

Bachelor's thesis
Degree programme
Nursing
2011

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PNEUMONIA IN PRE-SCHOOL CHILDREN

TERVEYSNETTI



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Pneumonia is an illness, usually caused by bacterial, viral or more rarely fungal organisms. Common symptoms in children and infants include difficult breathing, cough, and wheezing. Diagnosis involves confirmatory chest radiography and laboratory tests. Antibiotics are the preferred choice for treatment and management. Risks factors include low paternal education, low birth weight, lack of breastfeeding. Key strategies for the prevention of childhood pneumonia are community –based case management, adequate nutrition and zinc intake.

Main aim is produce guidelines for these families by producing web pages to be published in Terveystietä so that they can be able to understand and recognize the disease well. The purpose of my bachelor thesis is to provide information to families with pre-school children about pneumonia.

Literature review was used in analysis of research articles which were obtained from electronic sources in our school library. Main search engine used to retrieve the articles was CINAHL. Searches were limited and compared against each other thus the relevant information was retrieved by selecting meaningful articles and abstracts. Results concluded that pneumonia kills more children than any other illness- more than AIDS, malaria and measles combined resulting to over two million deaths each year.

In conclusion, increased understanding about etiology and pathophysiology of the disease should guide new approaches to tackle the immense global problem of child deaths from pneumonia, the most effective intervention to reduce pneumonia related deaths would be to improve access to early care where simple, appropriate interventions are provided, including referral where necessary.

KEYWORDS:

Pneumonia, 5years, preschool children, treatment, prevention, health education.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
BASICS	Basic Support for Institutionalizing Child Survival
CCM	Community Case Management
GAPP	Global Action Plan for Prevention and Control of Pneumonia
IMCI	Integrated Management of Childhood Illness
NGOs	Non-Governmental organizations
UNICEF	United Nations Children's Fund
WHO	World Health Organization
Hib	Haemophilus influenzae type b
MCH	Maternal Child Health
LTRI	Lower Tract Respiratory Infections
ARI	Acute Respiratory Infections

1. INTRODUCTION

Pneumonia has been identified as the major “forgotten killer of children” by the United Nations Children’s Fund (UNICEF) and WHO. (Wardlaw et al. 2006, 4-44.)

The World Health Organization defines pneumonia as an acute disease episode with cough combined with fast breathing with age specific cut-values for increased respiratory rate. This case definition of childhood pneumonia is widely used in poor-resource settings to guide the management of pneumonia. The definition is also commonly used as an entry criteria or endpoint in different intervention and disease burden studies. (Puumalainen 2008, 1-7.)

Scott (2008, 1291-1299), simply defines it as an illness usually caused by infection, where the lungs become inflamed and congested, thus reducing oxygen exchange and leading to cough and breathlessness. It’s the leading cause of mortality among children under five years of age, despite effective vaccines and nutritional and environmental interventions. (Scott et al. 2008, 1291-1299; Marsh et al. 2008, 381-389.)

Pneumonia has received very little attention as there has been little research on the disease apart from vaccine trials that included the evaluations of the impact of these vaccines on pneumonia. Despite concrete evidence of effectiveness and affordability that costs of reducing pneumonia are relatively low, there has been slow progress in expanding coverage of these interventions. This is resulted from the serious lack of appreciation about the magnitude of the problem of childhood pneumonia. Expanding community-based approaches had been met with resistance due to concerns raised about lower-level health workers such as community health workers administering antibiotics to children with pneumonia with fears that these activities could exacerbate antibiotic resistance. (Greenwood 2007, 502.)

Scott (2008, 1291-1299), also notes that this global disease is typically curable in developed countries but often tragic in the developing countries. It has neither a UN agency to highlight its importance nor funds nor any form of global networks to advocate for drugs, vaccines or care. Having a global burden of 5,000 childhood deaths every day, pneumonia is a continuous, tangible threat that should trigger similar responses- action and research on pneumonia are urgently required. (Scott et al. 2008, 1291-1299.)

Wardlaw (2006, 4-44), states that few headlines report the impact pneumonia has on children's lives yet the toll it exerts on them in developing countries is shocking or rather surprising. There are relatively low global resources dedicated to tackling this problem and the burden placed by pneumonia on families and health care systems in low resource countries, in turn, exacerbates inequalities. Overwhelmingly, children who are poor, hungry and living in remote areas are most likely to be visited by this 'forgotten killer.' (Wardlaw et al.2006, 4-44; WHO 2009, 4-18.)

Jadavji (1997, 703-711), asserts that occurrence of pneumonia is often experienced in early childhood than at any other age. Lack of rapid, commercially available, accurate laboratory tests for most pathogens makes it very difficult to identify the cause of childhood pneumonia. Children had previously been excluded from treatment guidelines of differences between adults and children in frequency and type of underlying illnesses and causative agents. (Jadavji 1997, 703-711.)

Final product of my thesis will be web pages produced for parents or families with children under five years and will be published in terveysnetti. Here these parents or families can be able to access any useful information about pneumonia.

2. BACKGROUND

2.1 Pathophysiology

According to Scott (2008, 1291-1299), the pathophysiology of pneumonia and immune regulation of the inflammatory response to lung infections are poorly understood but Margolis (2006) notes that pneumonia typically follows an upper respiratory tract illness where the lower respiratory tract is invaded by bacteria, viruses or other pathogens that trigger the immune response and produce inflammation. (Margolis & Gadomski 2006, 308-313; Scott et al. 2008, 1291-1299.)

Lung tissue is normally sterile and is protected by numerous anatomical, biochemical and immunological defense mechanisms. Defensive wall has the upper airway filter, mucociliary clearance, innate and adaptive immunity and the cough reflex which facilitates the removal of large particles from the lower airways. Activation of inflammatory mediators, cellular infiltration and immune activation occurs after failure of the defensive mechanisms. Immune complexes and inflammatory mediators can damage bronchial mucous and alveolocapillary membranes, causing the white blood cells, fluid and cellular debris to fill the air spaces of the lower respiratory tract. (Miskovich-Riddle and Keresztes 2006, 43-53; Margolis & Gadomski 2006, 308-313; Lahti 2008, 11-38.)

