Current prescribing practices of hospitalized children suffering from pneumonia with respect to Essential Drug List of Bangladesh

In partial fulfillment of the requirements for the degree of M. Pharm in Clinical Pharmacy and Molecular Pharmacology

Submitted by:

HAMZA HEMAL

2012-3-79-024

Dissertation Supervisor:

Mr. Md. Anisur Rahman

Senior lecturer

Department of Pharmacy

East West University

Declaration by the Research Candidate

I, Mr. Hamza Hemal, hereby declare that the dissertation entitled "Current prescribing practices of hospitalized children suffering from pneumonia with respect to Essential Drug List of Bangladesh", submitted by me to the Department of Pharmacy, East West University, in the partial fulfillment of the requirement for the award of the degree of M. Pharm in Clinical Pharmacy and Molecular Pharmacology (Masters) is a bonafide record of original research work carried out by me under the supervision and guidance of Mr. Md. Anisur Rahman, Senior lecturer, Dept. of Pharmacy, East West University and it has not formed the basis for the award of any other Degree/Diploma/Fellowship or other similar title to any candidate of any University.

Place: Dhaka

Date: 17/01/2014.

Hamza Hemal
ID# 2012-3-79-024
Department of Pharmacy
East West University

Certificate

This is to certify that the thesis “Current prescribing practices of hospitalized children suffering from pneumonia with respect to Essential Drug List of Bangladesh”, submitted to the department of pharmacy, East West University in partial fulfillment of the requirements of the degree of of M. Pharm in Clinical Pharmacy and Molecular Pharmacology was carried out by Mr. Hamza Hemal (ID# 2012-3-79-024) under our guidance and supervision and that no part of the thesis has been submitted for any other degree. We further certify that all the sources of information and laboratory facilities availed of in this connection is duly acknowledged.

Mr. Md. Anisur Rahman
Senior lecturer
Department of Pharmacy
East West Unviersity, Dhaka

Dr. Chowdhury Faiz Hossain
Chairperson & Professor
Department of Pharmacy
East West Unviersity, Dhaka

Acknowledgement

At first, I would like to express my sincere thanks and gratitude to my Supervisor **Mr. Md. Anisur Rahman,** Senior Lecturer, Department of Pharmacy, East West University, for his inspiration, guidance and support throughout the entire work.

I was gratefully acknowledged to **Dr. Forhad Monjur,** Associate professor, Institute of Child Health and Shishu Sasthya Foundation Hospital (ICH & SSFH), for his co-operation to complete my study.

I was especially grateful to **Dr. Chowdhury Faiz Hossain**, Ph.D.; Chairperson & Professor, Department of Pharmacy, East West University, for his support throughout the work

I also would like give thanks to **Ms. Farhana Rizwan,** Assistant Professor, Department of Pharmacy, East West University for helping me during data collection of my research project.

I also would like give thanks to **Dr. Meer Imteaz Hossain**, Training Unit Manager, **Mr. Kazi Shamim**, **Mr. Arfan Ahmed Shourov** and all colleagues of Radiant Pharmaceuticals Ltd. for their friendly assistance during of my research project.

I would like to express my sincere gratitude to my parents and all of friends for their kind co-operation and support to complete my study including my research project.

Finally, I would like to thanks to almighty Allah.

Abstract

This retrospective study was designed to observe the adherence of the prescribing practices of hospitalized children suffering from pneumonia with the essential drug list (EDL) of our country. During ten months study period, 532 children (under 5 years of age) suffering from Pneumonia were enrolled from the Institutes of Child Health & Shisu Sasthya Foundation Hospital, Mirpur, Dhaka. This research revealed that cephalosporin alone or in combination with an aminoglycosides was most common antibiotics which were prescribed for the treatment of children suffering from pneumonia. But surprisingly this given treatment had very insignificant (7.98%) adherence with the essential drug list (EDL) of Bangladesh. So, this result supports the need of updating the Essential drug list of Bangladesh with modern evidence based effective drugs. Another outcome of this study indicated that in 75.2% cases there is a practice of polypharmacy in Bangladesh. Polypharmacy and overuse/misuse of drugs, especially antibiotics, should be discouraged to avoid drug resistance and its consequences. Furthermore, countywide multicenter research with a larger sample is still needed to consolidate the observation of this study.

Keywords: Pneumonia, Essential Drug List, , RTI, Polypharmacy, Ceftriaxone

Abbreviation

ARDS- Acute respiratory distress syndrome

BOOP- Bronchiolitis obliterans organizing pneumonia

CAP- Community-acquired pneumonia

COPD- Chronic obstructive pulmonary disease

CRF- Case report form

EDL- Essential drug list

ICH- Institutes of Child Health

ICU- Intensive care unit

LRTI- Lower respiratory tract infection

MRSA- Methicillin-resistant *Staphylococcus aureus*

RSV- Respiratory syncytial virus

SARS- Severe acute respiratory syndrome

SSFH- Shisu Sasthya Foundation Hospital

UNICEF -United Nations Children's Fund

VAP- Ventilator-associated pneumonia

WHO -World Health Organization

List of contents

List of Tables

List of Figures

Chapter One

Introduction

1. INTRODUCTION

1.1 Objective

The aim of the study was to find out the common antibiotics and supportive drugs given to the hospitalized children suffering from pneumonia. In addition, this study was preformed to identify the adherence of the given treatment with the essential drug list (EDL) of our country. Furthermore, the polypharmacy practice in case of the treatment of hospitalized children with pneumonia was also observed.

1.2 Significance of the study

Pneumonia is a common illness in all parts of the world. It is a major cause of death among all age groups. In children, the majority of deaths occur in the newborn period, with over two million worldwide deaths a year. In fact, the WHO estimates that one in three newborn infant deaths is due to pneumonia. Antibiotics and supportive drugs are given commonly as the treatment of pneumonia in hospital. This research will bring out the list of drugs which are commonly prescribed in hospital of Bangladesh for the treatment of pneumonia. If the outcome of the result showed insignificant adherence of the given treatment with essential drug list (EDL) of Bangladesh then this list should be updated. If the outcome of the study indicated that there was a practice of polypharmacy then awareness among the doctor need to be created which may ultimately enhance the patient compliance and cost effectiveness of the treatment. Therefore, it will bring a radical change in the treatment of hospitalized children with pneumonia.

1.3 Pneumonia

Pneumonia is a severe form of acute lower respiratory tract infection (LRTI) that specifically affects the lungs. Pneumonia kills more children than any other disease like AIDS, malaria and measles combined. Pneumonia affects children everywhere but is most prevalent in South Asia and sub-Saharan Africa. Every year, it kills an estimated 1.1 million children under the age of five years which is 18% of all deaths of children under five years old worldwide (WHO, 2013).

Human lungs are composed of thousands bronchi that subdivided into smaller bronchioles which end in alveoli. The alveoli contain capillaries where oxygen and carbon dioxide exchange occur. When a child has pneumonia, the alveoli are filled

with pus and fluid, which makes breathing difficulty and limits oxygen intake (UNICEF & WHO, 2006).

Pneumonia may occur in human at any age from tiny babies to really old people. Getting wet doesn't cause pneumonia instead an infection from bacteria or a virus does. On the other hand a cold or flu that gets worse can turn into pneumonia. Cold or flu will irritate the lungs and make easier for pneumonia germs to move in and start an infection (Harms, 2013).

Bacterial pneumonia is commonly caused by *streptococcus pneumoniae* and viral pneumonia is caused by the influenza virus. Symptoms of bacterial pneumonia are sudden fever, chills, a productive cough, and discomfort in chest (Harms, 2013).

Bacterial pneumonia is treated with antibiotics, fluid intake, supplemental oxygen, bed rest, chest physical therapy, bronchodilators and cough suppressants. If patients are having trouble breathing the treatment is given in the hospital through an intravenous IV line (Harms, 2013).

1.4 Epidemiology

Pneumonia is the commonest infectious cause of death and the 6th leading cause of death in the UK and USA. Up to 40% of UK patients with pneumonia require hospital admission. Hospital mortality varies between 5 and 12%. A multicentre UK study showed that 10% of patients with pneumonia require ICU admission and mortality up to 50% in those admitted to ICU. Pneumonia managed in the community has mortality of 1% (Chapman, 2005).

1.5 Types of pneumonia

There are two broad categories of pneumonia. They are Community-acquired pneumonia and hospital-acquired pneumonia.

1.5.1 Community acquired pneumonia

Community-acquired pneumonia (CAP) is the most common type of pneumonia. CAP is infectious pneumonia in a person who has not recently been hospitalized. The most common causes of CAP differ depending on a person's age, but they include

Streptococcus pneumoniae, viruses, the atypical bacteria and *Haemophilus influenza* (Harms, 2013).

1.5.2 Hospital acquired pneumonia

Hospital-acquired pneumonia also called nosocomial pneumonia. It is pneumonia acquired during or after hospitalization for another illness or procedure with onset at least 72 hrs after admission. Up to 5% of patients admitted to a hospital for other causes subsequently develop pneumonia. Hospital-acquired microorganisms may include resistant bacteria such as MRSA, *Pseudomonas, Enterobacter,* and *Serratia* (Harms, 2013).

1.5.3 Other types of pneumonia

Other types of pneumonia include Ventilator-associated pneumonia (VAP), severe acute respiratory syndrome (SARS), Bronchiolitis obliterans organizing pneumonia (BOOP), Eosinophilic pneumonia, Chemical pneumonia and Aspiration pneumonia (Harms, 2013).

1.6 Causes of pneumonia

Pneumonia is caused by a number of infectious agents including bacteria, viruses and fungi. It is known that the *Streptococcus pneumoniae* is the most common cause of bacterial pneumonia in children. *Haemophilus influenzae* type b (Hib) is the second most common cause of bacterial pneumonia. Respiratory syncytial virus (RSV) is the most common viral cause of pneumonia. In infants infected with HIV, *Pneumocystis jiroveci* is one of the commonest causes of pneumonia, responsible for at least one quarter of all pneumonia deaths in HIV-infected infants (WHO, 2013).

1.7 Signs and symptoms of pneumonia

Some common symptoms of pneumonia in children and infants include cough, rapid or difficult breathing, fever, chills, headaches, loss of appetite and wheezing. Young infants may suffer convulsions, unconsciousness, hypothermia, lethargy and feeding problems. Children under five with severe cases of pneumonia may struggle to breathe with lower chest wall indrawing. Children with pneumonia may have a range of symptoms depending on their age and the cause of the infection (UNICEF & WHO, 2006).

Table 1

Pathogen wise symptom of pneumonia

Pathogen	**Symptoms**
Streptococcus pneumoniae	High fever, acute onset, pleuritic chest pain and dry or no cough.
Legionella	More severe infection, neurological symptoms, evidence of multisystem disease e.g. abnormal liver enzymes and raised creatine kinase.
Mycoplasma pneumoniae	less multisystem involvement but extrapulmonary involvement including haemolysis and skin and joint problems
Staphylococcus aureus	Recent influenza-like illness
Chlamydia	Longer duration of symptoms prior to admission, headache, dry cough, high fever
Klebsiella pneumoniae	Low platelet count and leucopenia.
Virus	Infections often come on gradually and may worsen over time (Chapman, 2005).

1.8 Mechanism of causing pneumonia

Pneumonia is commonly caused when bacteria or viruses that are normally present in the mouth, throat, or nose inadvertently enter the lung. It is quite common for people to aspirate secretions from the mouth, throat, or nose during sleep. Some cases of pneumonia are abbreviated by breathing in small droplets that contain the microorganisms that can cause pneumonia. In other cases these droplets get into the air when a person infected with these germs coughs or sneezes. Normally, the body's reflex response and their immune system will prevent the aspirated organisms from causing pneumonia. However, if a person is in a weakened condition from another illness a severe pneumonia can develop. People with recent viral infections, heart disease, lung disease and swallowing problems as well as alcoholics, drug users and those who have suffered a stroke or seizure are at higher risk for developing pneumonia than the general population. As we age our swallowing mechanism can become impaired as does our immune system. These factors, along with some of the negative side effects of medications increase the risk for pneumonia in the elderly. Once organisms enter the lungs, they usually settle in the air sacs and passages of the

lung where they rapidly grow in number. This area of the lung then becomes filled with fluid and pus as the body attempts to fight off the infection (Schiffman, 2013).

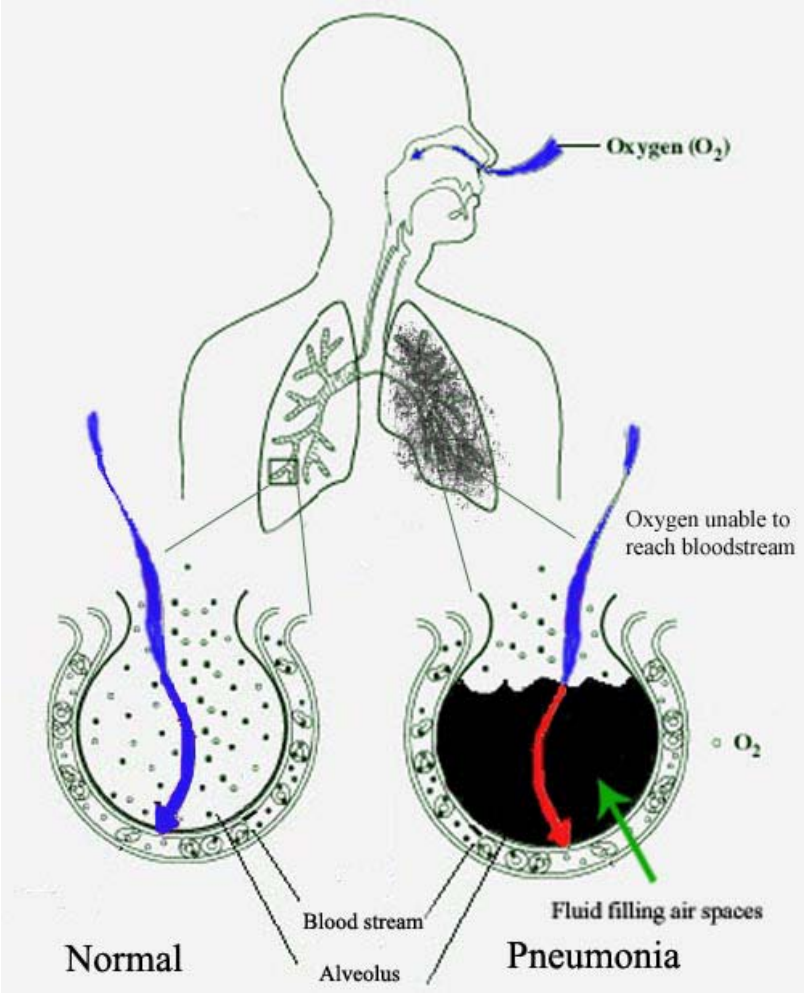


Figure 1: Lung's alveoli filled with fluid

1.9 Transmission

Microorganisms causing pneumonia may reach the child's lungs through different routes. The bacteria and viruses that are commonly found in a child's nose or throat can infect the lungs if they are inhaled. Babies are at higher risk of developing pneumonia from coming into contact with organisms in the birth canal or from contaminated substances contacted during delivery. They may also spread via air-borne droplets from a cough or sneeze. More inquiry needs to be done on the different microorganisms causing pneumonia and the ways they are transfer to another as this has critical importance for treatment and prevention (WHO, 2013).

1.10 Diagnosis

1.10.1 Chest X-ray: A chest X-ray is usually performed to confirm the diagnosis of pneumonia. The lungs have several segments referred to as lobes, usually two on the left and three on the right. When the pneumonia affects one of these lobes it is often referred to as lobar pneumonia (Schiffman, 2013).

1.10.2 Sputum culture: A sample of the sputum can be grown in special incubators, and the offending organism can be subsequently identified. Pneumonia caused by bacteria or fungi can be detected by this examination. Sputum samples can be collected and examined under the microscope. These types of cultures can help in directing more appropriate therapy. As we have used antibiotics in a broader uncontrolled fashion, more organisms are becoming resistant to the commonly used antibiotics (Schiffman, 2013).

1.10.3 Blood test: An individual's white blood cell count can often give a hint as to the severity of the pneumonia and whether it is caused by bacteria or a virus. An increased number of neutrophils are seen in most bacterial infections, whereas an increase in lymphocytes is seen in viral infections, fungal infections and some bacterial infections ((Schiffman, 2013).

1.10.4 Bronchoscopy: It is a procedure in which a thin, flexible, lighted viewing tube is inserted into the nose or mouth after a local anaesthetic is administered. Using this device, the doctor can directly examine the trachea and bronchi. At th same time, samples of sputum or tissue from the infected part of the lung can be obtained (Schiffman, 2013).

1.10.5 Thoracentesis: If a significant amount of pleural effusion develops, a needle is inserted into the chest cavity and fluid can be withdrawn and examined under the microscope. This procedure is called a thoracentesis (Schiffman, 2013).

1.11 Identification of patients with severe pneumonia

Pneumonia has a wide range of severity. Assessment of disease severity depends on the experience of the clinician, and a number of predictive assessment models have been trialled. These predictive models of severity should be regarded as adjuncts to

clinical assessment, and regular reassessment of the disease is needed. An assessment of severity enables the most appropriate care to be delivered in the most appropriate clinical setting (UNICEF & WHO, 2006).

Table 2

Assessment of severity of pneumonia

Signs	**Classify as**	**Treatment**
Fast breathing (>50/min for age <1year and >40/min for age 1-5 year). Lower chest wall indrawing. Stridor in calm child.	Severe pneumonia	Refer urgently to hospital for injectable antibiotics and oxygen if needed. Give first dose of appropriate antibiotic
Fast breathing (>50/min for age <1year and >40/min for age 1-5 year).	Non-severe pneumonia	Prescribe appropriate antibiotic Advise mother on other supportive measures and when to return for a follow-up visit
No fast breathing	Other respiratory illness	Advise mother on other supportive measures and when to return if symptoms persist or get worse (UNICEF & WHO, 2006).

1.12 Complications of Pneumonia

Sometimes pneumonia can lead to additional complications. Complications are more frequently associated with bacterial pneumonia than with viral pneumonia. The most important complications include Respiratory and circulatory failure, Acute respiratory distress syndrome (ARDS), sepsis and septic shock, pleural effusion (Harms, 2013).

