

Bachelor's thesis
Degree programme in Nursing
PNURSS15
2018

Eyerusalem Kifle and Gift Imuetinyan Omobogbe

PREVENTION OF HOSPITAL ACQUIRED INFECTION- FOCUS ON MRSA

BACHELOR'S THESIS | ABSTRACT
TURKU UNIVERSITY OF APPLIED SCIENCES
Degree programme in Nursing
2018
Eyerusalem Kifle and Gift Imuetinyan Omobogbe

HOSPITAL ACQUIRED INFECTION/MRSA

ABSTRACT

The purpose of this research was to gain knowledge and learn different ways of preventing Methicillin resistant staphylococcus aureus (**MRSA**) from spreading. The role of nurses is undeniably important in the preventing the spread of and in creating awareness of any hospital acquired infections (Caffery et al 2011.) The theoretical background information of this literature review consists of basic background information about MRSA, risk factors of MRSA, Diagnosis and complications of MRSA.

The method used in this thesis was literature review with systematic approach. Information was retrieved from a variety of databases. For instance, EBSCO, CDC, WHO, Cinahl ,PubMed and Science direct. Different criteria were used to find valid information of databases. A total of 19 articles were used in this literature review.

The result of this literature review showed that prevention, creating awareness and using a proper wound care method are key factors for tackling the spread of MRSA. Educating patients and family members is important, communicating and explaining preventive measures, treatment procedures and practical techniques are necessary to reduce the transmission of MRSA. Diagnosing these infections as soon as possible helps to get the treatment timely and patients are obliged to follow the treatment series from the start to the end (Thompson & Workman 2014.)

KEYWORDS:

NOSOCOMIAL INFECTION/HOSPITAL ACQUIRE INFECTION, MRSA

OPINNÄYTETYÖ | TIIVISTELMÄ
TURUN AMMATTIKORKEAKOULU
Degree programme in Nursing
2018

Eyerusalem Kifle and Gift Imuetinyan Omobogbe

SAIRAALAINFEKTION ENNALTAEHKÄISY – ESIMERKKINÄ MRSA

Tämän opinnäytetyön tarkoitus oli kasvattaa tietämystä ja opettaa erilaisia tapoja ennaltaehkäistä metisilliinille resistentin 'Stafylokokki aureus' bakteerin (MRSA) leviäminen. Hoitajien rooli kyseisen bakteerin torjunnassa on kiistatta tärkeä. Tietoisuus sairaalabakteerien olemassaolosta on osa hoitotyötä. Teoreettinen viitekehys tässä työssä on perustietoa MRSA:n riskitekijöistä, niin diagnoosin kuin komplikaatioiden osalta.

Opinnäytetyö on kirjallisuuskatsaus. Tietoa on haettu useista tietokannoista, kuten EBSCO, CDC, WHO, Cinahl, PubMed sekä Science direct. Myös erilaisia kriteereitä on käytetty lähteiden ja aineiston valinnassa. Opinnäytetyöhön valittiin 19 artikkelia

Yhteenvetona voidaan pitää oikeanlaisen haavahoidon tärkeyttä MRSA:n torjunnassa. Omaisten ja potilaiden tietoisuuden lisääminen taudin riskeistä, sen aiheuttajista sekä ennalta ehkäisystä ovat tehokkaita lisä keinoja. Vain oikeanlaiset toimintavat, menetelmät sekä ennakointi tuottavat parhaiten tuloksia MRSA:n leviämisen estämiseksi.

AVAINSAHAN:

SAIRAALAINFEKTIOIDEN, MRSA

CONTENT

1. INTRODUCTION	7
2. BACKGROUND	8
2.1 DEFINATION OF MRSA	9
2.2 SIGNS AND SYMPTOMS	9
2.3 RISK FACTORS	10
2.4 DIAGNOSIS	11
2.5 COMPLICATIONS	12
2.6 TREATMENT	13
2.7 WOUNDCARE	14
3. THE PURPOSE AND RESEARCH QUESTIONS	17
4. LITERATURE REVIEW WITH SYSTEMATIC APPROACH	18
4.1 RESEARCH METHOD	18
4.2 DATA COLLECTION	19
4.3 DATA ANALYSIS	24
5. RESULTS	25
5.1 PREVENTION	27
5.2 PATIENT EDUCATION	30
6. ETHICS AND RELIABILITY	31
7. DISCUSSION	33
8. CONCLUSION	34
9. REFERENCES	37
10. APPENDIX TERVEYSNETTI PPT	38

Tables

Table 1. Data collection	18
Table 2. Data analysis	19

Lists of abbreviations

- CA-MRSA- Community acquired methicillin resistant staphylococcus aureus (Alexander et al 2010).
- CDC- Center for disease control and prevention (CDC 2017)
- FDA - United states food and drug administration (Jacobs 2014).
- HAI – Hospital acquired infections (WHO 2002)
- HA-MRSA- Hospital acquired methicillin resistant staphylococcus aureus (Gibbons 2016).
- MRSA - Methicillin resistant staphylococcus aureus (Jacobs 2014).
- S.aureus - Staphylococcus aureus (Jacobs 2014).
- WHO – World health organization (WHO 2002).
- PPE- personal protective equipment
- CPE- Carbapenemase-Producing Enterobacteriaceae
- ESBLs- Extended-Spectrum beta-lactamases
- SCC- Staphylococcus Cassette Chromosome (Jacobs 2014)
- NF- Necrotizing Fasciitis (Jacobs 2014)
- CLABSI- Central Catheter- Associated Bloodstream Infections (Holt 2016)
- CHG- Chlorhexidine gluconate
- LTCF- Long- term care facilities

[Click here to enter text.](#)

1. INTRODUCTION

One third (33%) of world's population carries staphylococcus aureus bacteria in the nasal cavity of the anterior nares; In contrast, staphylococcus aureus doesn't show any symptoms or signs until the latest stage. (Center for disease control 2017.) Methicillin resistant staphylococcus aureus(MRSA) is mainly a nosocomial infection or hospital acquired infection. Nosocomial infection is referred to as " An infection acquired in hospital by patient who was admitted for a reason other than that infection" (World health organization 2002.) Hospital-acquired/ healthcare-associated infection (HAI) is of tremendous concern to health care providers as HAI is ranked as one of the top 5 causes of death in United States amongst other hospital acquired infections such as Extended-spectrum beta-lactamases (ESBLs), Carbapenemase-producing *Enterobacteriaceae* (CPE), Vancomycin resistant enterococci (VRE). . The centers of Disease Control and Prevention (CDC) estimate that 1 in 20 hospitalized patients will contract HAI. The World Health Organization estimates that 8.7% of hospitalized patients worldwide have HAIs at any one time, with the highest frequencies being reported in the Eastern Mediterranean and Southeast Asia regions 11.8% and 10.0% respectively. In the United States, HAI are contracted by an estimated 1.7 million patients annually accounting for nearly 99000 deaths and imposing additional health care costs of \$35.7 to \$45 billion. HAI infection may occur within 48-72 hours of admittance to the hospital or within 10 days from discharge from the hospital. It is characterized by long stay in the hospitals, ICU stay and the use of different types of tubes such as indwelling catheter, feeding tubes. In general, foreign substances that are used for other treatments may be the carrier for any bacteria fungai or virus. MRSA occurrence is not classified by age group since the pathogens can occur in children, adults as well as elderly, however, a compromised immune system is the main cause for MRSA. Acute surgeries and orthopedic wards showed a higher rate of MRSA. The reason behind this rise could be related to poor hand hygiene. (Jacobs 2014.)

