevent the transmission of ESBL producers from patients to staff or vice versa. Another study (Yeung *et al.* 2011) supports the finding in reporting the effectiveness of hand hygiene in controlling the spread of infection. It found out that during the study, the adherence to hand hygiene guidelines increased significantly and the infections decreased from 1.42 cases to 0.65 cases per 1000 residents in Hong Kong LTCFs.

The next takeaway from this thesis is antimicrobial stewardship. More than 50 % of the studied articles found that the frequent use of antibiotics was the main risk factor associated with the residents with ESBL. These articles highlighted use of right antibiotics to treat the residents with ESBL. There are some antibiotics such as trimethoprim-sulfamethoxazole and ciprofloxacin that are resistant to the ESBL-producing bacteria. These antibiotics are widely used for treating infection such as UTI. The physicians prescribe the antibiotics without taking clinical samples, inquiring the severity of the illness nor risk factors associated with it. Instead, physicians should consider the right choice of antibiotics after proper examination. As stated earlier, carbapenems and amikacins are effective for the treatment of ESBL-producing bacteria. Additionally, Shaikh *et al.* (2015) pointed out that carbapenems are still effective in the treatment of ESBL-producing *E. coli* and *K. pneumoniae*. It further stated that some ESBL-producing Enterobacteriaceae showed resistant to carbapenems. They also feared the rise of the “super bug” in the future, which will be resistant to all the existing antibiotics leading to a potential rise in mortality rates on a global scale.

It is true that nurses are not directly associated with prescribing of antibiotics in Finland but in other countries, nurse practitioners do prescribe medication. Even if the nurses do not prescribe these drugs, with adequate knowledge about antimicrobial stewardship, nurses can influence the correct use of antibiotics on a case-by-case basis. One example of this came from The Department of Health Advisory Committee on Antimicrobial Resistance and Healthcare Associated infection (2013). They postulated that a senior nurse could be dedicated as a member of an antimicrobial stewardship team. This nurse should ensure that the prescribing of antibiotics meet the evidence-based guidelines that includes right use of antibiotics, prescribing after the clinical sampling and correct duration of the antibiotic treatment. In addition, this person should report to the respective authority if the physicians are giving unnecessary prescriptions.

Not only was it revealed through this study that EBP, infection control and proper use of antibiotics are essential components in the delivery of quality care, but the lack of knowledge among nursing staff poses a problem. Sometimes, the nurses feel that the best practice they are using is “evidence” based, but their sources may not be research based. It was interesting to note the study by Thompson *et al.* (2003) stated that most of the knowledge source of nurses for the practice is from personal experience and advice from co-workers. Therefore, EBP helps the nurses in finding the best and effective research-based method in caring for a patient. It does not involve the tradition, myths, co-workers advice or guidelines from outdated version. For example, when nurses seek solutions for their problems relating to good practice, nurses should be careful about the origin of the guidelines. While considering a textbook, the nurse should note the year of publication. Asking for advice from co-workers may be from their personal experience, tradition or myths. If outdated knowledge is used for the practice, the quality of care is not improved (Beyea & Slattery 2006).

Not only do habits effect the implementation of EBP but also beliefs and attitudes. We saw in earlier chapters that it seems nurses can fear the fact that they might incur infection from the ESBL producing bacteria. Due to the fear, the nurses might not want to care for these residents. This has the potential of violating the personal rights of residents in receiving quality care. Therefore, Education is crucial for nurses. Nursing homes can prevent the spread of ESBL producing bacteria within their facilities by in-

creasing awareness and knowledge among staff through educational activities. Mohsen *et al.* (2016) recommended that there should be training available online. One of the articles suggested that nurses should also educate residents and visitors about ESBL and give them instruction on infection prevention measures. In the mission to prevent the spread of infection, the nurse can collaborate with residents and visitors. To reinforce the teaching, nurses can give them pamphlets and factsheets regarding the precautions measures (Baker 2016).