1.13 Risk factors

Children whose immune systems are compromised are at higher risk of developing pneumonia. A child's immune system may be weakened by malnutrition or undernourishment especially in infants who are not exclusively breastfed. Measles, HIV infections and other pre-existing illnesses also increase a child's risk of contracting pneumonia. Indoor air pollution, living in crowded homes and parental smoking also increase a child's susceptibility to pneumonia (WHO, 2013).

1.14 Treatment of pneumonia

Pneumonia should be treated with antibiotics. Most cases of pneumonia require oral antibiotics, which are often prescribed at a health centre. These cases can also be diagnosed and treated with inexpensive oral antibiotics. Hospitalization is recommended only for severe cases of pneumonia, and for all cases of pneumonia in infants younger than two months of age (Chapman, 2005).

1.14.1 Antibiotics

Antibiotics are used empirically at diagnosis of pneumonia in the absence of microbiological information. Treatment regimens are chosen based on efficacy of antibiotics in local settings. Some areas may have high levels of resistance to certain antibiotics. Severity assessment guides antibiotic therapy and the method of antibiotic administration. Local protocols and antibiotic resistance patterns may also guide choice of antibiotics (Chapman, 2005).

Oral antibiotics are used in those with community-managed pneumonia or those with non-severe hospital-managed pneumonia with no other contraindications. IV antibiotics are given in 50% of patients admitted to hospital. IV antibiotics are used if patient have severe pneumonia, loss of swallow reflex, impaired absorption and impaired conscious level. Switch from IV to oral antibiotics as soon as possible, usually when a patient has shown clear response to treatment with a normal temperature for 24 hours (Chapman, 2005).

There is no evidence to guide treatment length, but consensus suggests 07 days for non-severe or uncomplicated pneumonia, 10 days for severe microbiologically undefined pneumonia and 21 days for *Legionella*, *staphylococcal* or if Gram-negative pneumonia is suspected. Suggested initial antibiotics for pneumonia treatment are given in following table (Chapman, 2005).

Table 3

Guidelines of antibiotics for pneumonia

Place	**Preferred treatment**	**Alternative (if intolerant of, or allergic to preferred treatment)**
Community treatment	amoxicillin 500 mg to 1 g tds PO	erythromycin 500 mg qds PO or clarithromycin 500 mg bd PO
Hospital treatment for non-severe pneumonia		
Oral	amoxicillin 500 mg to 1 g tds PO erythromycin 500 mg qds PO or clarithromycin 500 mg bd PO	erythromycin 500 mg qds PO or clarithromycin 500 mg bd PO or levofloxacin 500 mg od PO
If intravenous treatment needed	ampicillin 500 mg qds IV or benzylpenicillin 1.2 g qds IV *plus* erythromycin 500 mg qds IV or clarithromycin 500 mg bd IV	Levofloxacin treatment needed 500 mg od IV
Hospital treatment: severe pneumonia	co-amoxiclav 1.2 g tds IV or cefuroxime 1.5 g tds IV or cefotaxime 1 g tds IV or ceftriaxone 2 g od IV *plus* erythromycin 500 mg qds IV (or clarithromycin 500 mg bd IV)	Levofloxacin 500 mg bd IV *plus* benzylpenicillin 1.2 g qds IV (Chapman, 2005).

1.14.2 Supportive treatment

In addition to antibiotic treatments, doctor recommends some over-the-counter medications to reduce fever, treat aches and pains, and soothe the cough associated with pneumonia. Different supportive treatments are described below:

Oxygen therapy: The amount of oxygen in the lungs and the bloodstream is increased by Oxygen therapy. If patient has signs that the cells of body are not getting enough oxygen patients may need oxygen**.** Oxygen therapy may use at home or in the hospital. Oxygen therapy may choose between a number of delivery systems and breathing devices including Concentrators, Cylinders of oxygen and Cylinders of liquid oxygen. Patient can breathe oxygen through a face mask, or nasal cannula (Thompson, 2013).

Nebulization: Nebulizer therapy is an effective and efficient way to deliver drug directly into the lungs by inhalation. Doctors prescribe a variety of different medications for conditions that demands nebulizer therapy. Bronchodilators are often given through a nebulizer in order to rapidly open airways in the event of pneumonia or COPD. Inhaled corticosteroids are inhaled forms of a type of hormone that decreases inflammation. Direct application of steroids to lung tissues using a nebulizer can help control exacerbations of inflammatory lung diseases **(**Kelly, 2010).

Expectorants: Expectorant medicine helps thin sputum (mucus from the lungs). When sputum is thin, it may be easier to cough it up and spit it out. This may make breathing easier and may help get better faster ((Drug information online, 2013).

Antipyretics: This medicine is given to decrease fever. Commonly used antipyretic to pneumonia children is paracetamol (Drug information online, 2013).

Steroid medicines: Steroid medicine may help open air passages so patient can breathe easier (Drug information online, 2013).

Bronchodilators: Bronchodilators are medicines that help open the bronchial tubes of the lungs, allowing more air to flow through them. Bronchodilators helps patient to breathe easier and cough up mucus. Some bronchodilators are inhaled, using a nebulizer or an inhalation aerosol. Others are taken as injections or by mouth. A few such as ephedrine can be bought without a physician's prescription but most are available only by prescription. Commonly used bronchodilators are sulbutamol, albuterol, epinephrine, ipratropium, metaproterenol (Ross, 2002)

Zinc: Zinc intake helps reduce the incidence of pneumonia and the severity of the disease. Specifically zinc intake during the acute phase of severe pneumonia decreased the duration and severity of pneumonia and reduced treatment failure rates. Improving the zinc status of children is currently being considered by public health and nutrition experts (UNICEF & WHO, 2006).

1.15 Rational antimicrobial prescribing

Unnecessary antibiotic use for viral illnesses contributes to the increasing problem of antibiotic resistance. The use of antibiotics may make definitive diagnosis and subsequent decisions about management more difficult. Empiric antibiotic therapy should only be prescribed when a serious bacterial infection is suspected and it is not safe or possible to obtain definitive culture specimens or culture results are pending.

Empiric therapy should be based on the likely cause, local antibiotic resistance patterns and individual host factors (e.g. immunocompromise) in accordance with local guidelines. For mild infections, the safest and best-tolerated antibiotic with the narrowest spectrum against the most likely pathogens should be chosen. For serious infections, broad-spectrum agents are chosen until the pathogen and its susceptibility is identified. Theoretical benefits of new antibiotics based on *in vitro* data do not necessarily translate into greater efficacy. Newer antibiotics often offer no advantages, might be expensive with more side effects and have a greater likelihood of leading to resistance or superinfection (Nigel et al., 2009).

1.16 Polypharmacy

Polypharmacy has been defined as the concurrent use of multiple drugs. It comes from two Greek root words: *poly*, meaning many, and *pharmakeia* meaning medicines or drugs. Polypharmacy also defined as the use of more drugs than are clinically indicated or too many inappropriate drugs, as two or more medications to treat the same condition and as the use of two or more drugs of the same chemical class. Polypharmacy has been linked to heightened risk of a detrimental health outcome. Polypharmacy increase the risk for drug interactions and adverse drug reactions. Polypharmacy leads to medication nonadherence and also likely to increase overall drug expenditures (Kirsten et al., 2007).

1.17 Essential drugs and medicines

Essential drugs (EDs) are the foundation for nearly every public health program. EDs aimed at reducing morbidity and mortality in Bangladesh as well as in the developing world. Essential drugs are those that satisfy the priority health care needs of the people. Essential drugs are selected with due regard to disease prevalence, evidence on efficacy and safety, and comparative cost-effectiveness (WHO, 2012).

According to WHO (2012) essential medicines are intended to be available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality, and at a price the individual and the community can afford (WHO, 2012).

Careful selection of a limited range of essential medicines results in a higher quality of care for patients, better management and use of medicines and more cost-effective use of health resources. Clinical guidelines and lists of essential medicines may improve the availability and proper use of medicines within health care systems (WHO, 2012).

Most countries have national lists and some have provincial or state lists as well. National lists of essential medicines usually relate closely to national guidelines for clinical health care practice which are used for the training and supervision of health workers (WHO, 2012).

Most developing countries maintain a list of essential drugs. A list of essential drugs is supposed to be updated regularly, but in Bangladesh no major review has been made since 1982. List of essential drugs of Bangladesh is given below:

Table 4

Essential drug list of bangladesh

Sl.	Name of drugs	Dosage form
1	Abacavir (ABC)	Oral Liquid, Tablet
2	Acetazolamide	Tablet
3	Acetylsalicylic acid	Suppository, Tablet
4	Aciclovir	Powder for injection, Tablet
5	Albendazole	Tablet (chewable)
6	Allopurinol	Tablet
7	Aluminium hydroxide + Magnesium hydroxide	Oral liquid, Tablet
8	Amitriptyline	Tablet
9	Amlodipine Besylate	Tablet
10	Amoxicillin	Capsule or Tablet, Powder for oral liquid, Powder for injection (DGDA, 2011)

Sl.	Name of drugs	Dosage form
11	Ampicillin	Powder for Injection
12	Anti-D immunoglobulin (human)	Injection
13	Antitetanus immunoglobulin (human)	Injection
14	Artemether + Lumefantrine	Tablet
15	Artesunate	Injection, Tablet
16	Ascorbic Acid	Tablet
17	Atenolol	Tablet
18	Atropine	Injection, Solution (eye drops)
19	Barium Sulfate	Aqueous suspension
20	BCG vaccine	Injection
21	Benzathine benzylpenicillin	Powder for injection
22	Benzoic acid + Salicylic acid	Ointment or cream
23	Benzyl benzoate	Lotion
24	Benzyl penicillin	Powder for injection
25	Betamethasone	Ointment or cream
26	Bleomycin	Powder for injection
27	Bupivacaine	Injection
28	Calcium gluconate	Injection
29	Carbamazepine	Oral liquid, Tablet (chewable), Tablet (scored)
30	Charcoal, activated	Powder
31	Chlorambucil	Tablet
32	Chloramphenicol	Eye drops, Eye ointment
33	Chlorhexidine	Solution
34	Chloroquine	Oral liquid, Tablet
35	Chlorpheniramine	Injection , Tablet
36	Chlorpromazine	Injection, Oral liquid, Tablet
37	Ciprofloxacin	Tablet or powder for suspension
38	Cisplatin	Injection
39	Clofazimine	Capsule
40	Clotrimazole	Vaginal cream, Vaginal tablet
41	Cloxacillin	Capsule, Powder for injection, Power for oral liquid,
42	Condoms	
43	Cyclophosphamide	Powder for injection, Tablet
44	Dapsone	Tablet
45	Dexamethasone	Injection
46	Dextran 70	Injectable solution
47	Diazepam	Injection, Tablet, Tablet (scored)

Sl.	Name of drugs	Dosage form
48	Didanosine (ddl)	Buffered powder for oral liquid, Capsule (unbuffered enteric coated), Tablet (buffered chewable, dispersible)
49	Diethylcarbamazine	Tablet
50	Digoxin	Injection, Oral liquid, Tablet
51	Diloxanide	Tablet
52	Diphtheria antitoxin	Injection
53	Diptheria vaccine	Injection
54	Dopamine	Injection
55	Doxorubicin	Powder for injection
56	Doxycycline	Capsule or Tablet, Tablet (dispersible)
57	DPT vaccine	Oral + Injection
58	Efavirenz (EFV or EFZ)	Capsule, Oral liquid, Tablet
59	Enalapril	Tablet
60	Epinephrine (adrenaline)	Injection, Solution (eye drops)
61	Ergocalciferol	Capsule or Tablet, Oral liquid
62	Ergometrine	Injection
63	Erythromycin	Capsule or Tablet, Powder for injection, Powder for oral liquid
64	Ethambutol	Tablet
65	Ethinylestradiol + Levonorgestrel	Tablet
66	Ferrous salt	Oral liquid, Tablet
67	Ferrous salt + Folic acid	Capsule, Tablet
68	Fluconazole	Capsule, Oral liquid
69	Fluorescein	Eye drops
70	Fluorouracil	Injection, Ointment
71	Fluphenazine	Injection
72	Folic acid	Tablet
73	Furosemide	Injection, Tablet
74	Gentamycin	Injection, Solution (eye drops)
75	Gentamycin + Hydrocortisone	Ear drop
76	Glibenclamide	Tablet
77	Gliclazide	Tablet
78	Glucose	Injectable solution
79	Glucose with sodium chloride	Injectable solution
80	Glyceryl trinitrate	Tablet (sublingual)
81	Griseofulvin	Capsule or Tablet
82	Haloperidol	Injection, Tablet
83	Halothane	Inhalation

Sl.	Name of drugs	Dosage form
84	Heparin sodium	Injection
85	Hepatitis B vaccine	Injection (DGDA, 2011)
86	Homatropine	Solution (eye drops)
87	Human normal immunoglobulin	Intramuscular administration, Intravenous administration
88	Hydrochlorothiazide	Tablet (scored)
89	Hydrocortisone	Powder for injection, Ointment or cream, Suppository
90	Hyoscine butylbromide	Tablet, Injection
91	Ibuprofen	Tablet
92	Indinavir (IDV)	Capsule
93	Insulin Injection (Soluble)	Injection
94	Isoniazide	Tablet, Tablet (scored)
95	Isoniazide + Ethambutol	Tablet
96	Isosorbide dinitrate	Tablet (sublingual)
97	Ketamine	Injection
98	Lamivudine (3TC)	Oral liquid, Tablet,
99	Levamisole	Tablet
100	Levodopa + Carbidopa	Tablet
101	Levothyroxine	Tablet
102	Lidocaine	Injection, Topical
103	Lithium Carbonate	Capsule or tablet
104	Lopinavir + Ritonavir (LPV/r)	Capsule, Oral liquid
105	Magnesium hydroxide	Oral liquid
106	Magnesium sulfate*	Injection
107	Mannitol	Injectable solution
108	Measles vaccine	Injection
109	Mebendazole	Tablet (chewable)
110	Mefloquine	Tablet
111	Metformin	Tablet
112	Methotrexate	Powder for injection, Tablet
113	Methyldopa	Tablet : 250 mg
114	Methylrosanilinium chloride (gentian violet)	Aqueous solution, Tincture
115	Metoclopramide	Injection, Tablet
116	Metronidazole	Injection, Oral liquid, Suppository, Tablet
117	Miconazole	Ointment/Ceam
118	Miltefosine	Capsule/Oral liquid
119	Misoprostol	Tablet
120	Morphine	Injection, Oral liquid, Tablet, Tablet (

Sl.	Name of drugs	Dosage form
121	Naloxone	Injection
122	Nelfinavir (NFV)	Oral powder, Tablet (DGDA, 2011)
123	Neomycin Sulfate + Bacitracin	Ointment
124	Neostigmine	Injection, Tablet
125	Nevirapine (NVP)	Oral liquid, Tablet
126	Nicotinamide	Tablet
127	Nifedipine	Immediate release capsule
128	Nitrofurantoin	Tablet
129	Nitrous oxide	Inhalation
130	Nystatin	Oral Suspension
131	Omeprazole	Capsule
132	Oral rehydration salts	Powder
133	Oseltamivir	Tablet
134	Oxygen	Inhalation
135	Oxytocin	Injection
136	Paracetamol	Oral liquid, Suppository, Tablet
137	Paromomycin	Solution for intramuscular injection
138	Peritoneal Dialysis Solution	Intraperitoneal dialysis solution (of appropriate composition)
139	Permethrin	Cream, Lotion
140	Pertussis vaccine	Injection
141	Pethidine hydrochloride	Injection
142	Phenobarbital	Injection, Oral liquid, Tablet
143	Phenoxymethylpenicillin	Powder for oral liquid, Tablet,
144	Phenytoin	Capsule, Injection, Oral liquid, Tablet, Tablet (chewable)
145	Pilocarpine	Solution (eye drops)
146	Poliomyelitis vaccine	Oral
147	Polyvalent anti snake venom	Injection
148	Potassium chloride	Tablet, Solution
149	Povidone Iodine	Solution
150	Prednisolone	Tablet, Solution (eye drops)
151	Primaquine	Tablet
152	Procainamide	Injection
153	Procaine benzylpenicllin	Powder for injection
154	Procarbazine	Capsule
155	Proguanil	Tablet
156	Promethazine	Oral liquid, Injection, Oral liquid, Tablet
157	Propranolol	Tablet
158	Protamine sulfate	Injection

Sl.	Name of drugs	Dosage form
159	Pyrazinamide	Tablet, Tablet (dispersible), Tablet (scored)
160	Pyridoxine	Tablet
161	Pyrimethamine	Tablet (DGDA, 2011)
162	Quinine	Injection, Tablet
163	Rabies immunoglobulin	Injection
164	Rabies vaccine	Injection
165	Retinol	Capsule, Tablet, Oral oily solution, Water-miscible injection
166	Riboflavin	Tablet
167	Rifampicin	Capsule or Tablet
168	Rifampicin + Isoniazid	Tablet
169	Rifampicin + Isoniazid + Ethambutol	Tablet
170	Rifampicin + Isoniazid + Pyrazinamide	Tablet
171	Rifampicin + Isoniazid + Pyrazinamide + Ethambutol	Tablet
172	Ritonavir	Oral liquid, Oral solid dosage form
173	Salbutamol	Injection, Oral liquid, Respirator solution for use in nebulizers, Tablet
174	Salicylic acid	Solution
175	Saquinavir (SQV)	Capsule
176	Senna	Tablet
177	Silver sulfadiazine	Cream
178	Sodium chloride	Injectable solution
179	Sodium Chloride 3%	I/V fluid
180	Sodium Chloride quartet strength (0.225%) + Dextrose 5%	I/V fluid
181	Sodium Hydrogen Carbonate	Injectable solution, Soution
182	Sodium stibogluconate	Injection
183	Sodium thiosulfate	Solution
184	Spironolactone	Tablet
185	Stavudine (d4t)	Capsule, Powder for oral liquid
186	Streptomycin	Powder for injection
187	Sulfadoxine + Pyrimethamine	Tablet
188	Sulfamethoxazole + Trimethoprim	Oral liquid, Tablet, Injection
189	Suxamethonium	Injection, Powder for injection
190	Tamoxifen	Tablet

Sl.	Name of drugs	Dosage form
191	Tenofovir disoproxil fumarate (TDF)	Tablet
192	Tetanus vaccine	Injection
193	Tetracycline	Eye ointment (DGDA, 2011)
194	Thiamine	Tablet
195	Thiopental	Powder for injection
196	Trimethoprim	Tablet
197	Tropicamide	Eye drops
198	Tuberculin, purified protein derivative (PPD)	Injection
199	Valproic acid	Oral liquid, Tablet (crushable), Tablet (enteric coated)
200	Vecuronium	Injection
201	Verapamil	Injection, Tablet
202	Vinblastine	Powder for injection
203	Vincristine	Powder for injection
204	Vitamin B-Complex (Vitamin B1- 5 mg + Vitamin B2- 2 mg + Vitamin B6 - 2 mg + Nicotinamide 20 mg)	Tablet
205	Warfarin	Tablet
206	Water for Injection	Ampoule
207	Xylometazoline Hydrochloride	Nasal drops
208	Zidovudine (ZDV or AZT)	Capsule, Oral liquid, Solution for IV infusion injection, Tablet
209	Zinc sulphate	Oral liquid, Tablet (DGDA, 2011)

Chapter Two

Literature Review

2. LITERATURE REVIEW

There are substantial amount of research on the treatment options of childhood pneumonia in various countries. Different studies showed different treatment protocol to treat pneumonia unlikely.