By the late 1950s, approximately 10% of *S.aureus* isolates had become resistant to penicillin yet remained susceptible to penicillinase-stable penicillin, particularly oxacillin and methicillin. However, *S aureus* strains began turning up that were no longer susceptible to oxacillin and methicillin. Shortly after methicillin's introduction as a treatment option, MRSA was identified. The first case of methicillin antibiotics resistance in *S aureus* was identified in 1961 in the United Kingdom shortly after methicillin was introduced into clinical treatment. Seven years later, in 1968, after its emergence in Japan, Europe, and Australia, the case of MRSA at Boston City Hospital in Massachusetts was the first case in the United States. (Jacobs 2014.) The first Canadian case of MRSA was identified in 1981 (Stirling et al, 2004). In recent years MRSA has become more common in places other than hospitals, the infections types are classified in two major categories, hospital-acquired MRSA (HA-MRSA) and Community-acquired MRSA (CA-MRSA). CA-MRSA infections are common in kindergartens, gymnasiums, school, prisons and major public gathering spaces such as shopping malls and public toilets. (Alexander et al 2010.) Health care professionals have a big responsibility to prevent, control and eradicate MRSA spread in health care settings as well as in the community. In Finland, a rise in the number of MRSA cases outside Helsinki was reported in late 1990s, an increase in MRSA cases has been detected in Helsinki metropolitan area since 2003. (Kerttula et al, 2007.) The global epidemiology of MRSA worldwide has the highest rates reported in North and South America, Asia and Malta are below 50%, Intermediate rates (25–50%) reported in China, Australia, Africa and some European countries are within 25–50% [e.g. Portugal (49%), Greece (40%), Italy (37%) and Romania (34%)]. Other European countries have generally low prevalence rates (e.g. The Netherlands and Scandinavia). (Stefani et al 2012.)

The purpose of this thesis is to educate nurses and patients in the implementation, creating awareness, educating patient on how to take preventative measures of MRSA.

2. BACKGROUND

2.1 WHAT IS MRSA?

According to Evidence-based medicine guidelines (2017) definition of MRSA (methicillin resistant *Staphylococcus aureus*) strains are *S. aureus* isolates, which are not susceptible to beta-lactamase resistant staphylococcal antibiotics (floxacillin and dicloxacillin) or other beta-lactam antibiotics (cephalosporins and carbapenems). MRSA usually causes hospital-acquired surgical site and bone infections or septic systemic infections. The community-associated MRSA infections are typically skin infections, these include soft tissue infections (cellulitis), impetigo, different pustular infections (folliculitis, furunculosis, carbuncles), abscesses and infected ulcers. The spectrum and severity of infections caused by MRSA are similar to those caused by methicillin-susceptible *S. Aureus*.

"Methicillin-resistant staphylococcus aureus(MRSA) is resistant to antibiotics in the class beta-lactams which include but are not limited to methicillin, penicillin, amoxicillin. Resistance to methicillin in *S aureus* occurs from the acquisition of the *mecA* gene that codes for a modified penicillin-binding protein (PBP2a) which confers resistance to methicillin and other semisynthetic penicillinase-resistant β -lactams that is all β -lactam antibiotics. The *mecA* gene which defines methicillin resistant when *S aureus* possesses this gene sequence is absent in susceptible strains and present in resistant strains. It is a part of a larger staphylococcus cassette chromosome (SCC) *mec* gene configuration, of which there are several variations and it is this *mecA* gene that determine whether MRSA is hospital-acquired or community-acquired in origin. All methicillin-resistant *S aureus* possess the determinant for methicillin-resistance, *mecA*, making the SCC*mec* element SCC*mec*. Sequencing of numerous SCC*mec* elements has revealed that elements possess structural differences, which are used in epidemiological studies to discern and determine MRSA strains. HA-MRSA bacteria possess types I, II and III of the SCC*mec* gene. HA-MRSA genetic elements, because of their large size, cannot be incorporated into a bacteriophage intermediary; therefore, transfer of genetic material cannot occur via transduction". (Jacobs 2014.)

MRSA are staphylococcus aureus bacteria that have become resistant to antimicrobials. Staphylococcus is a gram-positive genus of bacteria. Staphylococcus genus has over 40 species which most don't cause harm to humans or other species, However S.aureus is the most common hospital infectious species into the staph family, therefore, it is classified as a 'superbug'. S. aureus is a bacterium commonly found on the skin or in the nose. About 20% of healthy populations persistently carry the bacteria in their anterior nares, and 60% sporadically carry it. S aureus is transmitted through direct contact or less often, by the airborne route and can infect the skin resulting in boils, impetigo or cellulitis. Staph bacteria have a great affinity to warm and moist parts of the human body parts such as axillaries, groins and perineum areas. More serious infections in the body can spread to the bone, blood, and lungs. "S aureus are non-spore forming cocci that appear as golden tingled clusters when seen under a microscope" (Nazarko 2014.) S aureus organism usually cause superficial skin infections that are treated with appropriate antibiotics and proper skin care. It becomes resistant to beta-lactam inhibitors such as Methicillin, thus the name MRSA. Methicillin-resistant S. aureus can be transmitted via direct physical contact such as contaminated hands, or droplet transmission, it can also be indirectly transmitted by sharing items that contain the pathogen. Types of nosocomial infections include: wound infections, surgical incisions, catheters, pneumonia and sepsis. (Romero et al, 2006.)

Penicillin was discovered in the 20th century which was a relief to many patients and healthcare professionals. However, the relief did not last long as Penicillin (methicillin) has also become resistant to S.aureus. Oxacillin replaced methicillin at some point, which outcome was the same as that of methicillin. Some have considered to change the name MRSA to ORSA, but MRSA was dominantly known by health professionals. (Jacobs 2014)

According to CDC 2017, MRSA can be transmitted to patients by health care personnel or invasive medical devices that have been in contact with MRSA. This occurs through direct contact with an infected or colonized person or from contact with a contaminated surface that has not appropriately sanitized their hands can transmit MRSA. MRSA skin infection can be transmitted from person to person if there is skin-to-skin contact with an opening in the skin tissue such as abrasions,

cuts, lesions, or boils. MRSA can also contaminate surfaces outside the body when touched by an infected person.