If we take what has been discussed above and apply it using The Health Promotion Model, one can conclude that the person's past behavior has influence on future actions influencing health promotion. For example, risk of disease transmission can influence healthy behaviors. The reasons that affect the spread of infection are lack of awareness of the level of contamination, heavy workload and lack of hand hygiene guidelines. In order to influence the nurses' health behaviors, the solution may be to provide healthcare education on infection control and prevention. Continued education encourages the nurses to adopt healthy behaviors in order to prevent occupational accidents and diseases. The health behaviors include aspects of a safe work environment and use of personal protection equipment (Marziale & Jesus 2007). The Health Promotion Model encourages nurses to adopt health-promoting behaviors. For example, identifying the risk factors for infection and implementing the precaution guidelines appropriate for the type of infection.

Pender (2011) stated that the surroundings such as co-workers perception on engaging in a specific health behavior has also influence on the individual in adopting a specific health behavior. The emotional state of a person before, during or after implementation of an action affects the outcomes of specific health behaviors. Moreover, individuals are more committed to an action when their behavior influences other co-workers. Peer pressure to adopt the specific behavior can also aid in adaptation. If the nurses receive support that enables a specific health behavior, the nurses are more likely to follow-through and commit to health promoting behaviors. For example, if a nurse finds out that the other nurses are implementing the evidence-based hygiene guidelines for infection control, these actions might influence the nurse to adopt similar behaviors.

8 CONCLUSION

Through this investigation, the authors found that in many countries, there is a rapid shift in demographics as the number of elderly people increases. With this trend, the number of elderly requiring care in nursing homes also naturally increases. This study reported that in Finland, 20.9% of the inhabitants are over the age of 65 and the number is expected to increase further in coming years (Statistics Finland 2017). This increase will likely result in added constraints to the already functioning nursing home facilities. Various studies show a higher prevalence of ESBL carriers in nursing homes. This is due to inadequacy in infection control practices, close proximity among the residents and high use of antibiotics (Pelly *et al.* 2006). Nurses have an active part to play in containing the spread of ESBL in nursing homes. However, the use of proper infection control guidelines based on evidence-based practices and sufficient knowledge about antibiotic resistant organism and ESBL-producing bacteria along with proper and use of antibiotics are necessary for providing efficient care.

This study also found that proper education and training programs aimed at developing necessary skill to equip nurses and healthcare staff are helpful in achieving these targets. The training should address any potential shortcomings in current practice to limit the spread of ESBL. Due to differences amongst the ESBL-producing strains and their rapidly increasing number, the detection of ESBL carriers could present a challenge. Those antibiotics that are still effective against ESBL infections should only be used in serious cases to restrict resistant ESBL strains from the further development (Amelia *et al* 2016).

8.1 Critical Analysis

The study covered a wide theme using a review of literature equaling 19 articles. Through this investigation, the authors were able to answer the research questions posed. The articles selected were consistent with the purpose of the study and the articles were from different countries each using different methodologies. This provided a diverse and multifaceted insight to the study. Most of the articles used in the study were fairly recent and only few from before 2010. The oldest article used for the study was

from 2007. Having two authors provided additional insight into the study. This allowed having two different views on the content offering different perspectives. Furthermore, it also allowed for detection of any biasness on the part of either of the authors, thus keeping the study as objective as possible. The authors distributed the workload, which allowed for broader coverage. This was seen as a positive aspect of this investigation; however, the lack of research experience on behalf of the writers understandably impacts the end result.

Although there was plenty of research on the topic, most of the data available lacked the necessary requirements for the study. The current EBP in nursing literature is associated primarily with acute and primary care settings. Knowledge about its use in community care settings is scarce though community settings can also implement the basic principle of EBP to improve patient care (Leufer & Cleary-Holdforth 2009). Thus, only a few of the articles actually fulfilled the underlying criteria for the study, which involved taking care of ESBL carrier residents at a nursing home with a nursing perspective. Further limitation on the study was due to the authors' selection of only full text articles that were freely available, followed by the restriction of data collected to that of the English language. During the study, the authors found out that the implementation of isolation precautions in nursing homes is not straightforward but filled with challenges specific to each facility. Due to the scope of this thesis, the writers were not able to perform a more extensive review of literature, which could have added additional clarity to this broad choice of topic. In conclusion, the authors feel that this topic is important as it concerns nurses, thus further research is indicated, as nurses must continually seek out the newest information for their professional development long-term. In the end, further study on the topic might bring a different approach to the control and the spread of ESBL in nursing home settings.