Accumulation of inflammatory exudates leads to alveolar edema, which serves as medium for the multiplications of bacteria and spread of infection to other parts of the lungs. Collapsed or airless portion of the lung (atelectasis) and obstruction of smaller airways occurs. Children are very susceptible to pneumonia because of the short distance between upper respiratory tract and alveoli, the small diameter of the airways, profuse mucus production, and the immaturity of the immune defense. Nasopharyngeal colonization of pneumonia causing bacteria is common in young children (Miskovich-Riddle and Keresztes 2006, 43-53, Lahti 2008, 11-38.)

Findings indicate that crackles are due to explosive equalization of gas pressure between terminal bronchiole and the alveoli. Wheezes result from the oscillation of air through a narrowed airway that produces a musical sound likened to a vibrating reed while decreased breath sounds may also be heard in areas of consolidation. Virulence of the causative organism and the inflammatory response in the lungs predicts the outcome of a pulmonary infection. Insufficient inflammatory response can result in life-threatening infection, but an excessive response can lead to life-threatening inflammatory lung injury (Margolis & Gadomski 2006, 308-313; Lahti 2008, 11-38.)

Characteristics of severe pneumonia include lower chest wall indrawing and hypoxia. Lower chest indrawing occurs because young children have a soft sternum, horizontal ribs and poor intercostal muscle development. Their lower chest wall collapses in the event of trying to generate greater negative pressure to inflate the lungs due to presence of consolidation and lower airway obstruction. In severe infection, stiffness and inelasticity of lungs occurs due to loss of alveolar epithelial cells, accumulation of degradation products, cell edema, and loss of surfactant causes lungs to become. Hypoxia results from ventilation or perfusion mismatches i.e. areas of the lungs which are infected and unventilated. Children do respond well to treatment with small amounts of oxygen. Without correction, hypoxia and acidosis set the stage for respiratory failure and death. (Scott et al. 2008, 1291-1299.)

According to Wardlaw (2006, 4-44), data on the pathogen specific causes of pneumonia are limited, and available information is often difficult to interpret, though it is known that pneumonia is caused by viruses, bacteria and fungi. Fungal infections are more likely to affect those who are immunosuppressed. (Wardlaw et al. 2006, 4-44). Bacteria are major causes of pneumonia in children in developing countries while viruses are major causes in developed countries. (Mitike et al. 2001, 18-24.)

Streptococcus pneumoniae is the leading cause of severe pneumonia in children. Other bacterial pathogens include *Haemophilus influenzae* type b, also considered as a major cause, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *E. coli*, *Bordetella pertussis*, *Listeria monocytogenes*, *Neisseria meningitidis*, *Pseudomonas aeruginosa*, *Streptococcus pyogenes* and other Gram-negative bacilli. Group B β -haemolytic *Streptococcus* or *Streptococcus agalactiae* causes neonatal infections from the mother's genital tract. (Robinson and Robertson 2003, 496; Wardlaw et al. 2006, 4-44). Mechanism thought to be responsible for the enhanced development of bacterial pneumonia during or after viral infection include disruption of epithelial integrity, changes in airway function such as ciliary dysfunction, and upregulation of adhesion receptors. (Lahti 2008, 11-38.)

Viral pathogens include Respiratory syncytial virus (RSV), which is the most frequent cause in infancy, Influenza A and B, Parainfluenza, Human metapneumovirus (hMPV), Human bocavirus (HBoV), Human herpes virus 6, Varicella-zoster virus, Rhinoviruses, Cytomegalovirus and Epstein-Barr virus. *Pneumocystis jirovecii* (PCP) is the fungal pathogen causing pneumonia particularly in young children with AIDS. Other fungal pathogens include *Actinomyces*, *Aspergillus*, *Candida*, *Cryptococcus* and *Histoplasma*. Protozoa pathogens like *Pneumocystis carinii* also cause pneumonia mostly in immunosuppressed children. Viruses can pave the way for bacterial pneumonia by making the host more susceptible to bacterial infections. As children become older, viruses become less frequent and bacterial infections become more prominent. (Clayden and Lissauer 2001, 322; Mitike et al. 2001, 18-24; Robinson and Robertson 2003, 496; Wardlaw et al. 2006, 4-44.)

Mixed viral-bacterial infections are the most frequent form of mixed infection and the most commonly found viral-bacterial combinations in children with pneumonia are *Streptococcus pneumoniae* and RSV or *Streptococcus pneumoniae* and rhinovirus. It is not fully understood about the mixed infection but it is proposed that viruses induced aspiration of bacteria into the lungs or escape of bacteria into the bloodstream could result into production of immune

complexes or bacterial antibodies. Detection in lung aspirate samples indicates their true concomitant role in development of pneumonia. (Lahti 2008, 11-38.)

In viral pneumonia, the invading pathogen often affects the conducting airways and alveoli, the virus proceeds to disrupt normal lung function through the associated inflammatory response. Aspiration of gastric contents, oropharyngeal secretions, lipids, oral laxatives, and water inhalation in cases of drowning leads to aspiration pneumonia. Ventilator associated pneumonia mainly occur in ventilated patients because the oropharyngeal tube provides free access for the pathogens to bypass the body's natural defense mechanism. (Kate 2004, 170-175; Dunn et al. 2005, 50-54.)

Luby (2008, 295-310), explains that viral infections are very common thus estimating viruses to be the most common cause of severe pneumonia and severe illness and hospitalization of young children is associated with Influenza virus. Some underlying disease such as pulmonary anomaly, congenital or acquired immunodeficiency or immunosuppression, lung disease such as cystic fibrosis, or neurological syndrome can impair the normal pulmonary defense mechanism. Thus this gives high chances of a previously healthy child developing pneumonia. (Lahti 2008, 11-38; Luby et al. 2008, 295-310.)

Pneumonia can be classified according the part of lung affected e.g. lobar or bronchi, the infectious agent and most commonly, whether the pneumonia is acquired in the community or in hospital. Katie (2004, 170-175), explains that a viral infection which has invaded the lung defenses facilitates occurrence of a bacterial infection. The viral infection alters normal secretions and flora, which in turn, disrupts the epithelial layer and disruption of phagocytosis. Subsequently bacterial pneumonia develops from the invasion of a bacterium in the upper respiratory tract. (Katie 2004, 170-175; Dunn et al. 2005, 50-54.)