Despite the fact that antimicrobials are developed at an increasing rate, MRSA continues to be anti- drug resistant. Staphylococcus aureus is the most infective within the Staph genus. The bacteria can incubate in the blood stream, soft tissues, pneumonia, and postoperative wound infections. (Dilnesaw and Bitew 2016.)

2.2. Signs and symptoms of MRSA;

MRSA is a form of staph infection. The signs and symptoms of MRSA are similar to those of other types of staph infection. The infection area might be red, swollen, pus-filled, warm to the touch, extremely painful or a combination of these signs. Other possible signs and symptoms include chills, headache, joint pain, low blood pressure, and a rash that covers most of the body. MRSA skin infections can occur anywhere in the body but are commonly found on the back of the neck, the legs, the groin, or buttocks. Fever might develop and as the infection continues, the infection might spread from the original site. The infection can turn into some deep, painful abscesses that require surgical draining or even subcutaneous tissue removal at the infected area if not addressed soon after symptoms develop. MRSA infected person with pneumonia might experience shortness of breath, fever, and cough. Because MRSA also can be an invasive infection and can occur in any organ of the body or the bloodstream, these signs and symptoms require immediate medical attention. (Jacob 2014.)

2.3. Risk factors for HA/MRSA

Risk factors for MRSA can be categorized into patient-level characteristics such as previous hospitalization, recent antimicrobial therapy, indwelling vascular devices, prior invasive or surgical procedures and hospital-level incidences, Hospital size has been associated with many MRSA cases in hospitals. The elderly and those with health conditions are the risk group for MRSA bacteremia infections. (Gibbons 2016.) "Patients who are colonized with MRSA when hospitalized are at risk of developing an MRSA infection, Hospital procedures such as intravenous infusions,

urinary catheterization and surgery provide a portal of entry for the MRSA bacterium and enable the bacteria that have been sitting harmlessly on the patient's skin to enter into the body and cause a potentially life-threatening infection". (Nazarko 2014.) MRSA can also be found on hospital bed linens bathroom fixtures, toilet basins, and on medical equipment such as stethoscope and blood pressure measuring cuff. It may also be found on the hands or fingernails of doctors, nurses and other hospital staffs. (CDC 2017.) Other risk factors might be recent hospitalization, surgical emergency, residence in long-term care facility, any type of indwelling catheter, prior antibiotic usage, an immunocompromised state, or intravenous drug use. A healthy person with intact skin with no cuts is less likely to contract MRSA however any direct contact with the infection could transmit the MRSA infection. Generally, longer stay in hospitals or longer residence of in care facilities with compromised immune system and using invasive medical equipment may increase the possibility of contracting MRSA. (Romero et al 2006.)

2.4. Diagnosis;

In recent years, molecular-based screening methods have become the standard for MRSA diagnosing. "Clinicians use several conventional laboratory tests to determine whether an *S aureus* infection is in fact MRSA" (Jacobs 2014). MRSA screening is a policy that involves screening patients admitted to a hospital to find out if the person is colonized with MRSA (Nazarko 2014). Diagnoses of MRSA are influenced by many factors such as clinical presentation/symptomology, laboratory test methods (blood culture test, molecular tests or agglutination tests), and the relative strength and weaknesses of the tests employed. Real- Time PCR (polymerase chain reaction) is generally faster and more accurate than traditional methods such as culture and is becoming the tool of choice to help clinicians understand MRSA and *S. aureus* infections and to guide patients care. (Gibbons et al 2016.)

"The CDC encourages clinicians to consider MRSA in the differential diagnosis of skin and soft tissue infections (SSTIs) compatible with *S. aureus* infections, especially those that are purulent (fluctuant or palpable fluid-filled cavity, yellow or white center, central point or "head," draining pus, or possible to aspirate pus with

needle or syringe). A patient's presenting complaint of "spider bite" should raise suspicion of an *S. aureus* infection".

In 2011, the FDA approved the use of a rapid-detection method called The KeyPath MRSA/MSSA Blood Culture Test which is a phenotypic test of ceftazidime susceptibility and resistance. The KeyPath test can distinguish between MRSA and MSSA in a blood sample within 5 hours after bacterial growth is first detected in the sample with 98.9% and 99.4% accuracy respectively. "Mueller-Hinton agar plate supplemented with oxacillin, the latex agglutination test for PBP2a and the ceftazidime disk screen test when used correctly, broth and agar-based screening methods usually can detect MRSA, with ceftazidime disk test as additional verification are microbiological tests for MRSA. Molecular-based screening methods have become the gold standard for MRSA detection recently. Molecular nucleic acid amplification testing methods involve isolation of the *mecA* gene through polymerase chain reaction (PCR). To accurately diagnose MRSA, clinical symptoms, and laboratory test are considerable method, but the most accurate and fastest is the Real-Time PCR". (Jacobs 2014.)

Smearing; The clinical microbiology laboratory is requested to screen specifically for MRSA from the samples. Nasal swab is performed by rotating a cotton swab in both nostrils, and applying the swab directly into enrichment broth or into transportation culture tube. (Vuopio 2017.)

2.5. Complication;

MRSA can lead to relatively harmless colonization, but it can also lead to life-threatening illnesses such as septicemia and pneumonia. (Nazarko 2014.) Methicillin-resistant *S. aureus* may be result in devastating bloodborne and bone infections (Romero et al, 2006). MRSA is one of the bacteria considered to be "flesh eating" although the bacteria does not actually eat the flesh of infected individuals, they produce and emit toxins that destroy the infested tissue. This medical condition is known as necrotizing fasciitis (NF), a severe bacterial infection of the fascia that causes extensive tissue death. NF is a rare but serious bacterial infection that can be caused by several bacteria, including group A streptococcus, Klebsiella, Clostridium, E coli, S aureus and Aeromonas hydrophila. MRSA has been reported to lead to

Necrotizing fasciitis (NF). Although MRSA is not the most common causative agent of NF, most cases of NF result from group A streptococcus bacteria entering the body through a break in skin. If MRSA infests the lungs, it can cause pneumonia. (Jacobs 2014.)

MRSA is a common cause of bacteremia and is the causative organism reported in 7.4% of central catheter-associated bloodstream infections (CLABSIs) in critical care patients and it is the most common pathogen for ventilator-associated pneumonia and surgical site infections (Holt 2016).