In 1975, treatment regimens of the various types of pneumonia like staphylococcal, pneumococcal and pneumonia due to gram-negative and anaerobic gram-negative bacilli were outlined on a study of Sabath. In discussing current concepts of several treatments, Sabath reported that proper treatment of pneumonia depends upon a correct diagnosis (Sabath, 1975).

In 1982, Perlino had evaluated moxalactam in 71 patients for the therapy of bacterial pneumonia. Phlebitis and pain on intramuscular injection were the most common adverse effects. The results of Perlino's study demonstrated that moxalactam may represent as effective therapy for bacterial pneumonia but the development of resistance during therapy limit its usefulness against Pseudomonas infections (Perlino, 1982).

At the same year, Ruhrmann & Blenk had compared the effect of erythromycin with that of amoxicillin in a randomized study on 120 cases of pneumonia. Ruhrmann & Blenk find out that, a discontinuation of therapy and acceptable side-effects were considerably more frequent with amoxicillin than with erythromycin (Ruhrmann & Blenk, 1982) .

After a year in 1983, Nelson and his group had evaluated cefuroxime as single drug therapy in an open study of 100 infants and children with suspected bacterial pneumonia. Nelson and his group concluded that cefuroxime was safe and effective single drug therapy for pneumonia in infants and children (Nelson et al., 1983).

A multicentre prospective randomized control trial was done by Mandell and his fellow at the same year to compare the efficacy and toxicity of ceftazidime with that of cefazolin/tobramycin in the treatment of hospitalized patients with non-pneumococcal pneumonia. The results was supported the use of ceftazidime as single-drug treatment of hospitalized patients with pneumonia (Mandell et al., 1983).

In 1985, the thesis of Teele about antimicrobial therapy for infants and children suggested that when a baby confronted with pneumonia then the physician should perform a limited number of diagnostic tests and prescribe antimicrobial therapy. Teele was founded that choice of antimicrobial therapy was usually influenced to only a lesser extent by clinical results or presentation of laboratory tests and to most heavily by the age of the patient (Teele, 1985).

At the same year, Levison & Kaye had discovered that the patients suffering from gram-negative bacillary pneumonia were usually debilitated and immunocompromised and their mortality was high. Levison & Kaye was recommended combination therapy with a beta-lactam antibiotic plus an aminoglycoside for gram-negative bacillary pneumonia. Because the spectrum of antibacterial activity was increased, Emergence of resistance may be retarded and Synergistic activity may result. (Levison & Kaye, 1985).

In next year Kemmerich and his group suggested that several quinolone derivatives may be effective for the treatment of P. aeruginosa pneumonia. Kemmerich and his group also suggested that combination of quinolones with beta-lactams or aminoglycosides may not increase efficacy against P. aeruginosa pneumonia (Kemmerich et al., 1986).

Two year later, Pennington discovered that combinations of beta-lactam and aminoglycoside agents were particularly popular due to the high incidence of Staphylococcus aureus and Gram-negative bacillary pneumonias in the hospital setting (Pennington, 1988).

Next year Jibril and his fellow conducted a comparative evaluation of amoxycillin and amoxycillin plus clavulanic acid in the treatment of bacterial pneumonia in children and founded that the overall clinical efficacy rate of amoxycillin/clavulanic acid-treated patients was significantly better than that of the amoxycillin group (Jibril et al., 1989).

At the same year, the introduction of new broad-spectrum antibiotics, such as third-generation cephalosporins, monobactams and imipenem has introduced the possibility

of monotherapy for the treatment of nosocomial pneumonia. In general, monotherapy had proven by LaForce to be a useful alternative to combination therapy with success rates ranging from 77 to 96%. But the development of resistance during therapy particularly by *Enterobacter*, *Pseudomonas* and *Serratia* spp had remains an unresolved problem (LaForce, 1989).

At the same year, a survey was conducted by Kappstein & Daschner in 800 medical departments of university hospitals and large to small teaching and non-teaching hospitals in the Federal Republic of Germany and West Berlin to gather information on the usage of antibiotics for the treatment of community-acquired pneumonia. Kappstein & Daschner founded that in cases of non-life-threatening pneumonia the therapy specified was mostly correct although macrolides as the treatment of choice were stated only rarely. Kappstein & Daschner also detected that patients with life-threatening pneumonia were most often treated with new β-lactam antibiotics or β-lactam antibiotics in combination with aminoglycosides. But the atypical pathogens causing pneumonia were not covered by most therapeutic regimens (Kappstein & Daschner, 1989).

Next year Pachon and his group brought out that diagnosis of the causative agents did not aid in increasing the survival rate but it did allow for better patient management. Pachon and his group mostly advised to make empirical treatment with erythromycin plus third generation cephalosporins in case of severe CAP (Pachon et al., 1990).

Mortality and morbidity of nosocomial pneumonia remain high. After a year Aoun & Klastersky founded penetration of antibiotics into lung tissue depends on physicochemical properties of the drug and the degree of inflammation of lung tissue. Aoun & Klastersky discovered that Quinolones, macrolides, tetracyclines and trimethoprim penetrate well into bronchial secretions. On the other hand penetration is moderate to low for aminoglycosides and beta-lactams. In the study of Aoun & Klastersky showed fluoroquinolones and new beta-lactam agents including third-generation cephalosporins, imipenem, aztreonam and ticarcillin-clavulanate comparative clinical efficacy in treatment of nosocomial pneumonia. Aoun & Klastersky suggested Aminoglycosides should not be used alone. Aoun & Klastersky founded that combination therapy reduces but does not eliminate the risk of selection

of Gram-negative resistant mutants and should not be used routinely except for Enterobacter cloacae, P. aeruginosa and Serratia marcescens infections (Aoun & Klastersky, 1991).

Next year, Unertl and his group explored that combination antibiotic regimens including beta-lactams and aminoglycosides were considered as standard therapy and are associated with clinical success rates of more than 80%. Monotherapy with broad spectrum antibiotics such as fluoroquinolones, imipenem and third generation cephalosporins can be considered as equally effective in the absence of P. aeruginosa infection. Unertl and his group reported that more active and less toxic antibiotics were still needed for problematic pathogens such as *Pseudomonas* species, methicillin-resistant *S. aureus* strains and multiresistant *Enterobacteriaceae*. They were suggested to placing new emphasis on prevention of infection and the use of immunotherapy (Unertl et al., 1992).

After two year, intravenously administered ciprofloxacin was compared with imipenem for the treatment of severe pneumonia by Fink and his research fellow. These results showed that in patients with severe pneumonia monotherapy with ciprofloxacin was at least equivalent to monotherapy with imipenem in terms of clinical response and bacteriological eradication. Results also showed that for both treatment groups the presence of *P. aeruginosa* had a negative impact on treatment success. But Seizures were more common with imipenem than with ciprofloxacin. Fink and his group suggested that Monotherapy for severe pneumonia was a safe and effective initial strategy but may need to be modified if *P. aeruginosa* is suspected or recovered from patients (Fink et al., 1994).

At the same year, Janknegt and his group analyzed the Antibiotic policies in Dutch hospitals for the treatment of pneumonia. A total of 42 formularies were examined. Amoxycillin was the most frequently used agent in the treatment of community-acquired pneumonia and a wide variety of drugs was used for the treatment of nosocomial pneumonia of which cefuroxime alone or in combination with an aminoglycoside was used most often. On the other hand Benzylpenicillin was the most frequently used drug in community-acquired aspiration pneumonia and this drug in combination with an aminoglycoside was also the drug of choice in hospital-

acquired aspiration pneumonia. Treatment of pneumonias with known or presumed pathogens was also surveyed. Janknegt and his group found that the most usual drugs of choice were amoxycillin for *Haemophilus influenzae*, benzylpenicillin for *pneumococci*, flucloxacillin for *staphylococci*, cotrimoxazole for *Pneumocystis carinii*, cefuroxime for *Enterobacteriaceae*, doxycycline and erythromycin for *Mycoplasma pneumoniae* and erythromycin for *Legionella pneumophila*. Janknegt and his group were remarked relatively wide variations in dosage guidelines for benzylpenicillin and amoxicillin but founded only a few formularies gave guidelines for the duration of treatment (Janknegt et al., 1994).

Next year, Ramirez and his group's investigation demonstrated that an early switch to oral cefixime from intravenous third-generation cephalosporins may be reasonable in hospitalized patients with CAP who have already shown a good clinical and laboratory response to therapy. Ramirez and his group detected that early switch therapy was clinically effective and minimizes hospital stay (Ramirez et al., 1995).

After a year Harris exposed that Amoxicillin and its derivatives or oral cephalosporins were the drugs of choice for initial therapy for mild to moderate Pneumonia. But in case of severe disease or if beta-lactamase producing organisms were a concern extended spectrum cephalosporins were indicated. Harris warranted the use of extended spectrum cephalosporins or vancomycin in case of Pneumococcal pneumonia unresponsive to penicillin therapy. The new macrolides had provided additional options for the clinician for older children in whom mycoplasma is a significant cause of pneumonia. Azithromycin and clarithromycin were well tolerated, efficacious and require less frequent dosing intervals. The introduction of ceftriaxone, a third-generation cephalosporin with a broad spectrum of activity and prolonged half-life allows once-a-day intramuscular therapy that can be administered on an outpatient basis. Harris recommended that the hospital admission was no longer required for the treatment of most cases of serious CAP with the availability of parenteral outpatient therapy (Harris, 1996).

In 1999, Ruuskanen & Mertsola had suggested macrolides as the first choice in outpatients and depending on the clinical picture and severity of the illness cefuroxime plus macrolide, penicillin G or macrolide in hospitalized patients.

Ruuskanen & Mertsola detected the recovery of children with pneumonia was usually rapid. In uncomplicated cases routine follow-up, radiographs and check-ups were unnecessary (Ruuskanen & Mertsola, 1999).

Next year, Vergis and his group brought out that treatment of immunocompetent patients who were hospitalized with CAP, azithromycin was as effective as cefuroxime plus erythromycin in the empirical management. On the other hand Azithromycin was well tolerated too (Vergis et al., 2000).

At the same year Bartlett had recommended cephalosporin plus a macrolide, or a fluoroquinolone alone for empiric treatment of hospitalized patients. Bartlett's (2000) recommendations for ICU patients were a beta-lactam combined with either a fluoroquinolone or a macrolide. But when concern had arisen about increasing resistance to fluoroquinolones then arguments in favor of these agents included the fact that they had good in vitro activity against nearly all treatable pathogens except some anaerobes. A retrospective review of Bartlett had shown superior outcome with fluoroquinolone treatment compared to cephalosporins including a 36% reduction in mortality (Bartlett, 2000).

Same year, Feagan and his group assessed clinical practices and outcomes among patients with community-acquired pneumonia admitted to Canadian hospitals. Data from 20 hospital were reviewed to determine length of stay (LOS). The median LOS ranged from 3.0 to 6.5 days across hospitals. Although 79.8% of patients received treatment according to clinical practice guidelines, the rate of compliance with the guidelines ranged from 47.9% to 100% across hospitals (Feagan et al., 2000).

Next year, Kirk and his fellow analyzed the patients treated for CAP at a Danish university hospital had clinical outcomes fully at height with findings from other countries. They detected that half of the patients were successfully treated with penicillin monotherapy. Between patients were treated empirically with broad-spectrum therapy and penicillin monotherapy, no differences in clinical outcomes were documented. Therefore, penicillin appeared to be a reasonable first choice for initial therapy of CAP in Denmark as in other regions with similar patterns of microbial pathogens and resistance (Kirk et al., 2001).

Then, Paladino and his group analyzed the cost-effectiveness of IV to Oral switch therapy by comparing azithromycin vs cefuroxime with or without erythromycin for the treatment of CAP. Paladino and his group discovered that despite a higher per-dose purchase price, overall costs with azithromycin tended to be lower due to decreased duration of therapy, reduced hospital length of stay, lower preparation and administration costs. They stated that as empiric therapy azithromycin monotherapy was cost-effective compared to cefuroxime with or without erythromycin for patients hospitalized with CAP who have no risk factors for either drug-resistant pneumococci or enteric Gram-negative pathogens and no underlying cardiopulmonary disease (Paladino et al., 2002).

In 2003, Korppi analyzed on ambulatory patients with CAP and found that amoxicillin was the drug of choice from the age of 4 months to 4 years and at all age if *S. pneumoniae* was the presumptive causative organism. Korppi also founded that Macrolides preferably clarithromycin or azithromycin were the first-line drugs from the age of 5 years onwards. But in hospitalized patients who need parenteral therapy for CAP, cefuroxime or penicillin G was the drug of choice. Korppi advised that Macrolides should be administered concomitantly if *M. pneumoniae* or *C. pneumoniae* infection was suspected. Korppi assured that radiologic findings and C-reactive protein (CRP) levels offered limited help for the selection of antibacterials and alveolar infiltrations. High CRP levels indicate pneumococcal pneumonia but the lack of these findings does not rule out bacterial CAP. Korppi found that most guidelines recommend antibacterials for 7-10 days except azithromycin which had recommended treatment duration of 5 days. Korppi suggested if no improvement takes place within 2 days the therapy must be reviewed (Korppi, 2003).

At the same year, Principi & Esposito had found that the lead pediatricians used a combination of different antimicrobial classes to treat almost all cases of CAP. Principi & Esposito suggested to avoid unnecessary antibiotic use and to limit the spread of antibiotic resistance. Principi & Esposito also suggested consensus guidelines for the management of CAP in childhood should be developed and used by practitioners in their offices and hospitals (Principi & Esposito, 2003).

Next year Berman and his group's study demonstrates that meropenem monotherapy is effective and well tolerated for patients with hospital-acquired pneumonia (Berman et al., 2004)

At the same year Zervos and his group had noticed that the combination of a third-generation cephalosporin and a macrolide was at least as efficacious as monotherapy with a fluoroquinolone with enhanced anti-pneumococcal activity for hospitalized patients with moderate to severe CAP. They advised that to minimize the development of multiresistant nosocomial Gram-negative bacilli, the combined medication with a macrolide and third-generation cephalosporin may be favored over fluoroquinolones as first-line therapy of hospitalized patients with CAP (Zervos et al., 2004).

Same year, Koch and his group had marked that Moxifloxacin was a very effective and safe treatment for patients with CAP and was highly accepted by physicians and patients because of good tolerability and rapid symptom improvement (Koch et al., 2004).

In 2005, Bodmann had published guidelines for the treatment of infections in hospitalized patients with respect to new German resistance trends in Gram-negative and Gram-positive bacteria. Bodmann recommended combination therapy with an anti-pseudomonal beta-lactam and a fluoroquinolone or an aminoglycoside to provide the necessary spectrum of activity and to prevent the emergence of resistant organisms. Bodmann found that for the treatment of severe CAP, NP and septicemia, appropriate beta-lactam antibiotics recommended in international and German guidelines either as monotherapy or as combination therapy were the 4th generation cephalosporin cefepime, the carbapenems meropenem and imipenem and the acylamino-beta-lactamase inhibitor combination piperacillin-tazobactam (Bodmann, 2005).

Reyes and his group conducted a prospective multicentre study in 425 CAP patients hospitalized on ward. Study was to evaluate adherence to guidelines when choosing an empirical treatment and its impact upon the prognosis of community-acquired pneumonia (CAP). Initial empirical treatment was classified as adhering or not to

Spanish guidelines and adherent treatment was defined as an initial antimicrobial regimen consisting of beta-lactams plus macrolides, beta-lactam monotherapy and quinolones. On the other hand non-adherent treatments included macrolide monotherapy and other regimens. Initial severity was graded according to pneumonia severity index (PSI). The end point variables were mortality, length of stay (LOS) and re-admission at 30 days. Reyes and his group found a high adherence to CAP treatment guidelines though with considerable variability in the empirical antibiotic treatment among hospitals and Non-adherent other regimens were associated with greater mortality. Reyes and his group) also found that Beta-lactam monotherapy was associated with an increased re-admission rate (Reyes et al., 2007).

According to Aspa and his group it was necessary to know which factors actually determine the real impact of antimicrobial resistance on the outcome of pneumococcal infections because microbial resistance causes a great deal of confusion in choosing an empirical treatment for pneumonia. They said that several different aspects had to be taken into account when analyzing this matter such as the study design, the condition of the patient at the time of diagnosis, the choice of the initial antimicrobial regimen like combination or monotherapy and the pharmacokinetic/ pharmacodynamic variables of the chosen antibiotic. Aspa and his group recommended the use of standard antipneumococcal beta-lactam agents is unlikely to impact negatively on the outcome of CAP when appropriate agents are given in sufficient doses in the treatment of beta-lactam-resistant pneumococcal infections. For infections with penicillin-sensitive strains, penicillin or an aminopenicillin in a standard dosage was effective in the cases of strains with intermediate resistance as a general rule. Beta-lactam agents were still considered appropriate treatment although higher dosages were recommended. Resaercher also recommended that infections with isolates of high-level penicillin resistance should be treated with alternative agents such as the third-generation cephalosporins or the new antipneumococcal fluoroquinolones. Aspa and his group found that in areas of high prevalence of high-level macrolide resistance, empirical monotherapy with a macrolide was not optimal for the treatment of hospitalised patients with moderate or moderately-severe CAP. Fluoroquinolones were considered to be excellent antibiotics in the treatment of pneumococcal CAP in adults but their general recommendation had been withheld due to fears of a widespread development of resistance. Most international guidelines

recommend combination therapy like beta-lactam plus a macrolide for the treatment of hospitalised patients with CAP (Aspa et al., 2008).