2.2 Epidemiology

Pneumonia is responsible for about 19% of all deaths in children aged less than 5 years. Childhood pneumonia incidence is estimated to be 0.29 episodes per child-year in developing and 0.05 episodes per year in developed countries. 7-13% of all the community cases are severe enough to be life threatening thus requiring hospitalization. Estimated clinical pneumonia incidences are highest in South Asia (0.36 episodes per child-year), followed closely by Africa (0.33 episodes per child-year), Eastern Mediterranean (0.28 episodes per child-year), and lowest in Western Pacific (0.22 episodes per child-year) and American and European regions (0.10 and 0.06 episodes per child-year respectively). (Rudan et al. 2008, 408-416.)

15 countries have the highest predicted number of new episodes of pneumonia and their respective incidence, which accounts for the 74% (115.3 million episodes) of the estimated 156 million global. They include India, China, Pakistan, Bangladesh, Nigeria, Indonesia, Ethiopia, Democratic Republic of Congo, Vietnam, Philippines, Sudan, Afghanistan, Tanzania, Myanmar, and Brazil. However, more than half of these world's annual new pneumonia cases are concentrated in five countries i.e. India (43 million), China (21 million), and Pakistan (10 million), with additional high numbers in Bangladesh, Indonesia and Nigeria (6million). The same countries have the highest number of deaths due to clinical pneumonia with India 428,000 deaths and the least being Burkina Faso with 25,000 news deaths. (Rudan et al. 2008, 408-416.)

In Finland the overall incidence of pneumonia is 37/1000/year among children below 5 years. Half of the children under 5 years are admitted in hospital and susceptibility to respiratory infections is the most important risk factor. (Vuori-Holopainen 2001, 15.)

2.3 Diagnosis

Diagnosis of pneumonia consists of two very important parts; first is to determine the syndrome by history clinical examination and chest radiology;

and secondly is to determination of etiology by laboratory tests. Intensive physical examination should be done with the respiratory system being the main center of attention or focus. Important information can be gained through careful observation and it is of great importance especially in very young children as they difficult to examine. (Katie 2004, 170-175; Scott et al. 2008, 1291-1299.)

Kyle (2007, 545) suggests that it's very important eliciting a description of the present illness and complains. Fever, increased respiratory rate and history of lethargy, poor feeding vomiting or diarrhea in infants are some of the symptoms that may be brought forward during taking of a health history of the child. Also risk factors known to be associated with an increase in severity of pneumonia e.g. malnutrition, exposure to passive smoking should be inquired about. Inquire from the parent about prior chest symptoms like noisy breathing, chest rattling, and trouble breathing. The information given is very useful as it may suggest reactive airway disease in cases of recurrent bouts of pneumonia. Infants under 2 months of mother who had Chlamydia during pregnancy may develop afebrile pneumonia. (Margolis & Gadomski 2006, 308-313; Kyle Theresa & Kyle Terri 2007, 545.)

Physical examination should include an assessment of the child's general appearance, respiratory rate measurement, evaluation of the work of the breathing, and chest auscultation. A child's general appearance may provide important leads like presence and severity of a bacterial illness thus factors to be evaluated or assessed include; being attentive to the environment, ability to breastfeed or drink, ability to sustain sucking, vocalization, smiling, color and consolability. (Margolis & Gadomski 2006, 308-313.)

Observing chest wall movements over a 1 minute period when the child is calm, sleeping or feeding is the best way to measure the respiratory rate. This is done to avoid measurement errors. Respiratory measures used to indicate elevated rates are greater than 60/min in infants younger than 2 months, 50/min in infants of 2 to 12 months of age, and greater than 40/min in children older than 12 months. (Margolis & Gadomski 2006, 308-313.)

Evaluation of chest wall movements, nasal flaring, and grunting are some of the works of breathing assessed to determine the severity of the infection. Chest wall movements include retractions or inward movement of lower chest wall when child breathes (chest indrawing) which are best observed with the chest fully exposed. The chest should be viewed laterally and look for indrawing of the ribs or lower sternum with every inspiration. Hoover sign, or paradoxical or seesaw breathing (movement of abdomen outwards and chest inward during inspiration) may be observed. Impending respiratory failure can be predicated or assumed if there is grunting which is always a sign of severe disease. (Margolis & Gadomski 2006, 308-313.)

Chest auscultation produce adventitious sounds like crackles, rales or crepitations (discontinuous or popping sounds), wheezes and rhonci (continuous sounds throughout breathing) which can be musical, high-or low-pitched. Wheezes reflect small airway obstruction while rhonci reflect obstruction of larger airways. Auscultations should be performed after the visual inspection of the child and it is important to listen to the front, back, and side of the child's chest as the sounds may only be heard in one location. Wheezing can be heard by listening to the sound of the breaths from the child's mouth. (Margolis & Gadomski 2006, 308-313.)

Confirmatory chest radiography is important as two main patterns of pneumonia are recognized; interstitial and alveolar. Viral infections are associated with diffuse interstitial infiltrates, hyperinflation, alveolar filtrates and peribronchial thickening while bacterial pneumonia is associated with lobar infiltrates, alveolar infiltrates and pulmonary abscesses. Circular filtrates are seen in the early stages of pneumococcal pneumonia. Mycoplasma pneumonia has been associated with nodular infiltrations, actelectasis, lobar consolidation and hilar adenopathy. Medina (2009, 47-51) seconds this by noting that presence of lung opacity on chest radiography often confirms and defines the diagnosis of pneumonia. (Jadavji et al. 1997, 703-711; Medina et al. 2009, 47-51.)

Identification of the agents and extensions of infection is done by conducting laboratory tests. For patients with suspected pneumonia complete white blood

cell count and leukocytes differentiation should be considered. In cases of bacterial pneumonia, the WBC is usually increased with a predominance of polymorphonuclear cells. In both developing and developed countries, blood cultures are performed to determine bacterial and viral pathogens as it remains the standard method. They do appear to have low sensitivity but are still worthwhile in identifying the causative agents. (Jadavji et al. 1997, 703-711; Medina et al. 2009, 47-51.)