2.6 Treatment;

Delaying treatment or recognition of MRSA may lead to severe suffering or even death to the carrier. There are few antimicrobial drugs available to treat MRSA from mild to severe invasiveness, for instance clindamycin, doxycycline, tigecycline antibiotic groups. However, these group of antibiotics may cause side effects or carry significant contraindications. CA-MRSA isolates are typically eligible for clindamycin and gentamicin. (Thompson & Workman 2014.)

Decolonization of MRSA begins the time upon diagnosis with a series of treatment methods. The first procedure is to transfer the MRSA- diagnosed patient to a MRSA (infectious disease control) unit, typically, many hospital districts have their own MRSA infection control unit. However, if the required units aren't available MRSA treatment seeking patients should be isolated from the patients who aren't colonized with the infection until they have negative test results. The isolation process is called contact isolation. Secondly, the decolonization process which consists of a five-day series of daily whole body washing with cyldimonium chloride, mupirocin (nasal ointment) 2 times per day, and Corsodyl mouth rinse (chlorhexidine gluconate 0.2 %, undiluted) 10 ml per day will be started. If a patient's clinical status is deteriorating despite antibiotic therapy, the causative organism may be resistant to the current medication. The patient's clinical status should be correlated to laboratory values, especially the white blood cell count. A decrease in the white blood cell count is not always an indication the antibiotic is effective. Antibiotics won't be started on this stage of treatment unless the infection is complicated or multiple parts of the body

are severely infected. At this stage of treatment, it is important to notice the overall hygiene of the patient such as changing the beddings daily and cleaning the patient's room thoroughly. After the ward stay is over the patient is supposed to follow a series of swab tests every other 3 months (1st, 3rd, 6th and 12th) after discharge and treatment. The last follow up is after 12 months of discharge. All swab tests results should show negative results to finish the treatment. Any positive result from those 4 test results will follow another cycle of treatment. (Kohler et al 2012.)

CDC recommended evidence-based infection control measures required to prevent the spread of MRSA. Multiple studies have shown that decreasing the skin's bacterial load with chlorhexidine gluconate (CHG) baths decreases rates of infection with MRSA. CHG is a topical antiseptic active against many both gram-positive and gram-negative microbes. Patients with bacteremia or other severe infections caused by MRSA response to treatment must be assessed. Up to 1 week may be required after the start of treatment with appropriate antibiotics before blood cultures indicate eradication of MRSA. (Holt 2016.)

2.7 Wound Care

Wound healing process is affected mainly by patient-related factor, wound-related factor, skill of healthcare providers, resources and treatment factors. (Milne 2017.)

Wounds which are caused by MRSA infections may begin as redness or a rash with a pus-filled pimple or boil. Then, it may progress to an open, inflamed area of skin. In some encounters, it may appear as an abscess, tender and swollen. When the abscess is cut open or spontaneously bursts open, pus drains from the area. If the infection is severe or may be spreading into the blood (bacteremia), as a result fever and illness may occur. (Thompson & Workman 2014.) In this BA thesis will be discussed, the most efficient wound care methods used across the globe for centuries to treat chronic wounds infected by MRSA. This is somewhat indirectly related to the research question of this thesis study consequently only a few wound

care methods were mentioned because it was not the focus of this study. Infected wounds are optimal environments for bacteria. MRSA and surgical wounds are directly proportional, therefore, when nursing interventions are used help ease the spread of HA-MRSA is mentioned, wound care can be addressed in accordance with treatment and prevention. MRSA skin infection can be transmitted via physical contact where there is an opening in the tissue such as lesions (Jacobs 2014.)

Contemporarily, in many wound care guidelines, it is important to consider a variety of methods. These includes removal of exudates, optimal moisture, and protecting the surrounding tissues. These rules also apply to the care process of MRSA induced wounds. Medical honey has been used for centuries to heal different types of wounds. Although the honey from the comb has anti-microbial properties, it is important to remember that medical honey passes through filtration, radiation and a certain standard of hygienic tests." Manuka honey which is derived from honeybees consuming nectar from the New Zealand flowering plant *Leptospermum scoparium* has been found to have the best of effect in the treatment of MRSA, because it maintains its antibacterial activity, therefore absent of hydrogen peroxide". (Jacobs 2014.) Polyhexal wound foam dressing also showed antimicrobial properties towards MRSA by inhibiting bacterial growth to the other part and providing optimal moisture to the wound area. Since MRSA reproduce exponentially, Polyhexal foam dressing limits the exponential rates. On other hand, polyhexal foam dressing could also be used on an infected wound to prevent infections and new colonies to the area. Foam dressing could also be combined with silver based antimicrobial dressings, as silver has been known for its antibacterial effect. However, there are few studies on its use. One property known of silver coated dressing is that exudates cleared out very easily from the wound by silver's ionization property to water. (WOUNDS 2009.)



Photo Credit: Gregory Mo

Source: CDC image of MRSA wounds in public domain

3 THE PURPOSE AND RESEARCH QUESTIONS

The purpose of this research was to gain knowledge and learn different ways of preventing MRSA from spreading. The aim of this Bachelor thesis is to use nursing interventions in order to prevent MRSA from spreading and creating awareness about MRSA infections throughout different hospitals as well as in the community.

Research questions are;

1. How does Nursing interventions help to ease the spread of HA-MRSA?
2. How to educate patients about prevention of MRSA?

4 LITERATURE REVIEW WITH SYSTEMATIC APPROACH

4.1 Research method

This thesis was initiated and completed with literature review with systematic approach as the research method. A literature review is logically presented knowledge gained from reading books, selected articles and other sources. This literature review will include an introduction, discussion and summary of data collected and reviewed with the use of a system approach (Gray et al 2012). Data was collected and reviewed, a discussion was made and a conclusion of the sources found was written out. Sources were valid and reliable article for scholarly use, this source consists of scientific journal, textbooks, clinical journal.

4.2 Data Collection

During this stage of this literature review, data was collected by searching the literature, processing the literature, and writing a review of the articles related to our topic. This thesis was utilized electronic database available using EBSCO publishing database. Searches were conducted with keywords on databases such as Cochrane, Medline, Pubmed and Cinahl. Already published articles on hospital-acquired infections/MRSA were collected, synthesizing full-text online articles that were relevant. Each literature was searched using bibliographical databases and reference management systems such as Refwork. The table shows the inclusion and exclusion criteria for the articles used in this thesis.