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10 APPENDICES

10.1 Appendix 1. List of the articles selected for the study

Article Authors	Title	Journal and Year	Conclusion
Article 1 Helene Andersson, Christina Lindholm, Aina Iversen, Christian G. Giske, Åke Örtqvist, Mats kalin and Bjöörn fossum	Prevalence of antibiotic-resistant bacteria in residents of nursing homes in Swedish municipality: Healthcare staff knowledge of and adherence to principles of basic infection prevention	Scandina- vian Jour- nal of In- fectious Diseases 2012	Risk factor for the ESBL producing Enterobacteriaceae was the high use of antibiotics. Healthcare staff has lacked adherence to infection prevention guidelines.
Article 2 Ulzii-Orsihk Luvsansharav,It aru Hirai, Marie Niki, Arisa Na- kata, Aya Yoshinaga, Aki- ra Yamamo, Mayumi Yamamoto, Hi- royuki Toyo- shima, Fusao	Fecal carriage of CTX-M B-lactamase-producing Enterobacteriaceae in nursing homes in the Kinki region of Japan	Infection and Drug Resistance 2013	There was lowest finding of EBL producers in nursing home with fewer residents. Nursing homes should monitor Infection prevention.

<p>Kawakami and Nariaki Matsuura</p>			
<p>Article 3 Andreas Blom, Jonas Ahl, Fredrik Månsson, Fredrik Resman and Johan Tham.</p>	<p>The prevalence of ESBL-producing Enterobacteriaceae in a nursing home setting compared with elderly living at home: a cross-sectional comparison</p>	<p>BMC Infectious Diseases 2016</p>	<p>The prevalence of ESBL producing bacteria in nursing homes has increased. Relationship between antibiotic treatment and the ESBL producing bacteria.</p>
<p>Article 4 Rhonda L Stuart, Despina Kotsanas, Brooke Webb, Susan Vandergraaf, Elizabeth E Gillespie, Geoffery G Hogg and Tony M Korman,</p>	<p>Prevalence of antimicrobial-resistant organisms in residential aged care facilities</p>	<p>The Medical Journal of Australia, 2011</p>	<p>There was a high prevalence of ESBL producing bacteria in nursing homes. Nursing homes should provide education programs concerning good hand hygiene guidelines, environment cleaning and antimicrobial stewardship.</p>
<p>Article 5 Iman Dandachi, Elie Salem Sokhn,</p>	<p>Carriage of beta-lactamase-producing Enterobacteriaceae among nursing home residents in north Lebanon</p>	<p>International Journal of Infectious Diseases</p>	<p>Prevalence of ESBL producing bacteria was high.</p>

Elie Najem, Eid Azar and Zaid Daoud.		2016	
Article 6 Beatrice Jans, Didier Schoevaerds, Te-Din Huang, Catherine Berhin, Katrein Latour, Pierre Bogaerts, Claire Nonhoff, Olivier Denis, Boudewijin Catry, Youri Glupczynski	Epidemiology of Multi- drug-Resistant Microor- ganisms among Nursing Home Residents in Bel- gium	BioMed Centre In- fectious Diseases, 2013	The risk factor of ESBL colonization is use of an- tibiotic recently.
Article 7 M. A. Jallad, R. Naoufal, J. Irani and E. Azar	Extended Spectrum Beta- Lactamase Carriage State among Elderly Nursing Home Residents in Beirut	The scien- tific World Journal, 2015	Prevalence of fecal car- riage of ESBL producing bacteria is high in nursing homes.
Article 8 A. March, R. Aschbacher,	Colonization of residents and staff of a long term- care facility and adjacent acute-care hospital geriat-	Clinical Microbi- ology and Infection,	Prevalence of ESBL producing bacteria was high in long term care facilities than acute-care