Other diagnostic methods include antigen detection techniques which can provide a rapid diagnosis and are particularly useful in patients with preceding antibiotic treatment. Unlike bacteria, viruses rarely colonize the respiratory tract in the absence of disease, therefore, the detection of antigens of common respiratory viruses (RSV, influenza A and B, parainfluenza virus type 1, 2 and 3, and adenovirus) from the nasopharyngeal mucus is routinely used for diagnosis of respiratory tract infections. (Lahti 2008, 11-38.)

In developing countries, childhood pneumonia is diagnosed through clinical parameters based on the cough and raised respiratory rate. Blood cultures are used for investigating causative agents in most cases of pneumonia but very few cases are bacteriemic making it a very insensitive test in most setting. In poor resource settings without technologies like chest x-rays and laboratory tests, children and infants are assumed to be suffering from pneumonia infection if they have a cough or presence of fast breathing. (Magree et al. 2005, 427-432; Wardlaw et al. 2006, 4-44.)

Paucity of positive findings from blood or pleural cultures, low specificity of antigen tests like urine samples, dependence on antibody response, difficulty to obtain sputum samples from children, scarce utility of culture of respiratory tract samples and non-feasible invasive examination e.g. lung biopsy are some of the factors that make diagnosis of pneumonia in children to be very difficult. (Don 2009, 16-157.)

Wardlaw (2006, 4-44), states that the signs and symptoms in children with pneumonia depend on their age and cause of infection, nutrition and immunity

status of the host. Bacterial pneumonia leads to severe illness associated with high fever and rapid breathing while in the viral infections, they start gradually and worsen overtime. (Mitike et al. 2001, 18-24; Wardlaw et al. 2006, 4-44.)

Common symptoms in children and infants include cough, fever, chills, loss of appetite and wheezing, stuffy nose. Children under five with severe pneumonia may experience respiratory distress which is characterized by tachypnea, chest indrawing, grunting, flaring of the nose, cyanosis, and respiratory fatigue. Other symptoms are convulsions, unconsciousness, hypothermia, lethargy. For reasons not understood, infected pleural effusions i.e empyema are becoming more common in children with pneumonia especially if the pathogen is *Pneumococcus*. (Mitike et al. 2001, 18-24; Clayden and Lissauer 2002, 322; Wardlaw et al. 2006, 4-44.)

Lahti (2008, 11-38), points out that detected diagnostic sign of pneumonia is helpful in the developing world where radiographic facilities are rarely available, trained staff are lacking and pneumonia mortality is high. Chest indrawing is seen as a very useful indicator of childhood pneumonia in the developing countries. In the developed countries however, tachypnea as a sign of pneumonia should be used with caution. This is because most children presenting with tachypnea may have other respiratory diseases like bronchiolitis or asthma instead of pneumonia. (Lahti 2008, 11-38.)

2.4 Risk Factors and transmission

According to Okiro (2008, 914-926), pneumonia has multiple etiologies and the risk factors hence they can be common to all types of pneumonia, specific to viral pneumonias or may be agent specific. (Okiro et al. 2008, 914-926.)

Rudan (2008, 408-416), outlines some of the risk factors associated with pneumonia and also further classifying them into definite, likely and possible factors. Definite risk factors are malnutrition, no exclusive breast feeding, and lack of measles immunization, low birth weight, indoor air pollution and crowding. Likely risk factors are parental smoking, zinc deficiency, mother's

experience as a care giver. Possible factors include mother's education, day-care attendance, rainfall (humidity), high altitudes (cold air), vitamin A deficiency, and outdoor pollution. (Rudan et al. 2008, 408-416.)

Malnutrition is biologically plausible because the malnourished children are have impaired immunological responses and more severe infections thus increasing the risk and severity of pneumonia. Malnutrition itself is a cause of mortality in children under 5 years as well as a risk factor for incidence of and mortality due to other major causes of under-5 mortality such as HIV-infection. (Davies and Zar 2005, 1-20.)

There is a very high risk of contracting pneumonia in children who are not or partially breastfed than in children who are breastfed exclusively. Breastfeeding has a protective effect which is due to its special or unique anti-infective properties which facilitate passive protection against microorganisms, immune system stimulation and inhibition of gastro-intestinal invasion by Gram- negative species. Breast-feeding affords protection against childhood pneumonia which persists beyond the breastfeeding period. (Davies and Zar 2005, 1-20.)

Short period of breastfeeding and poorer nutritional status are examples of socio-economical deprivation which are associated with low birth weight, which in turn, increases the risk of contraction pneumonia in children. Low birth weight is associated with the morbidity and mortality of pneumonia and, furthermore, there are other means where low birth weight makes children prone to pneumonia i.e. reduction in immune system competence and lung function impairment. (Davies and Zar 2005, 1-20.)

Solid fuel use enhances air pollutants which have toxins or chemical properties that adversely affect defensive system of the host in the respiratory tract against pathogens which increases risk of contracting childhood pneumonia. Household cooking increases the risk of contracting pneumonia especially in children because they spend most of the time with their mothers thus are vulnerable to the hazardous respiratory effects of the fuels. Outdoor air pollution also increased risk of pneumonia through exposure to pollution especially fine

particles and ozone. Susceptibility to bacterial infection is increased by these air pollutants because they affect the immune system which causes inflammatory reactions. (Davies and Zar 2005, 1-20.)

Crowding conditions experienced at many homes increases the risk of disease transmission in children and this crowding is mainly caused by living in families of large size, small poor quality houses, and houses with poor sanitation. These are some of the factors increasing risk of respiratory illnesses. Pneumonia in children is also associated with damp and humid conditions thus when seeking interventions to reduce pneumonia incidence and mortality, it's always advisable to consider the influence the low socio-economic status has on the risk factors of pneumonia. (Davies and Zar 2005, 1-20.)

High risks are also seen in day care attendance as children attending day care are at risk of contracting pneumonia and also other upper respiratory tract illnesses which might prompt hospitalization of the sick children. Younger children and those with poor access to treatment have the highest risk of contracting pneumonia. (Victoria et al. 1994, 886-893; Davies and Zar 2005, 1-20.)

Pathogens that cause pneumonia may find their way into the child's respiratory system through many ways but there is a belief that common bacterial and viral microorganisms that cause pneumonia are already present in a child's nasal cavity or pharynx and are often inspired into the lungs, leading to infection. (Wardlaw et al. 2006, 4-44.)