INCLUSION CRITERIA FOR ARTICLES	EXCLUSION CRITERIA FOR ARTICLES
--	--

Hospital Acquired Infection / MRSA	Research Articles which are not related to Infections
Data published between 2002 to 2018	Articles published in other languages
English articles	Article not published in English
Research articles that focus on the aim and purpose of the thesis topic	Articles without full, free and open access
Full text article with open and free access	

Table 1 data collection

During the elimination process thousands of articles were reviewed. Some of the articles were relatively old and outdated. Thus 414 properly linked researches were provided. Out of 414 articles 19 articles were fully referenced and abstracts were also available. Some of the responses were inadequately linked to the topic.

4.3 Data Analysis

The steps to achieving data analysis after collecting information and knowledge available related to hospital-acquired infection/MRSA include analyzing and synthesizing content from the sources that was obtained. In doing so critical appraisal of individual study was important in clearly identifying relevant content in the articles and sources. Mapping out facts and principles to reflect the current knowledge about MRSA, Making connections between ideas,

theories from several sources to develop an overall view of this topic. (Gray et al 2012).

Title	Author, place and year of publication	The purpose of the study	Samples	Data collection method
Prevalence and antimicrobial susceptibility pattern of methicillin resistant staphylococcus aureus isolated from clinical samples at yekatit 12 hospital medical college	Dilnessa T, Bitew A, Ethiopia 2016	To determine the prevalence of MRSA strains from different clinical specimens on patients for routine culture testing	1360 participants	Cross sectional culture
General information about MRSA in healthcare settings	Centers for Disease Control and Prevention Web site, USA,2015	Patients	Patients	Public
Not just a matter of size: A hospital-level risk factor analysis of MRSA bacteremia in Scotland	Gibbons CL, van Bunnik, Bram A D, Blatchford O, et al. Scotland,2016	Thesis	Thesis	Literature review
Changing epidemiology of methicillin-resistant staphylococcus aureus in the veterans affairs healthcare system	Caffrey A, LaPlante K,2012, USA	A variety of demographic factors	Hospitals- 44,668 Outpatient7,250 s- Longterm care	Utilizing national database

			facilities -4,427	
Treating central catheter-associated bacteremia due to methicillin-resistant staphylococcus aureus: Beyond vancomycin.	Holt S, Thompson-Brazill KA, Sparks ER, Lipetzky ,2016	The emergence of vancomycin resistant MRSA	71-year woman	Case study
Hospital-acquired methicillin-resistant staphylococcus aureus: Status and trends.	Jacobs A, <i>Radiol Technol.</i> 2014, USA	Overall information about MRSA	Literature review	Literature review
Reality of wound care in 2017	Milne J, 2018,	Factors that hinders wound healing.	650 clinicians participated	Questionnaire
Being Met as marked – patients' experiences of being infected with community-acquired methicillin-resistant Staphylococcus aureus (MRSA)	Eva Skyman, Berit Lindahl, Ingegerd Bergbom, Harrieth Thunberg Sjöström and Christina Åhrén, 2017, Sweden	Psychological effects of patients with MRSA	12 patients aged 29–69	A phenomenological hermeneutic approach
Methicillin-resistant staphylococcus aureus (MRSA): A guide to prevention	Nazarko L, 2014, UK	Explores the decrease of MRSA epidemic	Literature review	Literature review

and treatment. <i>BR J HEALTHC ASSIST.</i> 2014				
Patient education on MRSA prevention and management: The nurse's vital role.	Noble DB,2009	Nursing role in the prevention and management of MRSA	Literature review	Literature review
MRSA decolonization: Success rate, risk factors for failure and optimal duration of follow-up.	P. Kohler,A. Bregenzer-Witteck , G. Rettenmund ,S. Otterbech ,M. Schlegel, 2012, Switzerland	To ease the controversial of MRSA controlling methods	Routine sample	78 patients

Hand-to-hand combat: Preventing MRSA...methicillin- resistant staphylococcus aureus.	Romero DV, Treston J, O'Sullivan AL, USA,2006	To combat the spread of asymptomatic MRSA	1100 MRSA infected patients	Randomized controlled studies
Methicillin-resistant staphylococcus aureus (MRSA): Global epidemiology and harmonization of typing methods.	Stefani S, Chung DR, Lindsay JA, et al, London,2012	To find out global prevalence of MRSA	9 different countries consensus	Clearly stated the prevalence of MRSA in different countries.
Nurses and the control of infectious disease: Understanding epidemiology and disease transmission is vital to nursing care.	Stirling B, Littlejohn P, Willbond ML, Canada,2004	To estimate the disease transmission in the population	35 hospitals	Screening
Hospital-wide infection control practice and methicillin- resistant staphylococcus aureus (MRSA) in the intensive care unit	Thompson DS, Workman R, USA,2014	To estimate the occurrence of MRSA in ICU.	6565 patients	Weekly screening of MRSA

(ICU)				
Diagnostic and therapeutic evaluation of community-acquired methicillin-resistant staphylococcus aureus (MRSA) skin and soft tissue infections in the emergency department. ;	Walraven CJ, Lingenfelter E, Rollo J, Madsen T, Alexander DP, London,2012	To determine clinical effects of MRSA wounds	58 adults	Microbiological samples
Prevention of hospital-acquired infections	G. Ducl J. Fabry, L. Nicolle, World health organization, Malta,2002	To tackle the frequency of nosocomial infection	Not applicable	Data throughout the globe
Multidrug-resistant bacteria in hospitals.	Vuopio Jaana, Finland,2017	Guidelines of different antibiotics administration for HAI'S	Lists of antibiotics	Guidelines

Table 2 Data analysis

5. Result

Result from CDC Studies show that about one in three people carry staph in their nose. Two in 100 people carry MRSA. MRSA is usually without any illness, a type of staph bacteria that is resistant to many antibiotics, such as methicillin-resistant *Staphylococcus aureus*. In a healthcare setting, MRSA can cause severe problems such as pneumonia and bloodstream infections. The highest colonization rate in individuals living in long-term care facilities have been obtained from nostrils and wound even though colonization of staphylococcus aureus occurs commonly at the nostril, skin, and perineum. MRSA infections can cause, if not treated quickly, sepsis and death. MRSA usually causes hospital-acquired surgical site and bone infections caused by methicillin-resistant *Staphylococcus aureus* are associated with higher morbidity and costs. Considerable reduction in MRSA prevalence could be achieved through Long-term decolonization therapy that could sustain higher clearance rate over time. Skin and soft tissue infection are the most common infection reported, followed by pneumonia, central catheter-associated bloodstream infections, endocarditis, osteomyelitis, bacteremia are caused by MRSA pathogens, surgical site infections, (CLABSIs

MRSA is highly prevalent in hospitals worldwide with the highest rates reported in North and South America, Asia and Malta. Intermedial rates reported in China, Australia, Africa and some European countries [e.g. Portugal (49%), Greece (40%), Italy (37%) and Romania (34%)]. Other European countries have generally low prevalence rates (e.g. The Netherlands and Scandinavia). Although in recent years India and Philippines have had the lowest values of MRSA reported compared to East Asia which has had the highest.