After two years, Lamontagne and his group conducted a systematic review of published and unpublished randomized trials to investigate the effect of corticosteroids in the treatment of acute respiratory distress syndrome, acute lung injury and severe pneumonia. Lamontagne and his group discovered that if low-dose corticosteroids administered within 14 days of disease onset may reduce all-cause mortality in patients with acute lung injury, acute respiratory distress syndrome, and severe pneumonia (Lamontagne et al., 2010).

At the same year, Kabra and his co-workers had enroled 11,928 children to compare multiple antibiotics. Oral amoxicillin had compared with injectable penicillin or ampicillin in children hospitalised with severe CAP and found similar failure and relapse rates. But death rates were higher in children receiving chloramphenicol compared to those receiving penicillin/ ampicillin plus gentamycin in very severe CAP. Kabra and his co-workers recommended that for treatment of ambulatory patients with CAP, amoxycillin was an alternative to co-trimoxazole. On the other hand Co-amoxyclavulanic acid and cefpodoxime may be alternative second-line drugs. Oral amoxycillin may be an alternative to injectable penicillin in hospitalised children for severe pneumonia without hypoxia. Penicillin/ ampicillin plus gentamycin were superior to chloramphenicol for children hospitalised with severe and very severe CAP. The other alternative drugs for such patients were levofloxacin, ceftrioxone, co-amoxyclavulanic acid and cefuroxime. These can be used as a second-line therapy until more studies were available. Kabra and his co-workers had suggested investigating more studies in community settings for ambulatory treatment with oral antibiotics (Kabra et al., 2010).

Weiss and his group conducted a study with adjunct corticosteroids in children hospitalized with CAP and found that adjunct corticosteroids were associated with a shorter hospital LOS among patients who received concomitant β-agonist therapy. A longer LOS and a greater odd of readmission were found among patients who did not received therapy with systemic corticosteroids. Weiss and his group considered β-agonist therapy as a proxy for wheezing. Study findings suggested that only patients

admitted to the hospital with acute wheezing and a diagnosis of CAP can get benefit from adjunct systemic corticosteroid therapy (Weiss et al., 2011).

Next year in Bangladesh, Ahmed & Islam analyzed the current status of the outcome of the National Drug Policy (NDP) 1982 objectives in terms rational use of drugs in the primary healthcare facilities including affordability by consumers. The study was covered a random sample of rural Upazila Health Complexes (UHCs) and an urban clinics (UCs) in the Dhaka. Ahmed & Islam noted that although >70% of patients/care-givers reported to have understood the dosage schedule but the dispensed drugs were not labeled properly. The copy of the list of essential drugs was available in 55% and 47% of the UCs and UHCs respectively with around two-thirds of the drugs being prescribed from the list. Study revealed that the availability of essential drugs (ED) for common illnesses was poor. The number of dispensed drugs out of the total number of prescribed drugs was higher in the UHCs than in the UCs. Ahmed & Islam (2012) also found that polypharmacy was higher in the UCs (46%) than in the UHCs (33%). An antibiotic was prescribed in more frequently for fever and common cold than for lower respiratory tract infection including pneumonia. Surprisingly the prices of key essential drugs differed 500% or more by brands. Evidence showed that the situation deteriorated in terms of both availability of essential drugs and their rational use. Ahmed & Islam detected that even after many years of approving the NDP 1982, the availability and rational use of drugs and the affordability of the poor people have remained to be achieved in Bangladesh (Ahmed & Islam, 2012).

In recent observation, Viasus and his group had found that the commonly used antibiotics such as β-lactams or macrolides had significantly increased the prevalence of resistance against causative pathogens of CAP. However, they had also reported that the frequency of fluoroquinolone resistance in *Streptococcus pneumoniae* remains low. Various newly developed antibiotics including quinolones, ketolides and cepholosporins reflected some promising results. These antibiotics had come out with marked activity against the main causative pathogens of CAP. Nevertheless, safety and efficacy data in patients with severe CAP were insufficient (Viasus et al., 2013).

During the same time frame, Leyenaar and his group had observed the limitation of empiric therapy for the management of community acquired pneumonia with *Mycoplasma pneumoniae*. Therefore, they had performed the study by consierining two different treatment protocol ceftrixone alone and ceftriaxone combined with a macrolide to analyze length-of-stay and total hospital costs. The outcomes they had got that combination therapy was associated with higher costs but did not seem benefit to preschool children. However, combination therapy was associated with a shorter length of stay without a significant impact on cost among school-aged children. Leyenaar and his group study suggested that sensitive diagnostic tests to identify children with *M. pneumoniae* infection may allow prescription of macrolides and combination therapy (Leyenaar et al., 2013).

This year, Moschovis and his group had conducted a study named Severe Pneumonia Evaluation Antimicrobial Research (SPEAR), which was sponsored by WHO and USAID. SPEAR was a multinational randomized controlled trial of antibiotics among 2 to 59 months aged children for severe pneumonia. Moschovis and his group assessed the effect of anemia on treatment outcome and analyzed the illness severity. Study result shown that children with more severe disease and children with anemia were at higher risk of poor outcome when being treated for severe pneumonia. Moschovis and his group study discovered that prevention and treatment of anemia among young children could improve outcomes of pneumonia (Moschovis et al., 2013).

In U.S. Hospitals, Berger and his group conducted a study to identify initial antibiotic therapy patterns to 40,392 CAP patients. Berger et al. (2013) found that the most frequently used initial antibiotic were levofloxacin (24.0%), ceftriaxone (9.0%), cefotaxime (7.3%), ceftriaxone plus levofloxacin (3.2%) and azithromycin plus cefotaxime (3.0%). However, four years ago in 2009, they were ceftriaxone plus azithromycin (18.5%), levofloxacin (12.7%), ceftriaxone (6.6%), moxifloxacin (4.7%) and ceftriaxone plus levofloxacin (3.2%). The use of vancomycin almost doubled between last few year. But the use of single-agent regimens declined from 48.2% to 30.0%. Berger and his group found that due to of widespread antibiotic resistance and evolving treatment guidelines, initial antibiotic therapy for non-ICU CAP had changed considerably in the United States over the past decade (Berger et al., 2013)

In Mongolia, Dorj and his fellow had analyzed the prescribing practices for the treatment of mild or moderate CAP with respect to national prescribing guidelines. Study discovered that most commonly prescribed drugs were aminopenicillins, mucolytics and vitamins with the average of three drugs per prescription. Study result shown that doctors in urban areas prescribed more inappropriate drugs than those in rural areas for both children and adults. Inappropriate drug selection was similar for adults and children. The proportion of prescribed injections for adults was significantly higher in urban areas. But according to the prescribing standard for non-hospitalized patients in Mongolia, Dorj states that injections should not be prescribed. Dorj and his fellow concluded that to improve prescribing pattern in Mongolia, it was necessary to develop comprehensive and dependable procedures nationwide for the treatment of mild or moderate CAP (Dorj et al., 2013).

In Northern England, Elemraid and his group (2013) performed a prospective survey on children regarding their clinical and radiological features of pneumonia in 11 different hospitals. These included CRP, total blood, blood culture and testing of respiratory secretions for viruses and bacteria. The survey result showed the enhancement of patient compliance due to the clinical and radiological investigations, that ultimately reduced the use of intravenous antibiotics and changes the route of antibiotic administration from IV to oral (Elemraid et al., 2013).

A prospective and cross-sectional study was done in Pakistan by Rehman and his group to determine etiology of CAP patients and to evaluate the therapeutic effects of antibiotics commonly used in treating CAP patients. Outcome of the study described that the common causative pathogen was *K. pneumoniae* followed by *S. pneumoniae* and commonly used antibiotics were cephalosporin (80%), aminoglycosides (65%) and penicillins (50%) either as monotherapy or combination treatment. Rehman and his group concluded that to define a reliable empirical therapy and proper treatment guidelines for CAP, there is a great need of further studies to be conducted in developing countries (Rehman et al., 2013).

.

Chapter Three

Materials and Methods

3. MATERIALS AND METHODS

3.1 Research Design

The study was a descriptive study, in which 532 hospitalized children (under 5 years of age) with Pneumonia were taken. Treatment informations were collected retrospectively from hospital records by filling the Case report form (CRF).

3.2 Materials

- Case report form (appendix I)
- Essential drug list of Bangladesh, 2012 (Table 4)
- SPSS version 13.0

3.3 Sample Characteristic's

The sample was collected from the Institutes of Child Health & Shisu Sasthay Foundation Hospital Mirpur, Dhaka from January 2013 to October 2013. All the case histories were collected retrospectively from the hospital record files of the discharged patients.

3.3.1 Inclusion Criteria:

Pneumonia patient: Patient only treated for viral or bacterial pneumonia was taken for research.

Age of patient: Children under 5 years of age were included in the study.

Sex of patient: Both male and female patient was included in the study.

The case history was included the following parameters:

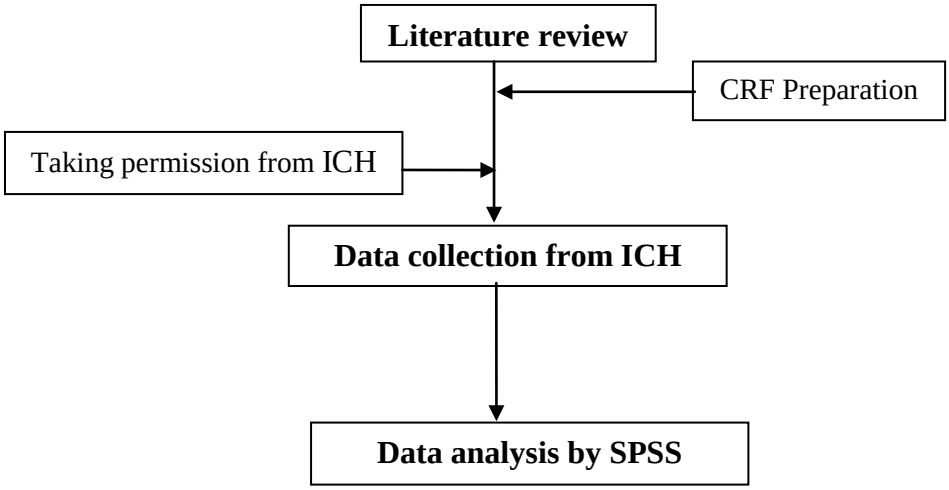
Antibiotics & other drugs prescribed for patientsSupportive treatments, Patients history, Physical symptoms, Diagnosis tests etc.

3.3.2 Exclusion Criteria:

Outpatient pneumonia Children or hospitalized patient with age of above 5 years was excluded from the study.

3.4 Procedure

The study was performed by completing 3 stages of the procedure. In the beginning literature review was done from 43 online literatures regarding pneumonia treatment. The aim of the literature review was to observe the situations and scopes of pneumonia treatment. Followed by the literature review data collection step was executed by collecting data with the help of previously prepared CRF (appendix I). Data regarding treatment given to the pneumonia patients were collected by survey retrospectively from records of ICH & SSF Hospital, Dhaka. Data collection periods were January 2013 to October 2013. In the final stage data analysis was made with the help of analytical software SPSS (Statistical Package for the Social Science) version 13.0.



Chapter Four

Results

4. RESULTS

4.1: Percent distribution of children according to sex who were having Pneumonia.

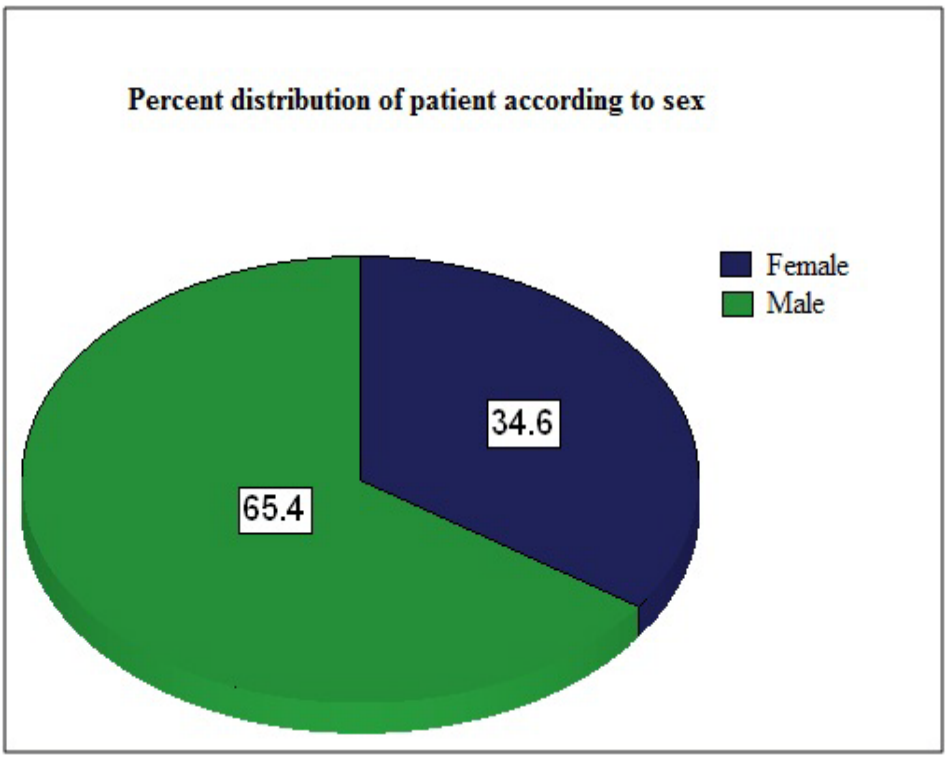


***Figure 2*: Distribution of children according to sex who were having Pneumonia**

Figure shows that among the 532 children male & female percentage (%) was 65.4% & 34.6%. The number for male & female patients was 348 & 184 who were suffering from Pneumonia

4.2 Percent Distribution of children according to age who were suffering from Pneumonia.

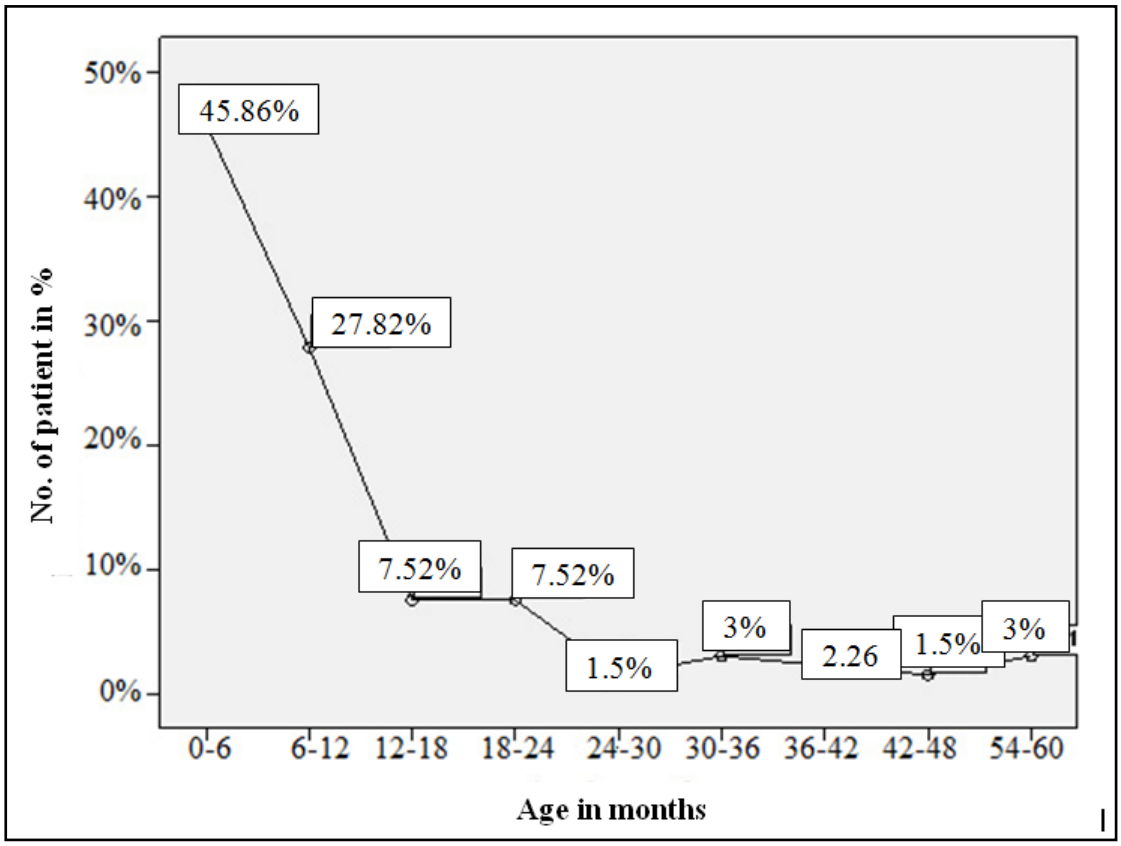


***Figure 3*: Percent Distribution of children age who was suffering from Pneumonia.**

Figure shows that the ill children were divided into ten groups. Among them 45.86% child was in 0-6 month's age group, 27.82% was in 6-12 months, 7.52% was in 12-18 months, 7.52% was in 18-24 months, 1.5% was in 24-30 months, 3% was in 30-36 months, 2.26% was in 35-42 months, 1.5% was in 42-48 months and 3% was in 54-60 months of old. No patient was in 48-54 months age range. 11.66 month was the mean age of the children with Pneumonia.