Pathogens may be air borne i.e. they can be spread to children through air borne droplets by coughing or sneezing or also through blood-borne infections. Infants have a higher risk of contracting pneumonia when they come into contact with pathogens in the birth canal. More research needs to be done on these pathogens and how they are spread and this has critical importance of treatment and prevention. (Wardlaw et al. 2006, 4-44.)

2.5 Complications of pneumonia

According to Prayle (2011, 60-69), major complications of pneumonia include and lung abscess, pleural effusion and empyema, pneumothorax. Other complications include overwhelming sepsis and septic shock, arthritis, osteomyelitis, meningitis, myocarditis and pericarditis. (Mitike et al. 2001, 18-24; Prayle et al. 2011, 60-69.)

A lung abscess is a circumscribed, thick-walled cavity in the lung that contains purulent material resulting from suppuration and necrosis of the involved lung parenchyma. Pulmonary aspiration is thought to play a primary role in development of lung abscess particularly in those children with neurodevelopment delay or immune deficiency. Other factors include frequency and volume of aspiration, diminished clearance mechanisms, embolic phenomena, and hematogenous spread from septicaemia. Lung abscess is treated through intravenous antibiotic therapy; according to causative pathogen, aspiration of the abscess and placement of catheter for drainage. Surgical treatment may be rare on in cases of large lung abscesses associated with hemoptysis. (Puligandla et al. 2008, 42-52.)

Pleural effusion and empyema is accumulation of purulent fluid or pus in the pleural cavity. Basic principle for treatment is to drain the infected pleural space and allow lung re-expansion. It includes administration of high dose intravenous antibiotics, surgical debridement i.e. video-assisted thoracoscopic surgery and fibrinolytic therapy. (Puligandla et al. 2008, 42-52.)

Pneumothorax is the accumulation of air in the pleural cavity, with secondary lung collapse. Therapeutic management should take into consideration clinical severity, presence and nature of the underlying lung disease. Lung re-expansion and prevention of recurrences should be the primary goal of treatment. Thoracoscopic treatment is safe and effective for children as it can be performed under regional anesthesia, and also in children with severe respiratory insufficiency. (Ozcan et al. 2003, 1459-1464.)

2.6 Prevention and treatment

According to Wardlaw (2006, 4-44), reducing pneumonia deaths also requires implementing effective measures so that children are healthier and less likely to develop pneumonia in the first place. The key strategies for prevention of childhood pneumonia are community-based care management, mainly through Integrated Management of Childhood Illness (IMCI), and immunization, particularly the newer vaccines against *Haemophilus influenzae* type b and pneumococcus. (Wardlaw et al. 2006, 4-44; Mulholland et al. 2008, 399-407.)

Immunization helps reduce deaths related to childhood pneumonia by preventing children from developing infections that cause pneumonia or can lead to pneumonia as a complication e.g. measles and pertussis. The vaccines have the potential to reduce deaths from childhood pneumonia include the measles, Hib and pneumococcal conjugate vaccines. Both Hib and pneumococcal conjugate vaccines have proven safety and effectiveness of radiologically preventable confirmed pneumonia in children, including low-income and industrializing countries. (Wardlaw et al. 2006, 4-44; Madhi et al. 2008, 365-372.)

Proteins and energy are some of the nutrients required for proper functioning of the immune system by boosting the respiratory muscles which facilitate adequate clearing of secretions found in the respiratory tract hence reducing risk of contracting childhood pneumonia. Exclusive breastfeeding is another key preventive measure children who are exclusively breastfed are vulnerable to fewer infections and experience less severe illnesses. Also breastfeeding provides better nutritional status during the first few months of life hence the children are less likely to be exposed to contaminated foods which might cause gastro-intestinal infections thus impairing their nutritional status. Breast milk contains nutrients, antioxidants, hormones and antibodies which a child for survival and development of a strong and viable immune system. (Davies and Zar 2005, 1-20; Wardlaw et al. 2006, 4-44.)

Zinc intake assists in reducing severity of pneumonia by boosting the protective immune responses regardless of the zinc status of the child. It helps in reduction of inflammation and lower airway obstruction, thus, reducing severity and duration of pneumonia and reduced treatment failure rates when compared to placebo intervention. Hand washing and lowering indoor air pollution plays a role in reducing pneumonia in developing countries. Also preventing pneumonia morbidity and mortality can be through reduced indoor air pollution by using other fuels, improving combustion and ventilation. (Brooks et al. 2004, 1683-1688; Wardlaw et al. 2006, 4-44; Dherani et al. 2008, 390-398.)

Community-based management of pneumonia significantly reduces child mortality and such Interventions for diagnosing and treating pneumonia have a significant impact of pneumonia mortality in under-five children. Case management approach works even in the most difficult and deprived settings and among children with multiple risk factors. Community health workers who are well trained have the potential to increase the number of pneumonia cases receiving management in setting with poor resources through appropriate health systems' support for logistics, supervision and monitoring. (Wardlaw et al. 2006, 4-44; Dawson et al. 2008, 339-343.)

According to Harris (2011, 1-19), the most important decision in the management of pneumonia is whether a child should be treated in the community or refer and admit for hospital based-care. This decision is best informed by an accurate assessment of severity of illness at presentation and likely prognosis. In previously well children there is a low risk of complications and treatment in the community is preferable, thus, microbiological investigations, initial antimicrobial therapy, and route of administration, duration of treatment and level of nursing and medical care are factors that determine the management of severity of these children in the community. (Harris et al. 2011, 1-19.)

General management of a child who does not require hospital referral comprises advising parents and guardians about management of fever, preventing dehydration, identifying signs and other serious illnesses. Provide

the parent with information on warning symptoms which may be in written form, and by arranging a follow-up appointment as a certain time and place. Co-operation with other health care teams ensures that the parent has access to a further assessment for the child. (Harris et al. 2011, 1-19.)

It is not possible to differentiate reliably between bacterial or viral pneumonia on clinical radiographic grounds, so all children diagnosed as having pneumonia should be given antibiotics as the pathogen is rarely known when the treatment is started. The choice of antibiotics depends on child's age, severity of the disease and appearance of chest x-ray. Amoxicillin has proven to be the most effective treatment and is generally used unless the child has an allergy. Other antimicrobial agents used for pediatric therapy include Cefuroxime for 3 months to 5 years, erythromycin, amoxicillin, co-amoxiclav, and ceftriaxone. (Clayden and Lissauer 2002, 322; Jadavji et al.1997, 703-711.)