HA-MRSA is defined by CDC as positive culture obtained from a sterile site within 48 hours after hospital admission, or history of previous hospitalization or medical procedures. Specific screening methods and microbiological diagnosis of MRSA is important for proper treatment and prevention purposes, surveillance culture must always include swap samples from nostrils and skin lesions. The health care

provider's overuse of antibiotics has been shown to be one factor responsible for the rapid spread of MRSA (Nazarko 2014).

According to the research question, there has risen methods of combating MRSA.

The research questions were:

1. How does nursing interventions help to ease the spread of HA-MRSA?
2. How to educate patients about prevention of MRSA?

5.1 Prevention;

Nurses are in close contact with bodily fluids and perform intimate procedures, no other healthcare professional spends as much time face to face with patients as nurses. The time spent with the patient depends on the area of practice and the severity of the patient's needs. Standard precautions apply to contact with blood and other body fluids, secretions and excretions, non- intact skin and mucous membranes to protect nurses and their patients from pathogens that can spread by body fluids. These procedures are taught to nurses in line with the three categories of transmission-based precautions include airborne precautions, droplet precautions and contact precautions These standard precautions include the importance of hand washing in reducing infections, barrier protections (gloves, gowns, etc.), the safe disposal of sharps and the proper handling of potentially infectious waste materials. (Stirling et al, 2004.) The Key for preventing MRSA is on everyone's responsibility. Furthermore, healthcare personnel's, families and friends have a huge roll in fighting the spread of MRSA. Maintaining good hand hygiene and the use of universally accepted wound care precautions are major factors to prevent MRSA. (Thompson & Workman 2014.) Infectious disease transmissions require three components which include an agent such as virus, bacterium, parasite, other pathogens, a vulnerable host and a conducive environment. Host factors that influence a person's susceptibility include age, gender, socio-economic status and lifestyle choices, among others. Environmental factors that affect susceptibility include climate, sanitation, the presence of vectors and elevation. (Stirling et al, 2004.)

Cleaning hands with soap, water and using an alcohol-based hand disinfectant is the main measure to consider before starting any surgeries or medical procedure. In addition, medical professionals should use alcohol-based hand disinfectant before and after contact with any patient. If a patient is diagnosed with MRSA it is best to assign a single room with a bathroom, or in some cases, two MRSA patients may share the same hospital room. While treating MRSA patient, it is important to treat them with dignity and empathy. However, healthcare providers must remember to conduct precautions such as disinfection of hands, wearing gloves, mask, and gowns before entering to the infected patient's room. The above-mentioned apparels should be removed when leaving the room and followed by the hand hygiene method according to the hospital policy. Visitors and immediate relatives should follow the same apparel method as of the staff. (WHO 2012.)

MRSA patients should remain in their rooms to prevent the transmission of the infections to other patients whom immune system is compromised. However, they may go to other treatment or test units as needed. While transferring MRSA- patients to other units it is important to inform orally and provide written medical history that includes the patient's infections in a confidential way. (CDC 2017.) Counseling patients on preventing the spread of MRSA to others is important. Hand hygiene keeps MRSA from spreading. Hand washing is preferable, but alcohol-based gel hand sanitizers are also effective, except for *Clostridium difficile*-associated diarrhea. Patients should cover all draining wounds to prevent transmission of the bacteria. Because patients usually have some type of long-term venous access, such as a peripherally inserted central catheter, they and their family members should be instructed on proper care of the catheter and use of aseptic technique before, during, and after each administration of an antibiotic. Patients should be educated about the signs of infection at the catheter site and be instructed to notify their health care provider if infection occurs. Patients and caregivers assisting with wound dressing changes must wear gloves during wound care and must wash their hands immediately after. Family members should be warned to avoid sharing personal or hygiene items with the patient. Nurses should encourage frequent disinfecting of surfaces with products labeled as a disinfectant which the patient infected with MRSA has come into contact with. The cleaning agent must stay in contact with the contaminated surface for 10 minutes. Clothing and linen should be washed

frequently. If wound drainage is present, clothing and bed linens should be washed daily. Additionally, patients with active MRSA infections should avoid participating in contact sports and in exercising at public facilities such as gyms until the patient is cleared by their health care provider. (Holt 2006.)

MRSA can be prevented through proper hand-washing practices, medical equipment sterilization and eliminating the use of unnecessary catheter lines in patients. There are resources for health care professionals on the proper hand-washing technique provided by the CDC and the World Health Organization. The CDC recommended using an alcohol-based hand sanitizer containing at least 60% alcohol, when soap and water are not available as in some emergency situations. It is advised that not all germs are killed with hand sanitizers when hands are visibly dirty. (Jacobs 2014.)

Many hospitals follow MRSA eradication protocols thus standard MRSA screening tests are taken for every patient admitted to a hospital especially to ICU wards. The swabs are taken from the nasal mucus and the groin areas. The prevalence, transmission and infection to another patient may decrease when the measure is taken. (Thompson & Workman 2014.)

5.4 PATIENT EDUCATION

Health care personnel and patients need to be educated about skin infections, signs and symptoms to watch for and preventive measure. Standard precautions such as hand washing, using gloves, and decontaminating linens and surfaces should always be utilized. In addition, patients should be educated on using proper hygiene, including hand washing techniques. As MRSA is transmitted through direct physical contact via human hands, demonstrating proper hand washing techniques is important following the CDC recommendation that at least 20 seconds should be spent while washing hands, the demonstration can be repeated by the patient which will be helpful, giving the healthcare provider an opportunity to correct errors that may be made by the patient.

Educating patients not to share personal items (razors, toothbrushes, or towels) with friend and family members is important, education on covering wounds,

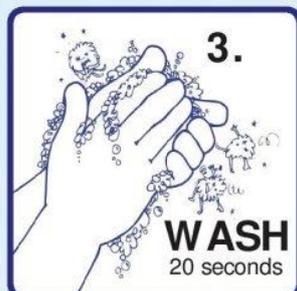
sanitizing equipment with antimicrobial cleansing agent between uses is also necessary. Covering skin lesions are all components contributing to infection reduction and prevention of spread. Patients and their family should be educated on the risk factors and how to recognize the sign and symptoms such as redness, swollen, tender, pain, fever and pus of MRSA so that immediate medical attention and treatment will be requested for as soon as these signs are recognized. (Romero et al 2006.)

During MRSA management, patient education is a critical competent to be put into consideration. In limiting the spread and reducing the transmission of MRSA, nurses should educate patients and caregivers/family members regarding standard precautions which are evidence-based practices for patient management in hospital facilities. Personal protective equipment (gloves, gowns or mask) should be worn by family during hospital visits to further minimize the spread of MRSA through person-to-person contact. (Noble 2009.)