4.3: Percent Distribution of children weight who were suffering from pneumonia.

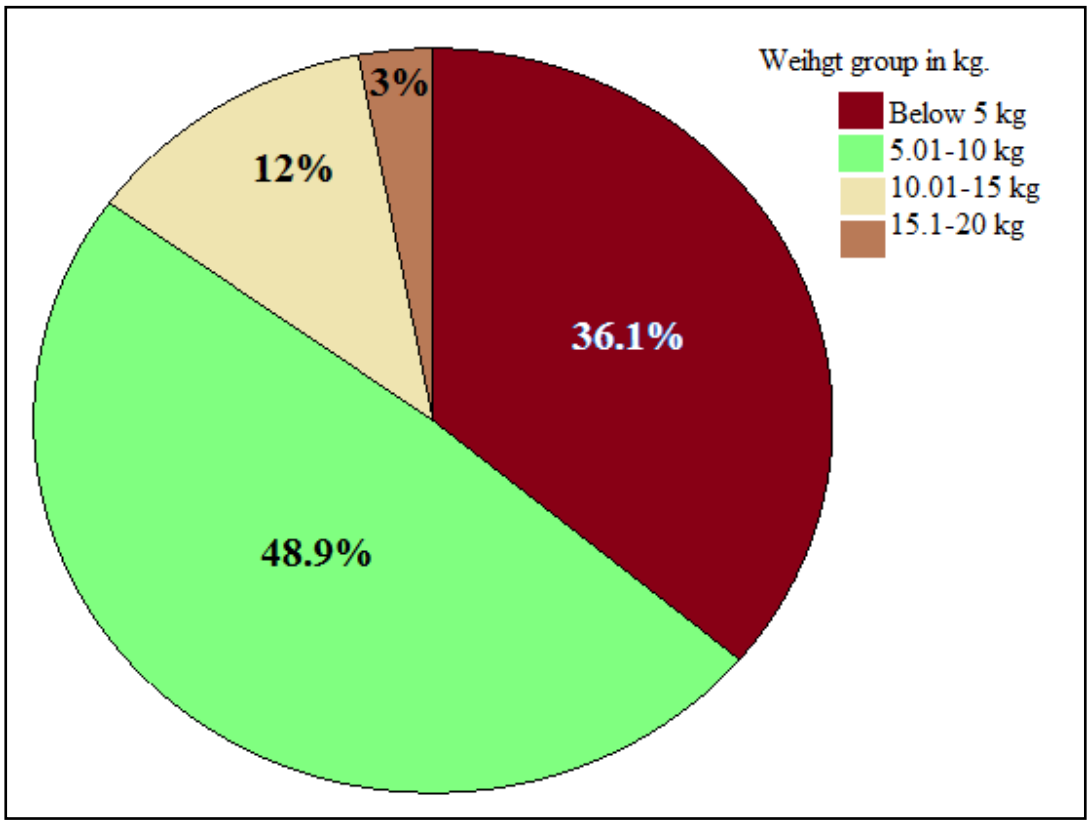


***Figure 4*: Percent Distribution of children weight who was suffering from pneumonia.**

Figure shows that number of the children with weight less than 5kg was 36.1%, 5.01-10kg was 48.9%, 10.01-15 kg was 12% and 15.1-20kg was 3% who were suffering from Pneumonia. Mean weight of the children was 7.18kg

4.4: Percent Distribution of symptoms of children who were suffering from pneumonia.

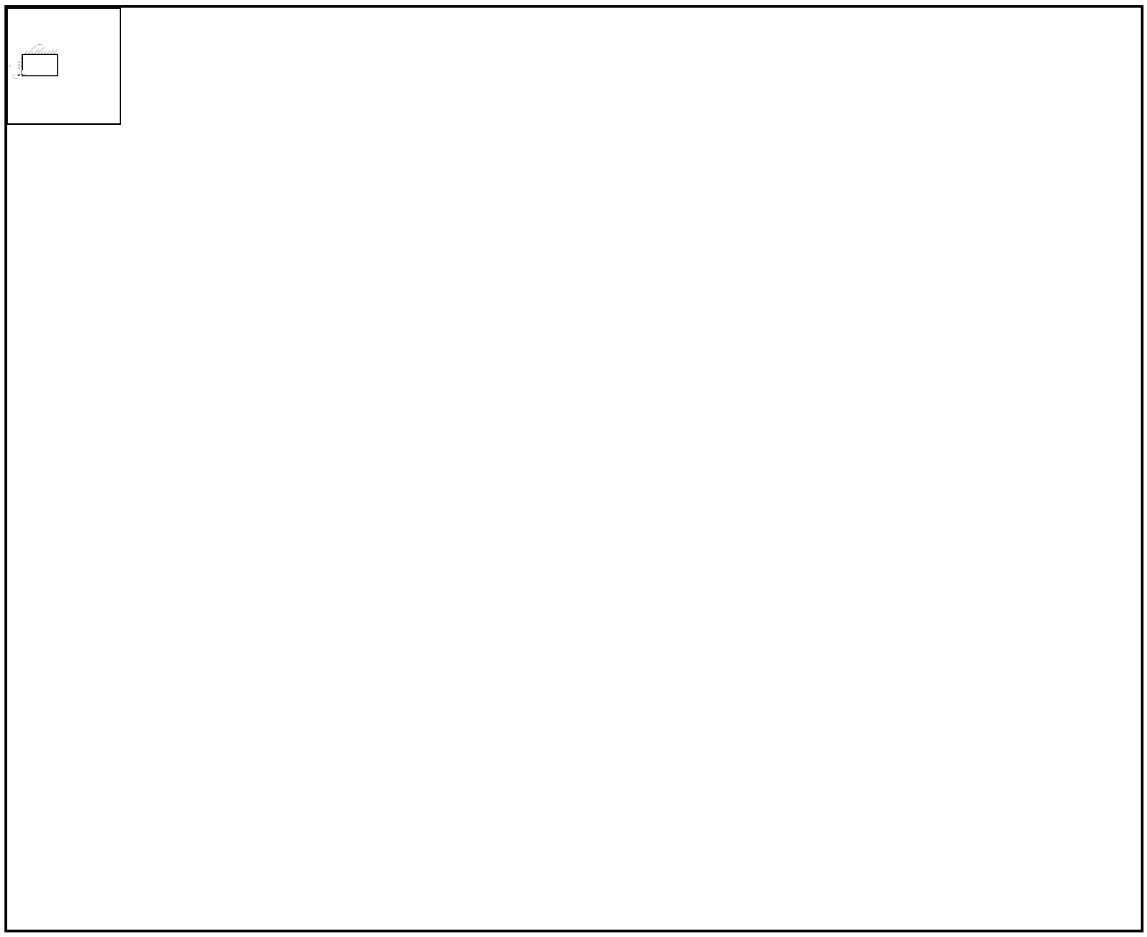


***Figure 5*: Percent Distribution of symptoms of children who were suffering from pneumonia.**

Each Bar of the figure representing the percent of patient had the particular symptoms. Figure shows that 83% of total children had cough, 74% had Vesicular breathe sound, 71% had fever, 68% had running nose, 62% had respiratory distress. 57% had pallor, 47% had creps, 39% had ronchi, 11% had vomiting and 7% of total children had convulsion.

4.5: Percent Distribution of different diagnostic tests performed to children who were suffering from pneumonia.

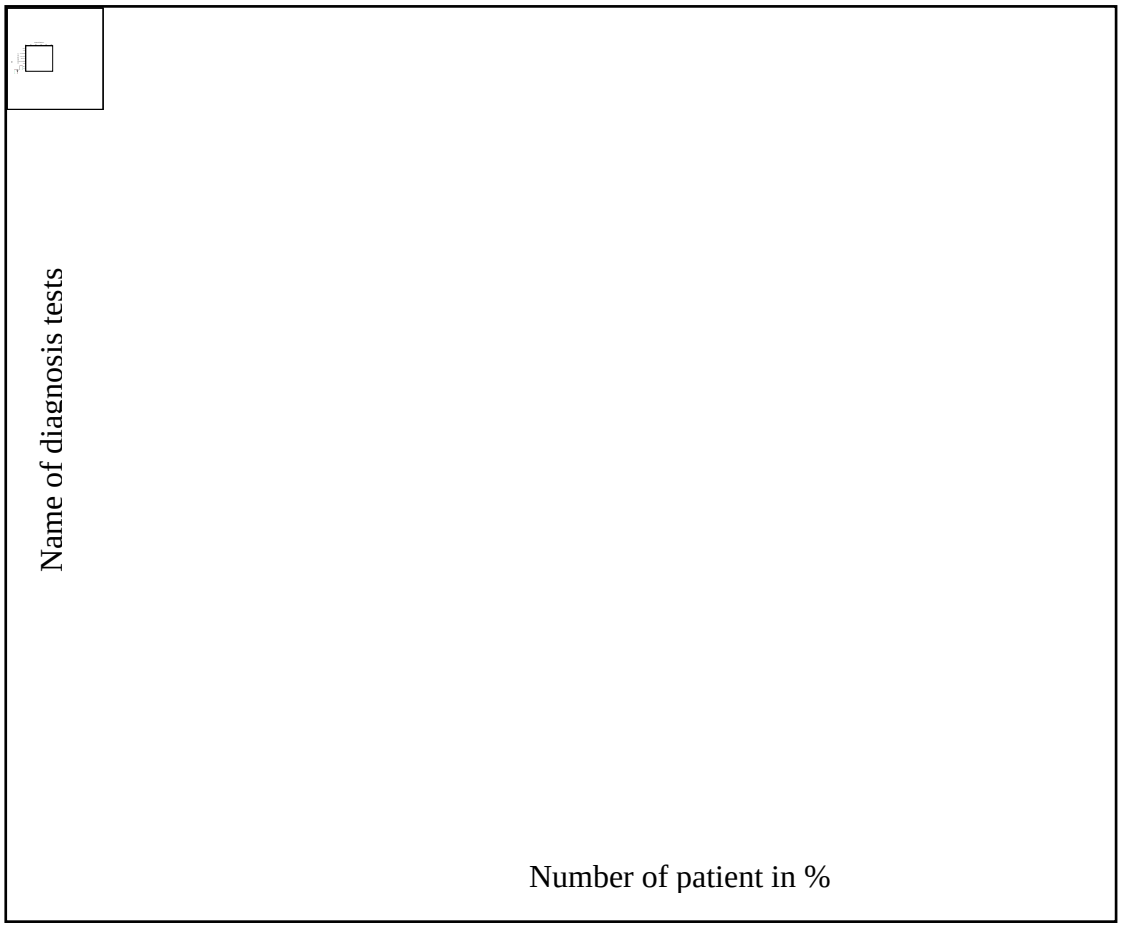


***Figure 6*: Percent Distribution of different diagnostic tests**

Each bar in the figure represents different diagnostic tests performed in children suffering from pneumonia. Figure shows that 89% of total patient was diagnosed by chest X-ray. CBC was done in 81% of patient, PBF test was done in 60% of patient, Blood grouping was done in 26% of patient, Blood C/S was done in 14% of patient, serum electrolyte test was done in 13% of patient, urine R/M/E was done in 11% of patient, CRP was done in 10% of patient and some other test was done in 8%% of children suffering from pneumonia.

4.6: Percent Distribution of children according to duration of hospital stays who were suffering from pneumonia.

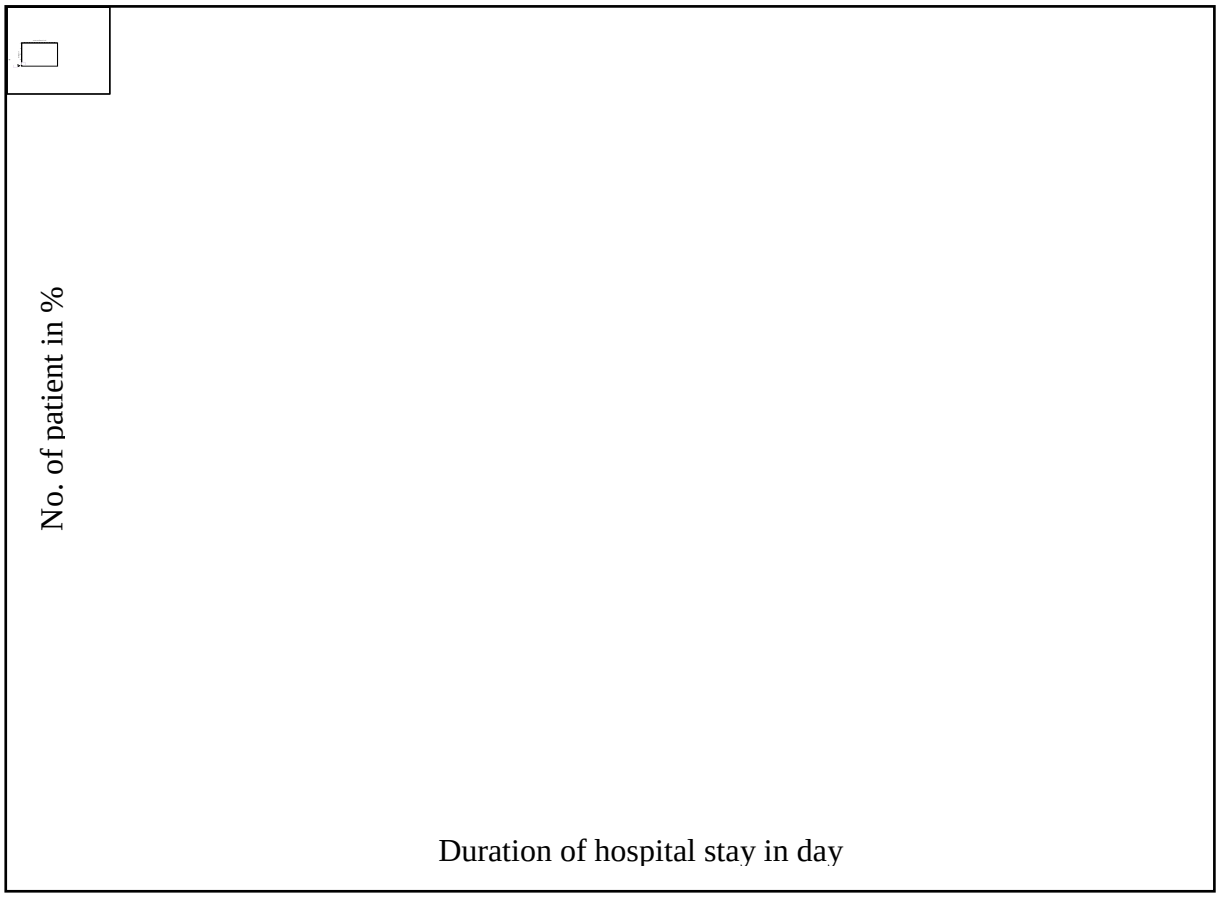


***Figure 7*: Percent Distribution of children according to duration of hospital stays**

Figure shows that 10.5% of children were stayed in hospital for 1 day with pneumonia. 16.5% of children were hospitalized for 2 days, 18% of children were for 3 days, 15% of children were for 4 days, 12% of children were for 5 days, 10.5% of children were for 6 days, 6% of children were for 7 days, 6.8% of children were for 8 days, 1.5% of children were for 9 days, 0.8% of children were for 11 days, 0.8% of children were for 12 days, 0.8% of children were for 13 days, 0.8% of children were for 15 days. There were no children hospitalized for 10 and 15 days. Average duration of hospitalization was 4.3 days for the children who were suffering from pneumonia.

4.7: Percent Distribution of therapeutic class of drugs from total number of drugs given to children who were hospitalized for Pneumonia

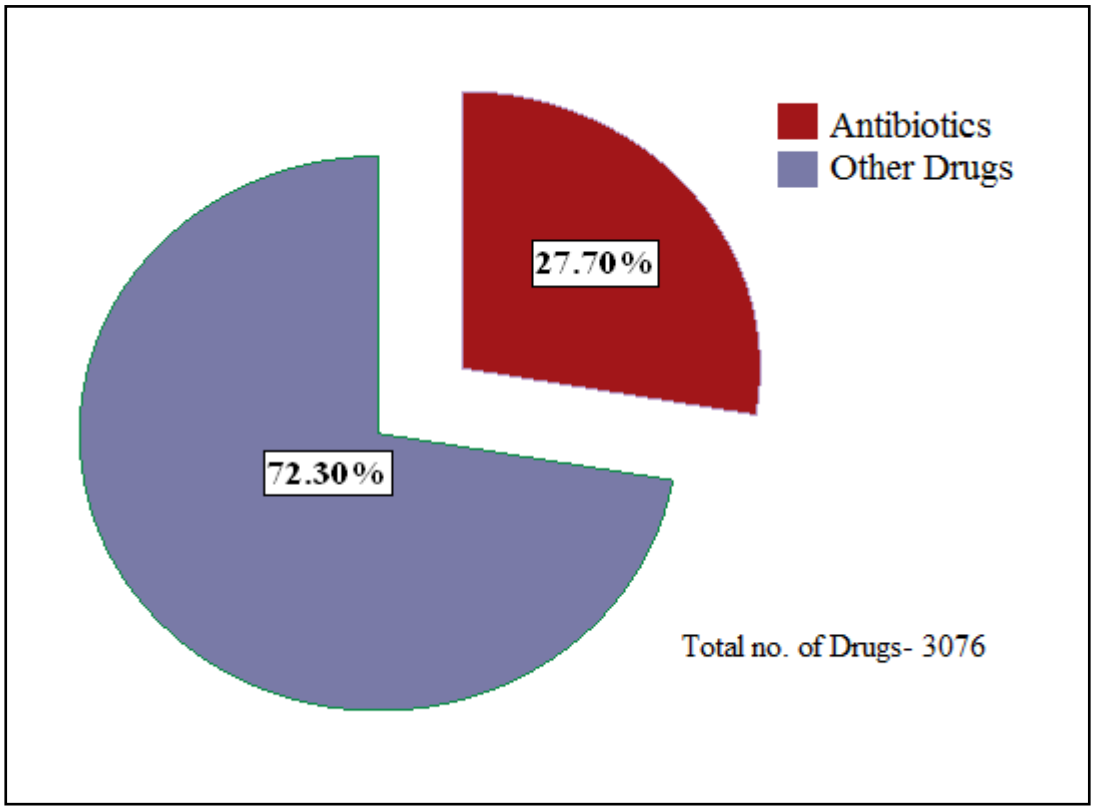


***Figure 8*: Percent Distribution of therapeutic class.**

Figure shows that total 3076 number of drugs was prescribed to 532 patients who were hospitalized with pneumonia. 27.7% of total drugs were antibiotics and 72.3% of total drugs were other supportive drugs.