<p>H. Dhanji, DM Livermore, A Bottcher, F. Sieghel, S. Maggi, M. Noale, C. Larcher and N. Woodford</p>	<p>ric unit by multiresistant bacteria</p>	<p>2009</p>	<p>geriatric units. It emphasizes in improvement in hand hygiene and monitoring the disease.</p>
<p>Article 9 Susanne Wiklund and Ingegerd Fagerberg</p>	<p>Staff experiences of caring for patients with extended-spectrum b-lactamase-producing bacteria: A qualitative study</p>	<p>American Journal of Infection Control, 2016</p>	<p>Healthcare staffs have enough knowledge for caring the residents with ESBL. Education is important to obtain evidence-based guidelines.</p>
<p>Article 10 Maija-Liisa Rummukainen, Aino Jakobsson, Maire Matsinen, Pertti Karppi, Salme Järvenpää and Outi Lyytikäinen</p>	<p>Three-year sustainability of alcohol-based hand rub use of increase in Finnish long-term care facilities</p>	<p>International Journal of Infection Control, 2011</p>	<p>After the education program about the use of alcohol-based hand rub, the nurses learnt to use it. There's constant need of training program regularly.</p>
<p>Article 11 Catherine Lud-</p>	<p>Colonization with ESBL-producing and carbapenemase-producing</p>	<p>BioMed Central Infectious</p>	<p>Study found that the colonization with ESBL-EC was common among long</p>

den, Martin Cormican, Akke Vellinga, James R Johnson, Bernie Austin and Dearbháile Morris	Enterobacteriaceae, vancomycin-resistant enterococci, and 60ethicillin-resistant Staphylococcus aureus in a long-term care facility over one year	Diseases, 2015	term care facilities residents.
Article 12 Silvano Esposito, Sebastiano Leone, Silvana Noviello, Filomena Ianniello and Marco Fiore.	Antibiotic resistance in long-term care facilities	New Microbiologia, 2007	Need for appropriate antimicrobial therapy use in long term care facilities.
Article 13 I Overdevest, M Haverkate, J Veenemans, Y Hendriks, C Verhulst, A Mulders, W Couprie, M Bootsma,	Prolonged colonization with <i>Escherichia coli</i> 025:ST131 verses other extended-spectrum beta-lactamase-producing <i>E. coli</i> in a long term care facility with high endemic level of rectal colonization, the Netherlands, 2013 to 2014.	Euro Surveill, 2016	ESBL ST-131 can colonize long term care facilities for prolonged period of time due to estimated half life of about 13-months.

J Johnson, J Kluytmans.			
Article 14 Marie-Hélène Nicolas- Chanoine, Vincent Jarlier and la Collegial	Extended-spectrum b- lactamases in long-term- care facilities	Clinical Microbi- ology and Infection, 2008	Prevalence of the same strain of ESBL-producing <i>E. coli</i> in the same LTCF for long period of time mainly due to antibiotic selection pressure and difficulties to implement isolation precaution
Article 15 Jameela Al. Salman, Rawan A. Al. Agha, Yazen A. Mus- sayab, Abbas F. Hassan	Infection in long term care facility in the kingdom of Bahrain	Journal of Infection and Public Health, 2014	There should be strict implementation of infec- tion control measures in long-term care facilities.
Article 16 Paul J. Rooney, Maureen C. O’ Leary, Mark McCalmont, Brian Smyth, Philip Donaghy, Motasim Badir, Neil Woodford, Edi Karisik, and	Nursing Home as reservoir of extended-spectrum be- ta-lactamase (ESBL)- pro- ducing ciprofloxacin- resistant <i>Escherichia coli</i> .	Journal of Antimi- crobial Chemo- therapy, 2009	High exposure to antibi- otics and prevalence of gut carriage of MDT <i>E.</i> <i>coli</i> among nursing homes in the UK,