Use of antibiotics early in the disease gives a prompt and favorable response. Antibiotics administered orally are safe and effective for children presenting with mild pneumonia. Intravenous antibiotics should be administered to children who can't take in fluids or antibiotics orally maybe due to vomiting, or presents with signs of septicemia or complicated pneumonia. (Harris et al. 2011, 1-19.)

Oxygen started early in the disease process is important and can be administered through an oxygen mask or hood. The masks or hoods are the best alternative since croupette or mist tent may make the child cyanotic due to difficulty in seeing the child. Intravenous fluids are needed to supply the required amounts of fluids while a chest drain is used in case of empyema. Persistency of pneumonia should prompt investigations to examine possible underlying conditions such as cystic, fibrosis, or immunodeficiency. (Marks et al. 1998, 357-360; Jadavji et al.1997, 703-711; Clayden and Lissauer 2002, 322.)

Vaccines are also used in treatment of pneumonia and include Pneumococcal Conjugate Vaccine (PCV) for *Streptococcus pneumoniae*, Hib vaccine for *Haemophilus influenzae* type b, and Measles vaccine. Pneumonia is a serious complication of measles, and most common cause of death associated with

measles, thus, reducing incidence of measles in young children through vaccination would also help to reduce pneumonia deaths. Reingold (2008, 144), states that use of expanded-valency conjugate vaccines might further reduce invasive pneumococcal diseases. Investigations to determine the etiology are not necessary during planning therapy for these children, thus only a short parenteral treatment period is required and the patients can be treated with antibiotics as outpatients. (Juven et al 2004, 140-144; Wardlaw et al. 2006, 4-44; Reingold et al. 2008, 144.)

Brook (2004, 1683-1688), reports that zinc prevents pneumonia by acting in the acute phase response to infection thus boosting the immune system of the body, protecting the lungs from inflammatory states, and lower airway obstruction. Also zinc contributes to faster inflammation resolution time, manifested by shorter duration of chest indrawing, high respiratory rate, and hypoxia. Adjuvant treatment with 20mg zinc per day accelerate recovery from severe pneumonia, reduce antimicrobial resistance, decrease multiple antibiotic exposures, and lessens complications and deaths where other drugs are not accessible. (Brooks et al. 2004, 1683-1688.)

2.7 Recognition of signs and care seeking behavior

Recognizing symptoms of pneumonia is a major first step in reducing pneumonia deaths among children under five years. Parents or guardians have a critical role to play in recognizing signs and symptoms of pneumonia and seeking medical attention for their sick children. Another crucial aspect of recognizing the symptoms is the risk pneumonia poses to the health of their children thus the parents should really understand the importance of pneumonia. (Wardlaw et al. 2006, 4-44.)

There are instances where some children are taken to appropriate health care centers while others are not. Good examples is seen where children from rural areas are less likely to be taken for medical attention than the other children in urban areas. Socio-economic status of families i.e. children in rich and poor families where poor children might even not be able to afford medical care

compared to the children from rich families, and for children with parents who are poorly educated as compared to those whose parents are well educated. (Wardlaw et al. 2006, 4-44.)

2.8 Interventions and awareness

Marsh (2008, 381-389), asserts that the global public health community needs an operational definition to better describe, monitor and evaluate CCM programs. CCM of pneumonia has a broad and growing constituency: WHO, UNICEF, Ministries of Health, donors, academics, and NGOs, including technical support groups like BASICS, which are important sources of technical support and advocacy. (Marsh et al. 2008, 381-389.)

Global Action Plan for Prevention and Control of Pneumonia (GAPP) is a programme that has been created by WHO in association with UNICEF in order to increase awareness of pneumonia as a major killer of children under five years, campaigning for the utilization of interventions of benefit that are proven, and provision of guidance on how the interventions can be put into use. The various interventions for controlling pneumonia in children under five are:

1. Protecting children by providing an environment where they are at low risk of pneumonia through exclusive breastfeeding for six months, adequate nutrition, prevent low birth weight, reduce indoor pollution and hand washing.
2. Preventing children from becoming ill through vaccination against measles, pertussis, *Streptococcus pneumoniae* and *Haemophilus influenzae b*, administering cotrimoxazole prophylaxis for HIV-infected and exposed children, and zinc supplementation.
3. Treating children who become ill from pneumonia through case management in community, health centre and hospital. (WHO 2009, 4-18.)

It is necessary for parents of these children to seek appropriate medical care immediately they recognize the signs and symptoms of pneumonia such as

cough and fast or difficult breathing. Educating the care givers is also an important consideration since most of them are misinformed or rather don't have the necessary education to be able to recognize these signs of pneumonia. The crucial role of caregivers in home-based treatment and educational programs dedicated for them have to ensure that caregivers have a clear or better understanding of the importance of pneumonia and its treatment course, and are convinced of treatment efficacy. (Wardlaw et al. 2006, 4-44.)

Development of guidelines for diagnosing pneumonia in children has a great impact in distinguishing most pneumonia cases from other respiratory tract illnesses. Training of the health personnel who also include community health workers can greatly assist in diagnosing pneumonia in children under five and this training can help the health workers treat children with pneumonia and refer severe cases to health facilities for advanced medical attention. (Wardlaw et al. 2006, 4-44.)

Children should be treated immediately with recommended antibiotics once a diagnosis of pneumonia has been made and this can be facilitated by making available an adequate supply of antibiotics to all health care facilities and community health personnel. In some cases, authorities may need to authorize trained community health workers to prescribe antibiotics for children diagnosed with pneumonia. Numerous countries in the developing world have successfully implemented guidelines for diagnosing and treating pneumonia. (Wardlaw et al. 2006, 4-44.)

Responsibility for formulating and coordinating the implementation of GAPP should be handled by a group or coordinating bodies. Formation of such groups may be necessary especially in countries with high mortality of childhood pneumonia, while in other countries such groups will be part of an existing national boards or committees related to survival of the children e.g. IMCI, immunization, making pregnancy safer, HIV, or environmental health. Responsibilities of these groups may include measuring progress, using the information for modifying the national plan, advocacy and resource mobilization, monitoring the clinical efficacy of pneumonia treatment. This promotes the

revision of national treatment policies which are based on antimicrobial resistant information, clinical outcomes and other data. (Wardlaw et al. 2006, 4-44.)