4.8: Percent Distribution of different antibiotics used to treat the children suffering from Pneumonia.

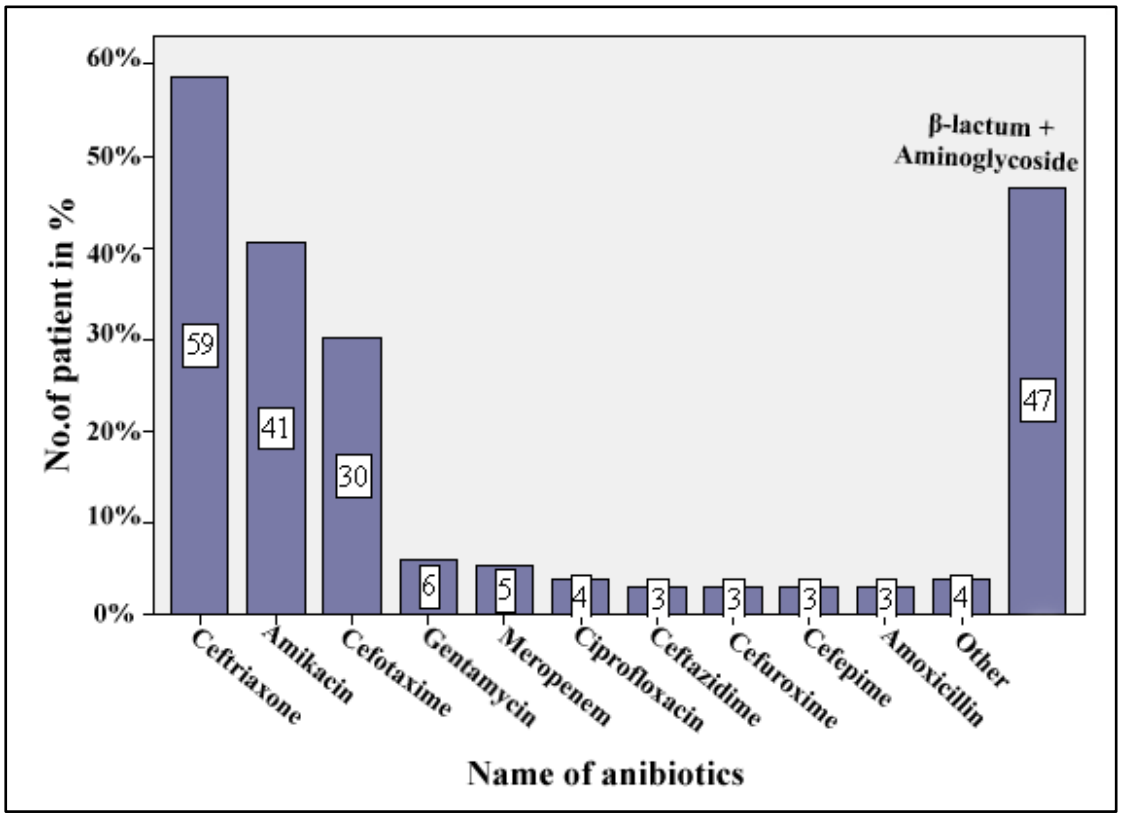


***Figure 9*: Percent Distribution of Antibiotics used to treat the children suffering from Pneumonia**

Figure shows that 59% children received Ceftriaxone, 41% received Amikacin, 30% received Cefotaxime, 6% received Gentamycin, 5% received Meropenem, 4% received Ciprofloxacin, 3% received Ceftazidime, 3 % received cefuroxime, 3% received Cefepime, 3% received amoxicillin and 4% received other antibiotics to treat children suffering from Pneumonia. β-lactum + Aminoglycoside combinations was given to 47% of children were hospitalized for pneumonia.

4.9: Percent Distribution of different drugs other than antibiotics used to treat the children suffering from Pneumonia.

Table 5

Percent Distribution of supportive drugs

Name of Drugs	Number of patient in percent
Salbutamol + Ipratropium	75.93%
Paracetamol	54.89%
Hydrocortisone	33.08%
B/S	30.83%
Furosemide	16.54%
Ambroxol	13.53%
NaCl 0.9% Nasal Drop	13.53%
Folic Acid	9.77%
Salbutamol syrup	9.02%
Oradaxon	8.27%
Potassium	8.27%
Levosalbutamol	7.52%
Ranitidine	6.77%
Vit+Min	6.77%
Zinc	6.02%
Miconazole Oral Gel	6.02%
Dextrose + sodium chloride	6.02%
Cholera saline	6.02%
Other	23.30%

In above table first column represents the name of drugs (other than antibiotics) and second column represents percent of patient received that particular drug. Table shows that 75.93% patient recieved Salbutamol + Ipratropium, 54.89% patient recieved Paracetamol, 33.08% patient recieved Hydrocortisone, 30.83% patient recieved B/S, 16.54% patient recieved Furosemide. Name of other drugs and the percent of patient is also shown in above table.

4.10: Percent Distribution of children received different types of supportive treatment in case of Pneumonia.

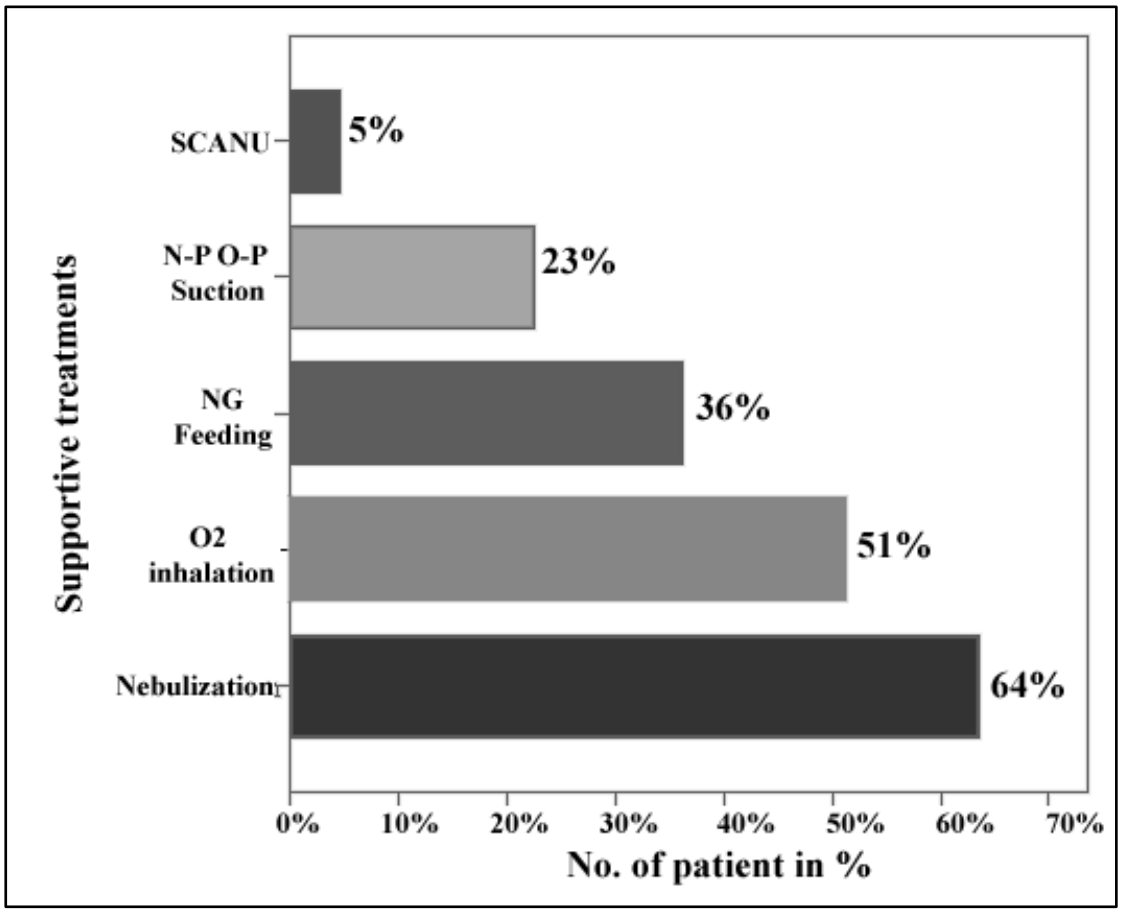


***Figure 10*: Percent Distribution of children received different types of supportive treatment in case of Pneumonia.**

Figure shows that 64% children was received nebulization, 51% received oxygen inhalation, 36% received NG Feeding and 23% received N-P O-P Suction. 5% children received care in SCANU in case of Pneumonia.

4.11: Percent Distribution of children who were suffering from pneumonia according to total number of drugs administered per day during hospitalization.

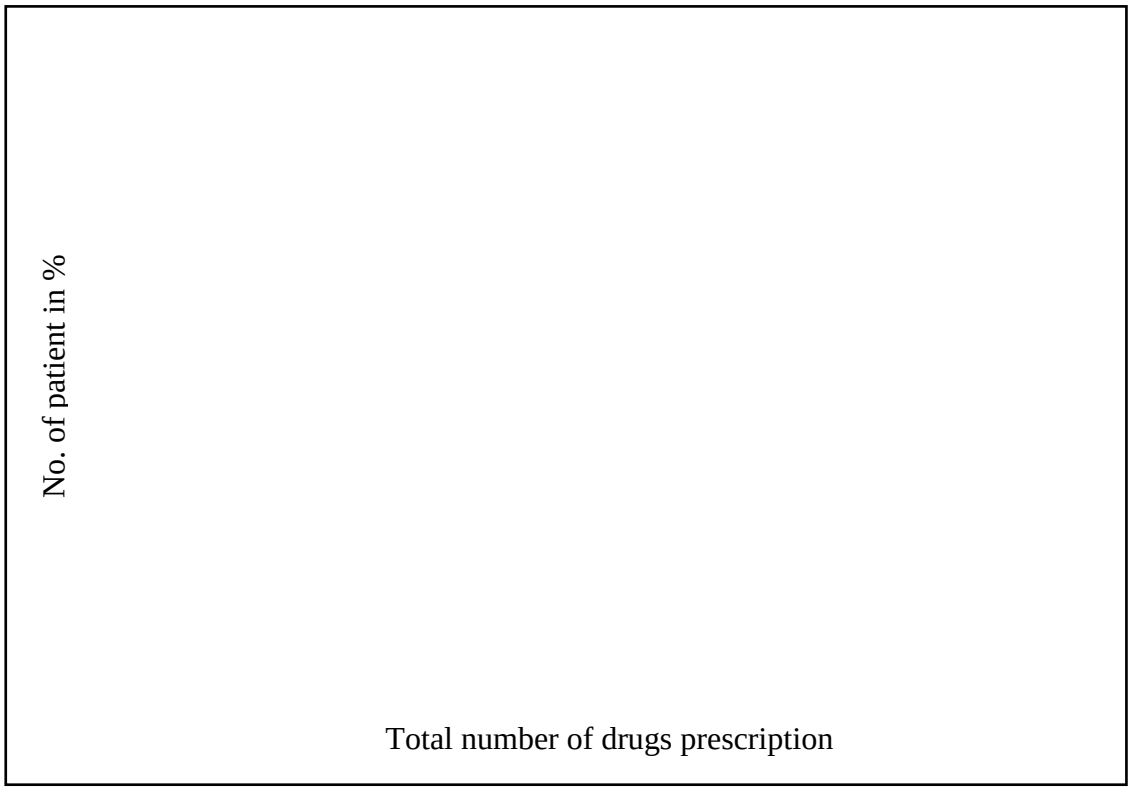


***Figure 11*: Percent Distribution of children according to total number of drugs in per prescription**

Figure shows that 4.5% of patient received 2 drugs per day during hospital stay for pneumonia. 4.5% received 3 drugs, 15.8% received 4 drugs, 22.6% received 5 drugs, 21.1% received 6 drugs, 16.5 received 7 drugs, 6% received 8 drugs, 4.5% received 9 drugs, 1.5% received 10 drugs, 2.3% received 11 drugs and 0.8% received 12 drugs per day during hospital stay for pneumonia. Average 5.8 numbers of drugs were administered to children who were hospitalized for pneumonia.

4.12: Percent Distribution of Number of drugs from EDL vs Total number of drugs in prescription of children who were suffering from pneumonia.

***Figure 12*: Percent Distribution of number of drugs from EDL vs. Total number of drugs**

Figure shows that children who were taken 2 drugs per day there was no drug from essential drug list (EDL) of BD. For the children who were taken 3 and 4 drugs everyday number of drugs from EDL was 1. For total number of drugs 5-7 the number from EDL was 2. For total number of drugs 8, 9 and 11 the number of drugs from EDL was 4. Children who was admitted with pneumonia and received 10 and 12 drugs per day they received 5 drugs from EDL.

4.13: Percent distribution of number of drugs given from EDL to children who were suffering from pneumonia.

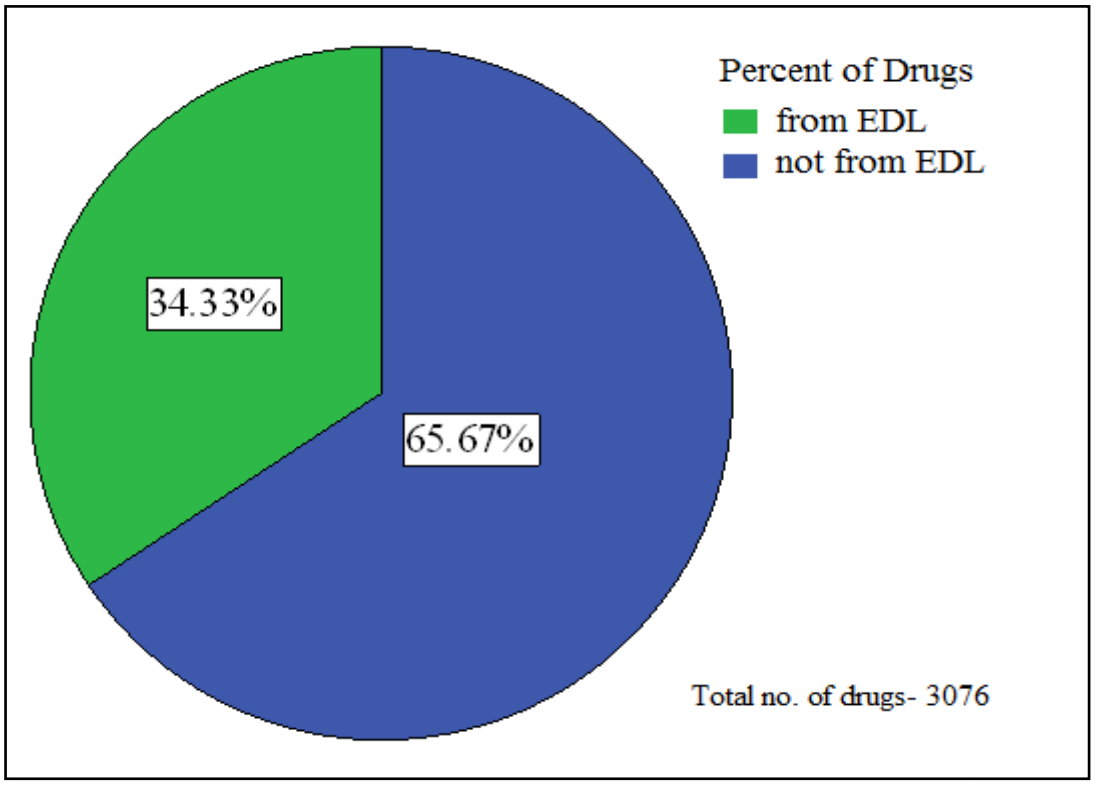


***Figure 13*: Percent Distribution of number of prescribed drugs from EDL**

Figure shows that total 3076 number of drugs was prescribed to children who were suffering from pneumonia. Among 3076 drug 34.33% was from essential drug list (EDL) of Bangladesh and 65.67% was not from EDL.

4.14: Percent Distribution of number of antibiotics from EDL given to children who were suffering from pneumonia.

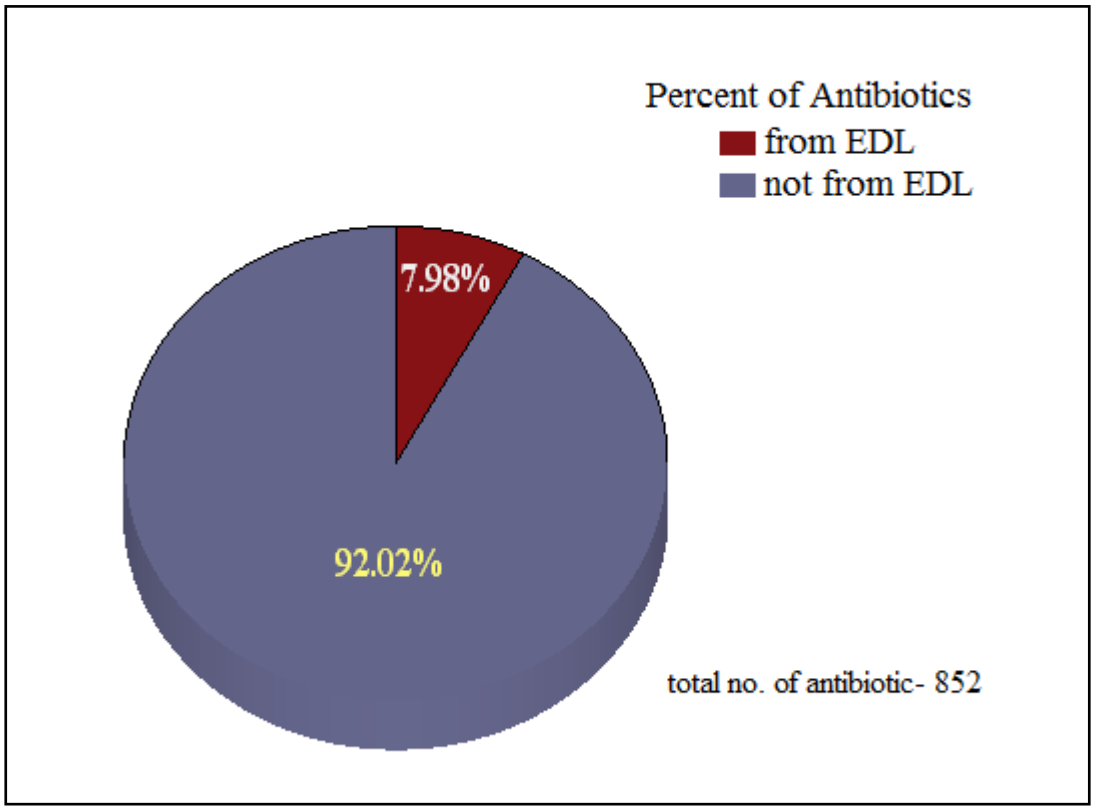


***Figure 14*: Percent Distribution of number of antibiotic prescribed from EDL**

Figure shows that total 852 antibiotics was prescribed to 532 children who were hospitalized with pneumonia. 7.98% of total antibiotics was from essential drug list (EDL) of bangladesh and remaining 92.02% was not from EDL.