Preventative patient education which should entail proper hand hygiene washing hands with soap and water, antibacterial/alcohol-based hand sanitizers are preferable, skin hygiene when cuts and lesions occur in the skin, it is a good practice to wash with water and cover wounds or non-intact skin using bandages and wound dressing to prevent exposure of the skin to bacteria, education on pain management, health maintenance including proper nutrition, exercise, smoking cessation and maintaining an functional immune system through the avoidance of stress and relaxation is very important.

Effective patient and family education should involve verbal explanation of important information about MRSA in such a way to increase their awareness about the infection, the reason for contact isolation to reduce anxiety regarding isolation in patients and family; standard precaution, and the reason for personal protective equipment(PPE) including demonstration of the standard precaution and how to wear personal protective equipment to patient's family during their visits; and hand washing demonstration to both patients and their caregivers/ family members. The use of video and pamphlets from CDC, hand washing posters and MRSA leaflets can increase compliance to successful adherence to prevent the infection and MRSA management measures reducing significantly the spread of the MRSA bacteria. (Romero et al 2006.)

Clean Your Hands!



How to wash your hands with soap and water:

- Use soap and warm, running water.
- Keep fingers pointing down.
- Rub hands vigorously for 20 seconds. Wash all surfaces:
 - Backs of hands
 - Wrists
 - Between fingers
 - Tips of fingers
 - Thumbs
 - Under fingernails
- Dry vigorously with paper or clean cloth towel.
- Turn off faucet with towel and open door with towel.

How it works:

- The soap suspends the dirt and soils.
- The friction motion helps pull dirt and greasy or oily soils free from the skin.
- Warm running water washes away suspended dirt and soils that trap germs.
- Final friction of wiping hands removes more germs.

How to clean your hands with an alcohol-based handrub:

- Apply a dime sized amount of handrub gel to the palm of one hand or use an alcohol-based handrub wipe.
- Rub hands together covering all surfaces of hands and fingers until handrub is absorbed.

How they work:

- Act quickly to kill microorganisms
- Reduce bacterial counts on hands

Wash your hands with soap and water when your hands are visibly soiled. If soap and water is not available, use alcohol-based handrub (wipes or gel).

Food handlers in restaurants, schools, delis and grocery stores must wash their hands with soap and water before applying hand sanitizers.
[Minn Rules Chap. 4626.0070 - 4626.0095]



Minnesota Department of Health
Food Safety Center
625 N. Robert St., PO Box 64975, St. Paul, MN 55164
651-201-5414, TDD/TTY 651-201-5797
www.health.state.mn.us



Source: CDC handwashing poster public domain

6 ETHICS AND RELIABILITY

There were plenty of ethical issues to be considered while planning and doing a certain research. Ethics in general prevents plagiarism and maintain the anonymity of intellectuals. (Tenk 2009). The bachelor thesis title was based on working life experiences in Finland and lectures provided by Turku University of Applied Sciences about infectious disease and MRSA. The topic was approved by Bachelor's thesis tutor. This bachelor thesis was carried out through literature review with systematic approach, therefore interviews, observation and questionnaires in the data collection process weren't used. However, any data that has been used in this BA thesis was cited as a reference according to Turku University of Applied Sciences referencing guidelines.

This thesis has carried along some limitations as any thesis would encounter. One of the limitations that this thesis encountered was unavailability of recent articles about HA-MRSA while there were plenty and more recent researches about CA-MRSA.

This thesis was carried out by two Turku University of Applied Sciences nursing department students. Working as a group has brought mutual understanding of the subject and developed team working spirits for both parties enabling opportunity for the share of ideas and thoughts.

7 Discussion

The purpose of this research was to gain knowledge and learn different ways of preventing Methicillin resistant staphylococcus aureus (**MRSA**) from spreading. The role of nurses is undeniably important in the preventing the spread of and in creating awareness of any hospital acquired infections. The study emphasizes serious implications of HA-MRSA. In addition, the thesis discusses different ways through which the infection spreads and different methods to reduce the transmission of MRSA infection. While addressing the impact of MRSA, it is also important to put into consideration the holistic approach of nursing care, that is, the emotional, social, and psychological aspect of patient's life.

Globally the impact of Hospital acquired infections are enormous both in healthcare aspects and financial statements. This impact expands to socio-psychological, political and emotional barriers. So far it is estimated that over 1.7 million people around the globe contract hospital acquired infections annually. (Jacobs 2014) However, this figure only indicates to those hospital district that have infection control database. Several death reports of hospital acquired infections are also have also been published. (CDC 2017.)

While this study began to advance our knowledge as a future nurse, we came to the realization of the seriousness of hospital acquired infections such as MRSA and future challenges that come along with it if adequate attention is not paid to the misuse of antibiotics in nursing care and non-septic hand hygiene. It is essential to properly diagnose HA-MRSA in high risk patient admission to hospital facilities; timely antibiotic susceptibility test and blood culture screening should be carried out to rule out the possibility of contacting a HAI especially in patients undergoing surgical procedures.

HA-MRSA eradication begins with strictly adhering to hand hygiene and surface / equipment decontamination protocols by health care providers and hospital facilities (Jacobs 2014). "Control measures for hospital facilities include the screening of patient lesions, isolating or cohorting patients who are already infected, covering

wounds with impermeable dressings, treating staff and patient carriers with antibiotics and improved hygiene". (Stirling et al,2004.)

Treating and preventing any hospital acquired infections should become a goal in fighting its spread. For this purpose, many hospitals have put their human and material resources to HAI causes. In contrast lack of proper patient education and misleading information about HAIs may lead to discrimination and ignorance in the society (Nazarko 2014.)

The epidemiology of MRSA brought a big challenge to healthcare settings as well as to the community. The occurrence of stigma that the patient is facing unquestionable. Most of the stigmas are coming from lack of knowledge and loss of respect and dignity. Furthermore, nurses should work on lifting the spirits of patients by encouraging them to follow the treatment plan as well as by protecting others. More research studies should be carried out about HA-MRSA and further studies should be engaged on the psychological well beings of MRSA patients.(Skyman et al 2017.)

8 CONCLUSION

In order to fight the spread of HA-MRSA the following conclusion has been drawn.