To raise awareness of the effects of pneumonia globally, a World Pneumonia Day was established. The first one was held on 2nd November 2009. Last year it held on 12th November 2010 and this year it will be held on 12th of November 2011. (WHO 2011, 1-23.)

World Pneumonia Day empowers citizens in more than 42 countries to create numerous events to advocate for improved pneumonia prevention and treatment programs. It also empowers advocates across the globe to implement a wide array of creative strategies to inform and motivate policymakers and the public on the need to take action against the urgent problem of child pneumonia. (WHO 2011, 1-23.)

3. AIMS AND PURPOSE OF THE PROJECT

The aim is produce guidelines for these families by producing web pages to be published in terveystietä so that they can be able to understand and recognize the disease well

The purpose of my bachelor thesis is to provide information to families with pre-school children about pneumonia.

4. IMPLICATION OF THE PROJECT

The general goal or aim of this thesis is public health education and this will be done by creating web pages which will be published in Terveystietä. This is a designed website for the public where they can easily access information about any of the diseases or ailments that they encounter.

This information generally targets the immigrants because there is the problem of understanding the local languages i.e. Finnish and Swedish immediately they arrive here. Majority can speak English so by publishing this information on the net it will give them an easier way of understanding this disease especially those with children less than five years.

5. HEALTH EDUCATION

Health education is any combination of learning experiences designed to help individuals and communities improve their health, by increasing their knowledge and influencing their attitudes and playing a crucial role in the development of a healthy, inclusive and equitable social, psychological and physical environment. It is a unique discipline which focuses almost exclusively on knowledge which is a critical point in the health education itself thus strives to provide knowledge as well as the requisite skills necessary to apply in developing appropriate attitudes which result in healthier behavior choices. (Gilbert 2011, 13; WHO 2011, 1-23.)

Health education comprises consciously constructed opportunities for learning involving some form of communication designed to improve health literacy, including knowledge, and developing life skills which are conducive to individual and community health. It is also concerned with fostering the motivation, skills and confidence (self-efficacy) necessary to take action to improve health. Health education includes the communication of information concerning the underlying social, economic and environmental conditions impacting on health, as well as individual risk factors and behaviors and use of the health care system. Communication of information and development of skills demonstrate the political feasibility and organizational possibilities of various form of action to

address social, economic and environmental determinants of health. (WHO 1998, 3-20.)

Stetson (1999, 4-6) asserts that health education is any combination of learning experiences designed to facilitate voluntary adaptations of behavior conducive to health i.e. behaviors detrimental to health to behaviors conducive to present and future health. It can be a strategy to help the poor and powerless gain greater control over their own health and lives and can sometimes be regarded as health promotion which is perceived to encompass health education while including complementary political and social actions, thus facilitating the necessary organizational, economic and other environmental supports for the conversion of individual actions into better health status. (Stetson 1999, 4-6.)

Osuala (2011, 53-60) indicates that health education is a process of passing information to individuals or groups with the purpose of helping with adoption of positive changes in attitudes and behavior in health related matters. Furthermore, it is geared towards change in behavior that persists over time thus has to be practiced repeatedly and reinforced through learning which helps to maintain, promote, prevent and restore the various components of man, and therefore contributes immensely to the achievement of health-related goals. (Osuala 2011, 53-60.)

Flores (2003, 1021), notes that many pediatric hospitalizations might be avoided if caregivers were better educated about the child's condition, medication, the importance of follow-up care, and the ways or methods of avoiding known disease triggers. (Flores et al. 2003, 1021.)

6. ESTABLISHING WEBPAGES

The end product of this project will be web pages that will have information to parents who have pre-school children about pneumonia. The information to be included in the web pages include a brief information on the pathophysiology (how the disease prevails in the body after infection), how it is diagnosed, the possible risk factors, what causes the diseases, what are the signs and symptoms (the ones they should carefully observe in case they present themselves in their children), treatment given to the sick children and how to prevent infection of their children. (Honcode, Consulted 15.9.2011.)

All the above contents which will be included in the webpage will be very simple and clear, and everyone will be able to understand all the contents since simple language will be used. There will be use of bulletins and sentences for explaining each and every details of the webpage. (Honcode, Consulted 15.9.2011.)

The target group is parents and guardians of children under five years who will be able to access this information easily through terveystietä. By doing this, their children's health will be promoted also reducing deaths related to pneumonia.

Webpages are therefore made to relay information that will help parents modify the behavior or rather their perception about pneumonia. This means that the webpages are to be used to educate the parents and guardians about what is important in improving the health and life of their children. Health education is the main end product of the whole thesis in form of these webpages.

7. RELIABILITY AND ETHICAL CONSIDERATIONS

Articles were gathered, analyzed so as to differentiate them into different topics that form this project. Articles or books with common or similar information were put together to produce similar results or conclusions thus proving them reliable. Reliability may be achieved through using equivalent forms of data gathering to yield similar results. (Cohen et al. 2007, 147.)

Information was retrieved with the help of search engines e.g. CINHALL where all materials are approved thus all the contents of this thesis do not breach any rights and also the use of own opinion by the author is totally avoided. This does not infringe the rights and freedom held by the authors of these literature materials. (Sanjeev 2009, 5-10.)

The author has included a list of references indicating the authors of the articles used. Also references have been cited at the end of sentences and paragraphs. This also provides a scenario of easy referencing if more information is needed about the topic. Howe and Moses (1999, 21-60), indicates that plagiarism can take different forms including copying another author's work verbatim, using intellectual property without the express permission of the owner of those ideas or lifting substantial portions of another's work without citation of that author. (Howe and Moses 1999, 21-60.)