4.15: Percent Distribution of prescription pattern according to polypharmacy practice to the children who were suffering from pneumonia.

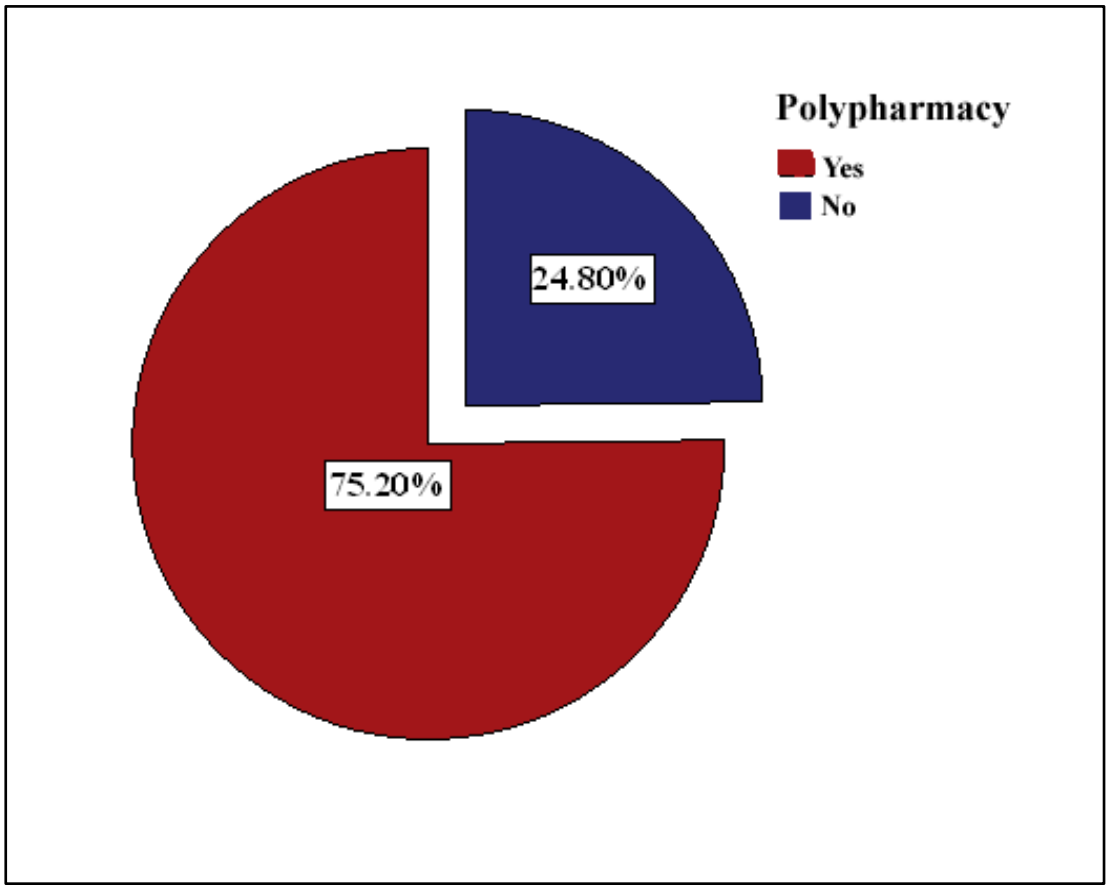


***Figure 15*: Percent Distribution of practicing polypharmacy in pneumonia treatment**

Figure shows that 75.2% of children with pneumonia were received 5 or more medication per day during hospital stay and in 24.8% of children number of drugs was less than 5.

Chapter Five

Discussion

5. DISCUSSION

Pneumonia is a common illness in all parts of the world. It is a major cause of death among all age groups. In children, many of these deaths occur in the newborn period. The World Health Organization estimates that one in three newborn infant deaths is due to pneumonia. Over two million children under five die each year worldwide. WHO also estimates that up to 1 million of these deaths are caused by the bacteria *Streptococcus pneumoniae*, and over 90% of these deaths take place in developing countries (WHO, 2013).

In this study, the sample was collected from the Institute of Child Health & Shishu Sasthya Foundation Hospital, Mirpur-Dhaka, from January 2013 to October 2013. The study was a descriptive study; in which 532 children suffering from pneumonia which are in below 5 years age range. Variables like patient's age, gender, Patients weight, type of antibiotics & supportive drugs given in the treatment of pneumonia, percentage of drugs from essential drug list and polypharmacy practice during the treatment in hospital to the children suffering from pneumonia were considered. Among the patients about 67% were male and 33% were female. Study showed that the incidence of pneumonia was more in male than female children. This result of the study has similarities with that of other studies (WHO, 2013).

Children of this study were divided into ten categories according to their age. Among them 45.86% children was in 0-6 month's age group, 27.82% was in 6-12 months. In the study it was found that the incidence of pneumonia was highest in below 6 months of age followed by 6-12 months age range. Aruolb & Stern's (1992) study showed that incidence of pneumonia was decreased gradually according to increasing of age of children. The cause of increasing incidence of pneumonia in below 6 months age group is a lack of antibody against common viral and bacterial pathogens (Aruolb & Stern, 1992).

In this study it was found that, most of the patient weight was less than 10kg among children who were suffering from Pneumonia. In this study it was statistically proved that low birth weight (<10kg) babies have had more risk of developing pneumonia. This assumption was also found in research work of WHO . So it can be said that low birth weight babies had significantly higher incidence of pneumonia (WHO, 2013).

Children with pneumonia may have a range of symptoms depending on their age and the cause of the infection. According to WHO and UNICEF common symptoms of pneumonia in children are cough, rapid or difficult breathing, fever, chills, headaches, loss of appetite and wheezing. Young infants may suffer convulsions, and feeding problems. The result of signs found of this study was similar to that of WHO and UNICEF study. It was clearly showed from this study that cough, vesicular breathe sound, fever, running nose, respiratory distress was the most common signs of pneumonia (UNICEF & WHO, 2006).

The survey result of Elemraid and his group showed the proper treatment of pneumonia and patient compliance depends on clinical and radiological investigations, which ultimately reduced the use of intravenous antibiotics and changes the route of antibiotic administration from IV to oral. According to Elemraid and his group, treatment cost and rate of treatment failure of pneumonia can be reduce with proper diagnosis. In this it was observed that, the patient were commonly diagnosed by chest X-ray, CBC, PBF, Blood C/S, serum electrolyte test, urine R/M/E, CRP and some other tests. But among them X-ray & CBC were the most common diagnostic test in case pneumonia (Elemraid et al., 2013).

According to Feagan and his co-worker, the duration of hospital stay and overall treatment cost was depends on clinical practice guidelines. They assessed clinical practices and outcomes among patients with community-acquired pneumonia admitted to Canadian hospitals. They found that 79.8% of patients received treatment according to clinical practice guidelines. The median length of stay was ranged from 3.0 to 6.5 days across hospitals. In this it was found that average duration of hospitalization in ICH was 4.3 days for the children who were suffering from pneumonia. This result of this study has similarities with that of Feagan and his co-worker's study (Feagan et al., 2000).

The result of this study shows that total 3076 number of drugs were prescribed to 532 patients who were hospitalized with pneumonia. 27.7% of total drugs were antibiotics and 72.3% of total drugs were other supportive drugs. Dorj and his group had analyzed the prescribing practices for the treatment of CAP in Mongolia. His study discovered that most commonly prescribed drugs were aminopenicillins, mucolytics

and vitamins with the average of three drugs per prescription. So antibiotics take one-third share of total drugs in case of treatment pneumonia (Dorj et al., 2013).

As discussed in literature review chapter, there are multiple antibiotics indicated and effective in the treatment of pneumonia. Administration of the most appropriate antibiotic as a first-line medicine may improve the outcome of pneumonia. In order to effectively treat the disease while minimizing antimicrobial resistance and virulence, it was important to know which antibiotics work best for children depending on the severity of the illness. Rehman and his group conducted a prospective and cross-sectional study in Pakistan and found that, commonly used antibiotics were cephalosporin (80%), aminoglycosides (65%) and penicillins (50%) either as monotherapy or combination treatment. My study shows that 59% children received Ceftriaxone, 41% received Amikacin, 30% received Cefotaxime, 6% received Gentamycin, 5% received Meropenem, 4% received Ciprofloxacin, 3% received Ceftazidime, 3 % received cefuroxime, 3% received Cefepime, 3% received amoxicillin and 4% received other antibiotics to treat children suffering from Pneumonia. The result of this study shows that Ceftriaxone & Amikacin are the most commonly prescribed antibiotics for the treatment of pneumonia in hospital of Bangladesh. So this result has similarities with that of Rehman and his group's study (Rehman et al., 2013).

This study was also co-related well with Levison & Kaye's study. In this study result it was shown that β-lactum + Aminoglycoside combinations were given to 47% of children who were hospitalized for pneumonia. Levison & Kaye was recommended combination therapy with a beta-lactam antibiotic plus an aminoglycoside for gram-negative bacillary pneumonia. The cause of their recommendation was combination therapy can give synergistic activity, the spectrum of antibacterial activity can increase and chance of bacterial resistance can decrease (Levison & Kaye, 1985).

Lamontagne and his fellows discovered that if low-dose corticosteroids administered within 14 days of disease onset may reduce all-cause mortality in patients with acute lung injury, acute respiratory distress syndrome, and severe pneumonia. In this study it was shown that 33.08% patient received Hydrocortisone during their hospitalization with pneumonia (Lamontagne et al., 2010).

In this it was also found that, most of the patient received Salbutamol + Ipratropium, paracetamol, hydrocortisone, B/S, furesemide in addition with some common antibiotics. Weiss and his group conducted a similar study with adjunct corticosteroids in children hospitalized with CAP and found that adjunct corticosteroids were associated with a shorter hospital LOS among patients who received concomitant β-agonist therapy. A longer LOS and a greater odd of readmission were found among patients who did not received therapy with systemic corticosteroids. Weiss and his group considered β-agonist therapy as a proxy for wheezing. Study findings shows that only patients admitted to the hospital with acute symptoms and a diagnosis of CAP can get benefit from adjunct therapy (Weiss et al., 2011).

According to WHO, it was assumption that almost all of pneumonia patient require at least one kinds of supportive therapy to manage or control pneumonia and/or associated diseases. This study shows most of the children was received nebulization, oxygen inhalation, NG Feeding and N-P O-P Suction. According to this statistical resul of this study it can be said that maximum patient required nebulization and oxygen inhalation during treatment with pneumonia in hospital (WHO, 2013).

This study also found that average 5.8 numbers of drugs were administered to children who were hospitalized for pneumonia. In Mongolia, Dorj and his fellows had analyzed the prescribing practices for the treatment of mild or moderate Pneumonia with respect to national prescribing guidelines. Their study discovered that average of three drugs had per prescription in Mongolia. So it can be assume that, average number of drugs for the treatment of pneumonia in Bangladesh is higher in Bangladesh than that of Mongolia (Dorj et al., 2013).

The result of this study show that children who were taken 2 drugs per day there was no drug from essential drug list (EDL) of BD. For the children who were taken 3 and 4 drugs everyday number of drugs from EDL was 1. For total number of drugs 5-7 the number from EDL was 2. For total number of drugs 8, 9 and 11 the number of drugs from EDL was 4. Children who was admitted with pneumonia and received 10 and 12 drugs per day they received 5 drugs from EDL. So it can be said that with increasing total number of drugs, the number of them from EDL also increase. But the

percentage of drugs from EDL remains poor. This study mostly co-related well with the Ahmed & Islam's study which analyzed the current status of the outcome of the National Drug Policy (NDP) 1982 objectives in terms rational use of drugs in the primary healthcare facilities including affordability by consumers. Ahmed & Islam's study was covered a random sample of rural Upazila Health Complexes (UHCs) and an urban clinics (UCs) in the Dhaka. Ahmed & Islam noted that the copy of the list of essential drugs was available in 55% and 47% of the UCs and UHCs respectively with around two-thirds of the drugs being prescribed from the list. Study revealed that the availability of essential drugs (ED) for common illnesses was poor (Ahmed & Islam, 2012).

From this study result, it was shown that total 3076 number of drugs was prescribed to children who were suffering from pneumonia. Among 3076 drug 34.33% was from essential drug list (EDL) of Bangladesh and 65.67% was not from EDL. It also shows that total 852 antibiotics was prescribed to 532 children who were hospitalized with pneumonia. 7.98% of total antibiotics was from essential drug list (EDL) of bangladesh and remaining 92.02% was not from EDL. Ahmed & Islam detected that even after many years of approving the NDP 1982, the availability and rational use of drugs and the affordability of the poor people have remained to be achieved in Bangladesh. Surprisingly the prices of key essential drugs differed 500% or more by brands. Evidence showed that the situation deteriorated in terms of both availability of essential drugs and their rational use (Ahmed & Islam, 2012).

In this study it was also shown that 75.2% of children with pneumonia were received 5 or more medication per day during hospital stay and in 24.8% of children number of drugs was less than 5. So this statistics reflect that around two-third of case has polypharmacy practice. In another study of Ahmed & Islam also found that polypharmacy was higher in the UCs (46%) than in the UHCs (33%). Polypharmacy can increase the treatment cost and drug related side-effects. As a solution of polypharmacy drug and disease monitoring is essential in Bangladesh (Ahmed & Islam, 2012).

Chapter Six

Conclusion

6. CONCLUSION

Antibiotics and some other supportive drugs are prescribed commonly as the treatment of pneumonia in hospital. This research was brought out that cephalosporin alone or in combination with an aminoglycosides was most common antibiotics which were prescribed for the treatment of children suffering from pneumonia. Among the cephalosporine- ceftriaxone and cefotaxime, among aminoglycosides- amikacin were mostly prescribed in hospital of Bangladesh for the treatment of pneumonia. This outcome of the study showed given treatment had insignificant adherence with the essential drug list (EDL) of Bangladesh. A list of essential drugs is suppose to be updated regularly, however in Bangladesh no major review has been made since 1982. In terms of updating the essential drug list comprehensively according to the clinical need for the treatment of pneumonia, further follow up is required for the inclusion of the evidence based effective drugs. Concerted efforts are needed to motivate and train those healthcare professionals about the benefits of prescribing from the national EDL, especially for the poor patient. Furthermore, for strengthen the regulatory capacity of Directorate of Drug Administration close monitoring and regular updating procedure need to be added in their operations. Another outcome of this study indicated that there was a practice of polypharmacy in Bangladesh. Polypharmacy and overuse/misuse of drugs, especially antibiotics, should be discouraged to avoid drug resistance and its consequences. Therefore, it will bring a radical change in the prescribing practices of hospitalized children with pneumonia. In conclusion, nationwide further multicenter research with a larger sample should be conducted to consolidate the observation of this study.

Chapter Seven

Reference

Ahmed, SM. & Islam, QS. (2012) 'Availability and rational use of drugs in primary healthcare facilities following the national drug policy of 1982: is Bangladesh on right track?' *J Health Popul Nutr* [Online], 30(1), 99-108. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22524126 [Accessed 11th September 2013].

Aoun, M. & Klastersky, J. (1991) 'Drug treatment of pneumonia in the hospital. What are the choices?', *Drugs* [Online], 42(6), 962-73. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1724642 [Accessed 28th October 2013].

Aruolb, JE., Stern, RC. Respiratory system, In: Bchrman RF, Nelson's Text Book of paediatrics, Saunder W.B, Philadelphia, 14th 1992; 1054-1077.

Aspa, J., Rajas, O., Castro, FR. (2008) 'Pneumococcal antimicrobial resistance: therapeutic strategy and management in community-acquired pneumonia', *Expert Opin Pharmacother* [Online], 9(2), 229-41. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8201146 [Accessed 07th November 2013].

Bartlett, J. (2000) 'Treatment of community-acquired pneumonia', *Chemotherapy* [Online], 46(1), 24-31. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10810210 [Accessed 26th September 2013].

Berger, A., Edelsberg, J., Oster, G., Huang, X. & Weber, DJ. (2013) 'Patterns of Initial Antibiotic Therapy for Community-Acquired Pneumonia in U.S. Hospitals, 2000 to 2009', *Am J Med Sci* [Online], 127(2), 255-63. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24029796 [Accessed 11th November 2013].

Berman, SJ., Fogarty, CM., Fabian, T., Melnick, D. & Lesky, W. (2004) 'Meropenem monotherapy for the treatment of hospital-acquired pneumonia: results of a multicenter trial', *J Chemother* [Online], 16(4), 362-71. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15332712 [Accessed 15th September 2013].

Bodmann, KF. (2005) 'Current guidelines for the treatment of severe pneumonia and sepsis', *Chemotherapy* [Online], 51(5), 227-33. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16103664 [Accessed 11th September 2013].