David M. Livermore.			
Article 17 R. E. Warren, G. Harvey, R. Carr, D. Ward and A. Doroshenko.	Control of infections due to extended-spectrum beta-lactamase-producing organisms in hospitals and the community	European society of clinical Microbiology and Infectious Diseases, 2008	High prevalence of CTX-M-producing <i>E. coli</i> among nursing homes in Bavaria, Germany. Importance of hygiene measures to prevent further spread of multidrug-resistant bacteria.
Article 18 Mark E. Rupp and Paul D. Fey	Measuring the quality of infection control in Dutch nursing homes using a standardized method; the Infection prevention Risk Scan (IRIS)	Antimicrobial Resistance and Infection Control, 2014	Shortcoming on the part of nursing homes under-study were the availability of infection control guides and level of environmental cleaning
Article 19 Pär-Daniel Sundvall, Marie Elm, Ronny Gunnarsson, Sigvard Mölsted, Nils Rodhe, Lars Jonsson Peter Ulleryd	Antimicrobial resistance in urinary pathogens among Swedish nursing home residents remains low: a cross-sectional study comparing antimicrobial resistance from 2003 to 2012	Bio Med Central Geriatrics, 2014	Relationship between antibiotic treatment and ESBL. Prevalence of resistance was high among residents who had antibiotic treatment few months ago or were hospitalized.

10.2 Appendix 2. Standard Precaution

Work uniform	<ul style="list-style-type: none"> ➤ Work uniform with short sleeves or sleeves rolled up to elbows ➤ Work uniforms are changed to civilian clothes at the end of the work day
Choice of room	<ul style="list-style-type: none"> ➤ Single room, if the patient leaves wound or abscess secretion stains or otherwise compromises infection control
Hand Hygiene	<ul style="list-style-type: none"> ➤ The skin of hands must be intact and supple, skin lesions are treated ➤ No wrist watches, rings or hand/wrist jewellery ➤ Short nails, no nail polish ➤ Artificial nails are forbidden <p>Disinfect hands</p> <ul style="list-style-type: none"> ➤ Before and after patient contact or procedure ➤ Before putting on protective gloves or other protective wear and after taking them off ➤ Before entering the care environment and when leaving it <p>Wash hands with water and soap</p> <ul style="list-style-type: none"> ➤ When you arrive at work ➤ When your hands are visibly dirty or feel dirty ➤ When you have examined or treated a patient with gastroenteritis
Protective wear: Protective gloves, protective apron or gown,	<ul style="list-style-type: none"> ➤ Protective gloves: when handling blood, secretions, wounds, lesions, mucous membranes or contaminated areas or equipment.

surgical mask	<ul style="list-style-type: none"> ➤ Each pair of protective gloves is only used for one procedure and microbes must not be spread to the environment with them. ➤ Other protective wear: if danger of spatter
Environment cleaning	<ul style="list-style-type: none"> ➤ The care environment is kept clean and tidy, and no clean care equipment is stored there ➤ Care equipment with secretions on it is washed in a disinfecting washing machine
Secretion stain disinfection and reducing blood contagion	<ul style="list-style-type: none"> ➤ Remove visible blood and secretion stains immediately <p>Two stage secretion stain disinfection:</p> <ol style="list-style-type: none"> 1. Soaking 2. Wiping with washing disinfectant (e.g. chlorine 1000 ppm or peroxygens)
Cleaning	<ul style="list-style-type: none"> ➤ Ordinary detergents for cleaning, patient location specific cleaning cloth (microfibre) ➤ Rooms are cleaned following the aseptic work procedure