Burns and Grove (2005, 365-366), assert that ethical research is essential for generation of sound knowledge for practice. Conducting research begins ethically with identification of the project topic and continues throughout the publication of the project. At the beginning of this project, the author presented his project idea, sought permission from the lecturers concerned with the thesis. Upon approval the author has used databases from the school library which are available in both electronic form and books to retrieve all articles. All the guidelines for writing thesis as outlined by Turku University of Applied Sciences have been followed with assistance from the lecturers. The author also avoided use of his own mother tongue and including own opinions in the project thus all the information in this project is from reliable sources which are listed at the end

of the project. Ethical actions essential in projects may include submitting a research proposal for institutional review and also obtaining permissions. (Burns and Grove 2005, 365-366.)

Limitations were also part of the production of this project. Language barrier was the major limitation encountered by the author. There were so many useful and reliable articles where very relevant information would have been retrieved but they were written in Finnish language of which the author is not fluent in it. This was particularly not appealing since omission of those articles in Finnish has limited or has hindered the author from getting important information especially concerning the epidemiology in Finland.

The author's mother tongue is not English so this project is liable to grammar and spellings mistakes which can be checked carefully.

9. DISCUSSION AND CONCLUSIONS

Pneumonia is a silent global disease which is easily detected and treated effectively in developed countries but in developing countries it always results into deaths i.e. it is not easily curable. Various abbreviations e.g. ARI and LTRI used to in description of pneumonia, its familiar and benign image in the developed world has brought a wrong perception about this disease as a public health problem thus undermining it as a single, tractable problem. Research on pneumonia is can be highly effective, especially if this disease is solely dealt with comprehensively. (Scott et al. 2008, 1291-1299.)

Pneumonia has been associated with poverty and malnutrition which are some of the risk factors, where effective management through the community programs has proven difficult to achieve thus monitoring equity is very importance during introduction of strategies for child survival. Economic poverty, ethnicity, geography and poor health facilities are some of the important factors that determine inequity of outcomes in health, facilitate the failure of access to health care hence leading to inequity in survival of the children. Measures like IMCI and use of new vaccines can be implemented effectively if countries can

appreciate the major determinants of inequity in the event of introducing child-survival strategies. (Mulholland 2008, 399-407.)

Graham (2008, 349-355), asserts that improved access to early health care in communities where appropriate and effective interventions are provided, expanding management of community cases and preventive measures based in the population are some of the most important options or ways that can be introduced or followed to reduce mortality of pneumonia in children. In order to realize outcome of these interventions, there has to be enough health workers, programs for training and support, antibiotics and oxygen which are readily available. By doing so, an increase in the effectiveness of health care systems is realized when these measures are combined with the existing facility-based case management. (Graham et al. 2008, 349-355; Niessen et al. 2009, 472-480.)

Scott (2008, 1291-1299) further explains that during any event of research on pneumonia, priority should be emphasized on having a clear understanding about the epidemiology of fatal pneumonia. Child deaths from pneumonia are immense global problem thus when implementing new guides to tackle this disease there should be an enhanced understanding and information that is intensively detailed about etiology and pathophysiology of the disease. Distinguishing epidemics and identification of pathogens using developed surveillance tools with new diagnostics, study of the pathophysiology and response of the affected child are some of the approaches that can be used to improve case management and clinical outcomes. Another important approach is studies based in the community which are used to evaluate the impact of prevention and strategies of case management, description of the epidemiology of fatal pneumonia, and investigating how equity plays a part in childhood death from pneumonia. (Scott et al. 2008, 1291-1299.)

Promotion of public health education in the community is significant in increasing knowledge and perception of the public in preventing and improves assessment of pneumonia thus ensuring better health practices. Emphasize should be laid on the signs and symptoms of pneumonia, causes and factors

related to pneumonia, and the perception of perceived pneumonia severity. Educational programs propose that nurses can play a very big part in impacting and enhancing the knowledge of the mothers about pneumonia and how they should take care of their children once they contract pneumonia. (Siswanto et al. 2007, 43-51; Parvez et al. 2010, 136-141.)

Management of pneumonia in the community has created a mid-term solution during strengthening of the efforts to curd this leading cause of childhood deaths. Improving the management of pneumonia in countries with inadequate human resources to provide health care is one of the major approaches in reducing child deaths from pneumonia. (Dawson et al. 2008, 339-343.)

Khan (1990, 577-585), seconds Siswanto (2007), by further stating that in health educating the mothers instruct them on how to recognize the signs and symptoms of pneumonia and during severe illness e.g. rapid respiratory rate and the inability to take oral fluids, the importance of childhood immunization, general hygienic measures like use of soap and water. Exclusive breastfeeding, neutral environmental temperature, and humidification of household air and avoidance of household smoke are some of the simplified supportive measures that mothers should be informed of. Education in the community also involves health workers who can be trained again in definition and management of cases, and using available protocol to tackle pneumonia. The integral package which focuses on care of the childhood disease should also include strategies to curb pneumonia, being the leading child killer disease. (Khan et al. 1990, 577-585; Stekelenburg 2002, 866-893 .)

Child survival can be improved by utilizing the vaccines against the common bacterial causes and have proved to be effective and safe to use in prevention of pneumonia especially in developing countries with low-income. Vaccines have the ability to reach a very high child proportion especially those who don't have access to health care facilities and scaling up of coverage are some of the advantages of vaccines as of a comprehensive child survival package. Preventive strategies and curative care should be complemented with these

vaccines as they target selected pathogens that cause pneumonia. (Madhi 2008, 365-372.)

According to Hildenwall (2009, 1-4), awareness of caretakers and health care providers on the symptoms and biomedical treatment of pneumonia should be improved. Also there should be definition and implementation of guidelines that will encourage the caretakers to immediately seek medical attention after recognizing signs and symptoms of pneumonia like rapid or fast breathing since severe illness develops rapidly. Management of children with pneumonia can be greatly improved if there is availability of antibiotics close to where people reside as well as quality care in both public and health care sectors. (Hildenwall 2009, 1-44.)

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APPENDICES

Data base	Search words	Hits	Selected with full text
CINAHL	Pneumonia	10337	26
CINAHL	Preschool children	1992	3
CINAHL	Pathophysiology	8	7
CINAHL	Causes	108	16
CINAHL	Signs and symptoms	7734	13
CINAHL	Diagnosis	370	9
CINAHL	Treatment and management	274404	10
CINAHL	Risk factors	123892	18
CINAHL	Epidemiology	33	5
CINAHL	Prevention	214	3
CINAHL	Health education	36846	6