Chapman, S. (2005) 'Bacterial respiratory infection'. In: Robinson, G. Stradling, J. and West, S. ed (1*) Oxford Handbook of Respiratory Medicine*. London: Oxford University Press. pp 187-199

DGDA (2011). Directorate General of Drug Administration. Available from: http://www.dgda.gov.bd/images/essential_drugs.pdf [Accessed 11th September 2013].

Dorj, G., Hendrie, D., Parsons, R. & Sunderland, B. (2013) 'An evaluation of prescribing practices for community-acquired pneumonia (CAP) in Mongolia', *BMC Health Serv Res* [Online], 13(1),379. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24088338 [Accessed 11th November 2013].

Drug information online. (2013) *Bacterial Pneumonia*. [Online] Available at: http://www.drugs.com/cg/bacterial-pneumonia-aftercare-instructions.html [Accessed 15th September 2013].

Elemraid, MA., Rushton, SP., Thomas, MF., Spencer, DA., Eastham, KM., Gennery, AR. & Clark, JE. (2013) 'Changing clinical practice: management of paediatric community-acquired pneumonia', *J Eval Clin Pract* [Online], 10(1), 12091. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24118607 [Accessed 11th September 2013].

Feagan, BG., Marrie, TJ., Lau, CY., Wheeler, SL., Wong, CJ. & Vandervoort, MK. (2000) "Treatment and outcomes of community-acquired pneumonia at Canadian hospitals', *CMAJ* [Online], 162(10), 1415-20. Available from: http://www.ncbi.nlm.nih.gov/pubmed/ 10834044 [Accessed 28th October 2013].

Fink, MP., Snydman, DR., Niederman, MS., Leeper, KV., Johnson, RH., Heard, SO., Wunderink, RG., Caldwell, JW., Schentag, JJ. & Siami, GA. (1994) 'Treatment of severe pneumonia in hospitalized patients: results of a multicenter, randomized, double-blind trial comparing intravenous ciprofloxacin with imipenem-cilastatin', *Antimicrob Agents Chemother* [Online], 38(3), 547-57. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8203853 [Accessed 28th October 2013].

Harris, JA. (1996) ‘Antimicrobial therapy of pneumonia in infants and children’, *Semin Respir Infect* [Online], 11(3), 139-47. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8883171 [Accessed 26th September 2013].

Harms, R. (2013). *Pneumonia*. [Online] Available at: http://www.mayoclinic.com/health/pneumonia/DS00135/DSECTION=causes [Accessed 28th November 2013].

Janknegt, R., Wijnands, WJ. & Stobberingh, EE. (1994) ‘Antibiotic policies in Dutch hospitals for the treatment of pneumonia’, *J Antimicrob Chemother* [Online], 34(3), 431-42. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7829419 [Accessed 26th September 2013].

Jibril, HB., Ifere, OA. & Odumah, DU. (1989) ‘An open, comparative evaluation of amoxycillin and amoxycillin plus clavulanic acid in the treatment of bacterial pneumonia in children’, *Curr Med Res Opin* [Online], 11(9), 585-92. Available from: http://www.ncbi.nlm.nih.gov/pubmed/2612203 [Accessed 28th October 2013] .

Kabra, SK., Lodha, R. & Pandey, RM. (2010) ‘Antibiotics for community-acquired pneumonia in children’, *Cochrane Database Syst Rev* [Online], 17(3). Available from: http://www.ncbi.nlm.nih.gov/pubmed/20238334 [Accessed 07th November 2013].

Kappstein, I. & Daschner, FD. (1989) ‘Antibiotic usage in community-acquired pneumonia: Results of a survey in 288 departments of internal medicine in German hospitals’, *Infection* [Online], 19 (5), 301-304. Available from: http://link.springer.com/article/10.1007%2FBF01645351 [Accessed 28th October 2013].

Kelly, Price. (2010) *What Is Nebulizer Therapy?* [Online] Available at: http://www.livestrong.com/article/252388-what-is-nebulizer-therapy/ [Accessed 28th November 2013].

Kemmerich, B., Small, GJ. & Pennington, JE. (1986) 'Comparative evaluation of ciprofloxacin, enoxacin, and ofloxacin in experimental Pseudomonas aeruginosa pneumonia'. *Antimicrob Agents Chemother* [Online], 29(3), 395-9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/ 2940970 [Accessed 23th October 2013].

Kirk, O., Glenthoj, J., Dragsted, UB., Helweg, J., Aru, TM., Benfield, TL., Jensen, K., Vestbo, J. & Lundgren, JD. (2001) 'Penicillin as empirical therapy for patients hospitalised with community acquired pneumonia at a Danish hospital', *Dan Med Bull* [Online], 48(2), 84-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11414124 [Accessed 26th September 2013].

Kirsten, V. Hege, B. Tron M and Aasmund, R. (2007) 'Polypharmacy as commonly defined is an indicator of limited value in the assessment of drug-related problems', *Br J Clin Pharmacol* [Online], 63(2), 187–195. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2000563/ [Accessed 15th September 2013].

Koch, H., Landen, H. & Stauch, K.(2004) 'Once-daily moxifloxacin therapy for community-acquired pneumonia in general practice : evidence from a post-marketing surveillance study of 1467 patients', *Clin Drug Investig* [Online], 24(8), 441-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17523704 [Accessed 15th September 2013].

Korppi, M. (2003) 'Community-acquired pneumonia in children: issues in optimizing antibacterial treatment', *Paediatr Drugs*, 5(12), 821-32. Available from: http://www.ncbi.nlm.nih.gov/pubmed/ 14658923 [Accessed 15th September 2013].

LaForce, FM. (1989) 'Systemic antimicrobial therapy of nosocomial pneumonia: monotherapy versus combination therapy', *Eur J Clin Microbiol Infect Dis* [Online], 8(1), 61-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/ 2495953 [Accessed 28th October 2013].

Lamontagne,F., Briel, M., Guyatt, GH., Cook, DJ., Bhatnagar, N. & Meade, M. (2010) 'Corticosteroid therapy for acute lung injury, acute respiratory distress

syndrome, and severe pneumonia: a meta-analysis of randomized controlled trials', *J Crit Care* [Online], 25(3), 420-35. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19896324 [Accessed 07th November 2013].

Levison, ME. & Kaye, D. (1985) 'Pneumonia caused by gram-negative bacilli: an overview', *Rev Infect Dis* [Online], 4, S656-65. Available from: http://www.ncbi.nlm.nih.gov/pubmed/3909320 [Accessed 24th October 2013].

Leyenaar, JK., Shieh, MS., Lagu, T., Pekow, PS. & Lindenauer, PK. (2013) 'Comparative Effectiveness of Ceftriaxone in Combination with a Macrolide Compared with Ceftriaxone Alone for Pediatric Patients Hospitalized with Community Acquired Pneumonia', *Pediatr Infect Dis J* [Online], 19(3), 209-15. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24168982 [Accessed 11th November 2013].

Mandell, LA., Nicolle, LE., Ronald, AR., Duperval, R., Robson, HG., Feld, R., Vincelette, J. & Fong, I. (1983) 'A multicentre prospective randomized trial comparing ceftazidime with cefazolin/tobramycin in the treatment of hospitalized patients with non-pneumococcal pneumonia', *Antimicrob Chemother* [Online], 12(Suppl A), 9-20. Available from: http://www.ncbi.nlm.nih.gov/pubmed/6352661 [Accessed 20th October 2013].

Moschovis, PP., Banajeh, S., Macleod, WB., Saha, S., Hayden, D., Christiani, DC., Mino, G., Santosham, M., Thea, DM., Qazi, S., & Hibberd, PL. (2013) 'Childhood Anemia at High Altitude: Risk Factors for Poor Outcomes in Severe Pneumonia', *Pediatrics* [Online], 132(5), 1156-62. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24101768 [Accessed 11th November 2013].

Nelson, JD., Kusmiesz, H. & Shelton, S. (1982) 'Cefuroxime therapy for pneumonia in infants and children', *Pediatr Infect Dis* [Online], 1(3), 159-63. Available from: http://www.ncbi.nlm.nih.gov/pubmed/6755404 [Accessed 20th October 2013].

Nigel, C. Mike, S. Joshua, W. (2009) 'Infectious diseases'. In: Kate, T. ed (8) *Paediatric Handbook.* Australia: Royal children hospital. pp- 380

Pachon, J., Prados, MD., Capote, F., Cuello, JA., Garnacho, J. & Verano, A. (1990) 'Severe community-acquired pneumonia. Etiology, prognosis, and treatment', *Am Rev Respir Dis* [Online], 142(2), 369-73. Available from: http://www.ncbi.nlm.nih.gov/pubmed/2382902 [Accessed 28th October 2013].

Paladino, JA., Gudgel, LD., Forrest, A. & Niederman, MS. (2002) 'Cost-effectiveness of IV-to-oral switch therapy: azithromycin vs cefuroxime with or without erythromycin for the treatment of community-acquired pneumonia', *Chest* [Online], 122(4), 1271-9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12377852 [Accessed 15th September 2013].

Pennington, JE. (1988) 'Recent advances in the treatment of pneumonia in the intensive care unit', *J Hosp Infect* [Online], 11(Suppl A), 295-302. Available from: http://www.ncbi.nlm.nih.gov/pubmed/2896723 [Accessed 20th October 2013].

Perlino, CA. (1982) ' Moxalactam therapy for bacterial pneumonia', *Rev Infect Dis* [Online], 4, 617-22. Available from: http://www.ncbi.nlm.nih.gov/pubmed/6218574 [Accessed 20th October 2013].

Principi, N. & Esposito, S. (2003) 'Paediatric community-acquired pneumonia: current concept in pharmacological control', *Expert Opin Pharmacother* [Online], 4(5), 761-77. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12739999 [Accessed 15th September 2013].

Ramirez, JA., Srinath, L., Ahkee, S., Huang, A. & Raff, MJ. (1995) 'Early switch from intravenous to oral cephalosporins in the treatment of hospitalized patients with community-acquired pneumonia', *Arch Intern Med* [Online], 155(12), 1273-6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7778957 [Accessed 26th September 2013].

Rehman, S., Rehman, K., Akash, MS. (2013) 'A prospective study of inpatients to determine microbial etiology and therapeutic outcome of antibiotics for community-acquired pneumonia in pakistan', *Bioimpacts* [Online], 3(2), 91-5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23878792 [Accessed 11th September 2013].

Reyes, S., Martínez, R., Cremades, MJ., Martinez, E., Soler, JJ. & Villanueva, R. (2007) 'Empiric treatment in hospitalized community-acquired pneumonia. Impact on mortality, length of stay and re-admission', *Respir Med* [Online], 101(9), 1909-15. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17628462 [Accessed 07th November 2013] .

Ross, N. (2002). *Bronchodilators*. [Online] Available at: http://www.healthline.com/galecontent/bronchodilators/%22%22 [Accessed 28th November 2013].

Ruhrmann, H. & Blenk, H. (1982) 'Erythromycin versus amoxicillin for the treatment of pneumonia in children', *Infection* [Online], 10(2),86-91. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7049959 [Accessed 20th October 2013].

Ruuskanen, O. & Mertsola, J. (1999) 'Childhood community-acquired pneumonia', *Semin Respir Infect* [Online], 14(2), 163-72. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10391410 [Accessed 26th September 2013].

Sabath, LD. (1975) 'Current status of treatment of pneumonia', *South Med* [Online], 68 (12), 1507-11. Available from: http://www.ncbi.nlm.nih.gov/pubmed/792 [Accessed 20th October 2013].

Schiffman. George, (2013) *Pneumonia How do people "catch pneumonia"?*. [Online] Available at: http://www.onhealth.com/pneumonia/page2.htm [Accessed 25th November 2013].

Teele, D. (1985) 'Pneumonia: antimicrobial therapy for infants and children', *Pediatr Infect Dis* [Online], 4(3),330-5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/4001002 [Accessed 25th October 2013].

Thompson, E. (2013*) Oxygen Therapy*. [Online] Available at: http://www.grandtraversesurgery.com/health-library/hw-view.php?DOCHWID=hw63596 [Accessed 28th November 2013].

Unertl, KE., Lenhart, FP., Forst, H. & Peter, K. (1992) 'Systemic antibiotic treatment of nosocomial pneumonia', *Intensive Care Med* [Online], 18(1), 28-34. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1640030 [Accessed 28th October 2013].

UNICEF & WHO. (2006) 'The forgotten killer of children'. [Online] Available at: http://whqlibdoc.who.int/publications/2006/9280640489_eng.pdf [Accessed 15th November 2013].

Vergis, EN., Indorf, A., File, TM., Phillips, J., Bates, J., Tan, J., Sarosi, GA., Grayston, JT. & Summersgill, J. (2000) 'Azithromycin vs cefuroxime plus erythromycin for empirical treatment of community-acquired pneumonia in hospitalized patients: a prospective, randomized, multicenter trial', *Arch Intern Med* [Online], 160(9), 1294-300. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10809032 [Accessed 26th September 2013].

Viasus, D., Garcia, C. & Carratala, J. (2013) 'Advances in antibiotic therapy for community-acquired pneumonia', *Curr Opin Pulm Med* [Online], 19(3), 209-15. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23422416 [Accessed 11th November 2013].

Weiss, AK., Hall, M., Lee, GE., Kronman, MP., Sheffler, S., & Shah, SS. (2011) 'Adjunct corticosteroids in children hospitalized with community-acquired pneumonia', *Pediatrics* [Online], 127(2), 255-63. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21220397 [Accessed 11th November 2013].

WHO, (2012). *Essential drugs and medicines policy*. [Online] Available at: http://www.afro.who.int/en/ethiopia/country-programmes/essential-drugs-and-medicines.html [Accessed 28th November 2013].

WHO. (2013) *Pneumonia*. [Online] Available at: http://www.who.int/mediacentre/factsheets/fs331/en/ [Accessed 25th November 2013].

Zervos, M., Mandell, LA., Vrooman, PS., Andrews, CP., McIvor, A., Abdulla, RH., Caprariis, PJ., Knirsch, CA., Amsden, GW., Niederman, MS. & Lode, H.(2004) 'Comparative efficacies and tolerabilities of intravenous azithromycin plus ceftriaxone and intravenous levofloxacin with step-down oral therapy for hospitalized patients with moderate to severe community-acquired pneumonia', *Treat Respir Med* [Online], 3(5), 329-36. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15606222 [Accessed 15th September 2013].

Appendix I

Case Report Form

Case Report Form (CRF)

General Information: **SL NO._____**

Name of institution: _____Ward No. _____ Bed No: _____

Date of admission (D/M/Y):_____ Date of discharge (D/M/Y): _____

Particulars of the Patient:

1. Patient Name: _____

2. Gender: Male / Female 3. Place of birth: Home / hospital / Clinic

4. Date of birth (D/M/Y): ____ _____ _ 5. Age in months: _____

6. Height: _____ 7. Weight: _____

Other Additional Information:

8. Address: _____

9. No. of Family Member: _____

10. Occupation of parents: Father: _____ Mother: _____

11. Smoking habit of parents: Father: Yes / No Mother: Yes / No

History

12. Total breast feeding (in months) _____

13. Immunization status:

☐ BCG ☐ DPT + Polio ☐ Measles

☐ MMR ☐ Hepatitis B ☐ Others

14. Previous clinical history of Pneumonia (last 1 year): Yes / No

15. History of medication during the last illness

Disease types:

☐ Pneumonia ☐ Very Sever Pneumonia ☐ -Other

☐ Bronchopneumonia ☐ Sever Pneumonia

Chief Complaints:

16. Fever: Ye s / No, Days ----------
17. Cough: Yes / No, Days ----------
18. Running nose: Yes / No, Days ----------
19. Vomiting: Yes / No, Days ----------
20. How many times a day: ----------
21. Weather following cough: Yes / No
22. Fast breathing: Yes / No, Days ----------
23. Difficult breathing: Yes / No, Days ----------
24. Convulsion: Yes / No, Days ----------
25. Ear pain: Yes / No, Days ----------
26. Loss of Appetite: Yes / No, Days ----------
27. Feeding: Unable ----------, Difficult ----------, and normal----------
28. Any clinical signs of zinc deficiency: Yes/ No

Physical examination:

Day	1	2	3	4	5	6	7
Date							
Temperature							
Respiratory rate							
Pulse rate/min							
Chest indrawing	Yes- No-	Yes- No-	Yes- No-	Yes- No-	Yes- No-	Yes- No-	Yes- No-
Lethargy	Yes- No-	Yes- No-	Yes- No-	Yes- No-	Yes- No-	Yes- No-	Yes- No-

Patient's investigation:

29. Blood culture (if done): ----------
30. Sputum culture (if done): ----------
31. Complete blood count: ----------
32. Chest X-ray: ----------
33. Electrolytes (if done): ----------

Drugs Given at Hospital:

Day	1	2	3	4	5	6	7
Date							
Name of the Drugs	Injection: Syrups: Tablets: Additional	Injection: Syrups: Tablets: Additional:	Injection: Syrups: Tablets: Additional	Injections: Syrups: Tablets: Additional	Injection: Syrups: Tablets: Additional	Injection: Syrups: Tablets: Additional	Injection: Syrups: Tablets: Additional

Supportive treatments given at hospital

Day	1	2	3	4	5	6	7
Date							
O2 inhalation	Starting time: ……. Off time: …….. duration …….	Starting time: ……. Off time: …….. duration …….	Starting time: ……. Off time: …….. duration …….	Starting time: ……. Off time: …….. duration …….	Starting time: ……. Off time: …….. duration …….	Starting time: ……. Off time: …….. duration …….	Starting time: ……. Off time: …….. duration …….
Nebulization	Times : …….	Times : …….	Times : …….	Times : …….	Times : …….	Times : …….	Times : …….
Bronchodilator							
Other supportive treatments	NG Fluid						
	I.V Fluid						
Others							

Outcome Variables:

34. Total number of drugs per day _____

35. Number of drugs from essential drug list of Bangladesh _____

36. Are all Drugs easily available? Yes / No

37. Is the drugs price affordable for patient's family? Yes / No

38. Is the practice follow rational use of drug? Yes / No

39. Clinical improvement: on _____ days

40. Radiological improvement: on _____days

41. Day on which became a febrile: _____

Comments (If any):