- Health care professionals are often in close contact with patients in hospitals, appropriate precautions must be followed strictly. Proper Hand hygiene cannot be over emphasized as much attention needs to be paid to aseptic and standard precautions during the treatment of HAIs and care of MRSA infected patients to reduce the spread and transmission to other healthy patients and hospital staffs.
- Gloves should be worn when in contact with body fluids and contaminated surfaces especially before and after contact with patients. Wound care is another area where much attention need to be paid, changing gloves during wound care, and eye protection should be worn if there is possibility of splashes from the wound.
- It is the responsibility of the healthcare provider to educate patients and family concerning precaution measures and hand hygiene techniques to prevent the spread of MRSA.
- The role of healthcare personnel to properly educate patients and family especially regarding accurate adherence to antibiotic regimen, prompt recognition of signs and symptoms and asepsis during wound care and skin infections promotes awareness and provides them with the important information and knowledge they need to prevent the spread of MRSA.
- Patient and family education shouldn't end in the hospital but must be followed up, patient education during discharge is vital to prevent the spread of MRSA into the community.
- The continuous growth and presence of MRSA pose a threat to both the community and health care facilities such as long-term care facilities and hospitals

9. REFERENCES

Caffrey A, LaPlante K. Changing epidemiology of methicillin-resistant staphylococcus aureus in the veterans affairs healthcare system, 2002-2009. *Infection*. 2012;40(3):291-297.
<http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=104469643&site=ehost-live>. doi: 10.1007/s15010-011-0232-3.

Dilnessa T, Bitew A. Prevalence and antimicrobial susceptibility pattern of methicillin resistant staphylococcus aureus isolated from clinical samples at yekatit 12 hospital medical college, addis ababa, ethiopia. *BMC Infect Dis*. 2016; 16:1-9. <http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=117364995&site=ehost-live>

General information about MRSA in healthcare settings. Centers for Disease Control and Prevention Web site. <https://www.cdc.gov/mrsa/>. Published May 22, 2017. Updated 2015. Accessed 2.2., 2018.

Gibbons CL, van Bunnik, Bram A D, Blatchford O, et al. Not just a matter of size: A hospital-level risk factor analysis of MRSA bacteraemia in scotland. *BMC Infectious Diseases*. 2016;16:1-7.
<http://search.ebscohost.com/login.aspx?direct=true&db=afh&AN=115584723&site=ehost-live>. doi: 10.1186/s12879-016-1563-6.

Gray JR, Grove SK, Burns N. *The practice of nursing research: Appraisal, synthesis, and generation of evidence*. 7th ed. Saint Louis: Saunders; 2012. [http://ebookcentral.proquest.com/lib/\[SITE_ID\]/detail.action?docID=2074383](http://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=2074383).

Holt S, Thompson-Brazill KA, Sparks ER, Lipetzky J. Treating central catheter-associated bacteremia due to methicillin-resistant staphylococcus aureus: Beyond vancomycin. *Critical care nurse*. 2016;36(4):46-57.
<http://www.ncbi.nlm.nih.gov/pubmed/27481801>. doi: 10.4037/ccn2016475.

Jacobs A. Hospital-acquired methicillin-resistant staphylococcus aureus: Status and trends. *Radiol Technol*. 2014;85(6):623-652. <http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=103968200&site=ehost-live>.

Milne J. Reality of wound care in 2017: Findings from interactive voting pads. *J COMMUNITY NURS*. 2018;32(1):56-61.
<http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=128564905&site=ehost-live>. Accessed 3 May , 2018.

National Advisory Board on Research Ethics. Ethical principles of research in the humanities and social and behavioural sciences and proposals for ethical review. <http://www.tenk.fi/sites/tenk.fi/files/ethicalprinciples.pdf>. Updated 2009.

Nazarko L. Methicillin-resistant staphylococcus aureus (MRSA): A guide to prevention and treatment. *BR J HEALTHC ASSIST*. 2014;8(8):377-383.
<http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=103984568&site=ehost-live>.

Noble DB. Patient education on MRSA prevention and management: The nurse's vital role. *Medsurg Nurs*. 2009;18(6):375-378. <http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=105273312&site=ehost-live6>

P. Kohler , A. Bregenzer-Witteck , G. Rettenmund , S. Otterbech , M. Schlegel. MRSA decolonization: Success rate, risk factors for failure and optimal duration of follow-up. . 2012.
<http://web.a.ebscohost.com.ezproxy.turkuamk.fi/ehost/pdfviewer/pdfviewer?vid=8&sid=6a01e687-2dbc-43fe-93c7-298a3911a320%40sessionmgr4010>.

Romero DV, Treston J, O'Sullivan AL. Hand-to-hand combat: Preventing MRSA...methicillin-resistant staphylococcus aureus. *Nurse Pract*. 2006;31(3):16-25.
<http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=106444249&site=ehost-live>.

Stefani S, Chung DR, Lindsay JA, et al. Meticillin-resistant staphylococcus aureus (MRSA): Global epidemiology and harmonisation of typing methods. *International Journal of Antimicrobial Agents*. 2012;39(4):273-282.
<http://www.sciencedirect.com/science/article/pii/S0924857911004687>. doi:
[//doi.org/10.1016/j.ijantimicag.2011.09.030](http://doi.org/10.1016/j.ijantimicag.2011.09.030).

Stirling B, Littlejohn P, Willbond ML. Nurses and the control of infectious disease: Understanding epidemiology and disease transmission is vital to nursing care. *Can Nurse*. 2004;100(9):16-20.
<http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=106593899&site=ehost-live>.

Skyman E, Lindahl B, Bergbom I, Sjöström HT, Åhrén C. Being met as marked - patients' experiences of being infected with community-acquired methicillin-resistant staphylococcus aureus (MRSA). . 2017.

Thompson DS, Workman R. Hospital-wide infection control practice and methicillin-resistant staphylococcus aureus (MRSA) in the intensive care unit (ICU): An observational study. *JRSM open*. 2014;5(10):2054270414547145. <http://www.ncbi.nlm.nih.gov/pubmed/25383196>.

Walraven CJ, Lingenfelter E, Rollo J, Madsen T, Alexander DP. Diagnostic and therapeutic evaluation of community-acquired methicillin-resistant staphylococcus aureus (MRSA) skin and soft tissue infections in the emergency department. *Journal of Emergency Medicine*. 2012;42(4):392-399. <https://www.sciencedirect.com/science/article/pii/S0736467911002848>. doi: 10.1016/j.jemermed.2011.03.009.

World health organization. Prevention of hospital-acquired infections. Consulted on 29.1.2018
<http://www.who.int/csr/resources/publications/drugresist/en/whocdscsreph200212.pdf?ua=1>. Updated 2002.

Vuopio Jaana. Multidrug-resistant bacteria in hospitals.
<http://www.terveysportti.fi.ezproxy.turkuamk.fi/dtk/ebmg/kotj>. Updated 2017.
[Accessed on 22.01.2018.]

APPENDIX TERVEYSNETTI POWERPOINT PRESENTATION



HOSPITAL-ACQUIRED
INFECTIONS.zip