10.3 Appendix 3. Contact Isolation Precaution

Choice of room	<ul style="list-style-type: none"> ➤ Single room, private toilet and shower recommended ➤ If a single room is not available, a cohort or room divider may be used ➤ Patient-specific and disposable care equipment is reserved for the patient room
Protective wear	<ul style="list-style-type: none"> ➤ Protective gloves are always worn when entering and working in a patient room and contact care of patients. ➤ Gloves are changed as necessary, following the aseptic work procedure, also disinfecting hands occasionally ➤ Protective gown in contact care, doctor's examinations, cleaning of rooms ➤ Surgical mask in wound care of MRSA carriers or if the patient, for example, suffers from a scaling skin condition or has an artificial airway
Cleaning	<ul style="list-style-type: none"> ➤ Room-specific cleaning supplies ➤ Concentrate on contact surfaces and cleaning of sanitary facilities ➤ Use disinfectant when cleaning, if MDR-Acinetobacter or gastroenteritis
Informing patients and visitors	<ul style="list-style-type: none"> ➤ A sign is put on the door to inform people entering the room about the contact safety measures, but the name of the microbe is not made available to outsiders. The patient is told his/her part in carrying out the safety measures ➤ Visitors use hand sanitizer when entering and exiting the room. If they participate in, for example, wound care, they are instructed to use protective wear.

10.4 Appendix 4. Illustration of theme and sub-themes

Theme	Evidence based practices and prevention of ESBL in nursing homes						
Sub-themes	Evidence based guidelines for taking care of ESBL carrier residents at nursing homes			Dynamics of antibiotic use in nursing homes to treat residents carrying ESBLs.		Education's role on nurses	Prevalence of ESBL at nursing homes
	Need for implementation of infection prevention	Lack of implementation of infection prevention measures	Isolation Precautions	Correlation between use of antibiotic and Extended Spectrum Beta-lactamase	Antibiotic treatment for patient with Extended Spectrum Beta-lactamase	Education to patients and relatives	
Unit of analysis	2, 5, 8, 18	1, 4, 9	4, 8, 14, 15	1, 5, 9, 11, 12, 16, 18, 19	2,3,4,6,13,14, 15,16,17,18,19	1, 9, 10, 18	1, 7, 8

10.5 Appendix 5. Guidebook for taking care of ESBL carriers

Overview of ESBL

- The bacteria are present in the intestinal tract, mucous membrane, urine and wounds.
- E. coli and K. pneumoniae are the most common among ESBL producing bacteria.
- ESBL bacteria are resistant to most of the antibiotics.
- Spread through cross transmission.
- A person carrying the bacteria without any symptoms of infection or had been infected in the past is called ESBL carrier.
- A person is considered to have an ESBL infection when the ESBL producing bacteria infect them. He/she has to be treated with antibiotics.



Implement Hand Hygiene

- No wristwatches, rings or wrist jewelry.

- Short nails and no nail polish.

- Guide the residents to implement hand hygiene.

- Give the information about hand hygiene to the visitors.
 - Guide them to use hand alcohol before and after entering the resident's room.
 - Use of gloves and gown if they are involved in the dirty procedures.

- Wash hands with soap and water
 - When arrive at work.
 - When your hands look or feel dirty.



Always disinfect hands

- Before and after contact with every residents.
- Before putting on personal protective wear and after taking it off.
- Before entering the care environment and when leaving.
- Before doing clean or aseptic procedures.
- After touching the resident's surroundings.

Hand rub

- Put about 3-5 ml of hand sanitizer in the palm.
- Rub the hand sanitizer from palm to palm, dorsum, fingers interlaced, tip of the fingers, thumbs, and wrists for about 20-30 seconds.
- Rub the hand until it is dry.

While taking care of ESBL carriers

- Single room is preferable otherwise implement necessary precaution in case of a multi-bedroom facility.
- Perform proper hand hygiene.
- Use of hand alcohol before and after the contact with them.
- The resident should put on clean clothes.
- Proper covering of the wound in case of any external wound.
- Use of gloves when handling blood, secretions, wounds, lesions, mucous membranes or contaminated areas or equipment.
- Use gowns during the dirty procedures.
- Proper decontamination of the equipment is a must after every use, especially those meant for common use.



- Proper and timely cleaning of the environment.