A STUDY COMPARING THE PRESCRIBING PATTERN OF ANTIBIOTICS FOR FEVER BETWEEN DHAKA CITY AND DIFFERENT VILLAGES IN BANGLADESH

By

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A thesis submitted to the Department of Mathematics and Natural Sciences in partial fulfillment of the requirements for the degree of Bachelor of Science in Microbiology

Department of Mathematics and Natural Sciences

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September, 2019

Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

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Approval

The thesis/project titled "A Study Comparing the Prescribing Pattern of Antibiotics for Fever between Dhaka City and Different Villages in Bangladesh" submitted by Noshin Sayiara Shuchi (15126025) of Summer, 2019 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Science on 05-09-2019.

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Abstract

The study “A Study Comparing the Prescribing Pattern of Antibiotics for Fever between Dhaka city and Different Villages in Bangladesh” was done with the aim to do a survey on the differences in antibiotic use pattern between the capital city and different villages. Due to misuse of antibiotics, the number of resistant bacteria are growing day by day. A total of 150 prescriptions were analyzed. Different classes of antibiotics were prevalent in different places. Whereas Quinolones were used in 29% of cases in Dhaka, 3rd generation Cephalosporins were used in villages in 28% of cases. These two broad spectrum antibiotics were used in highest amount in both places respectively. The rate of diagnosis indicated in villages was quite low, only 25% and in Dhaka it was 44%, which is not satisfactory as well. Antibiotics aren’t supposed to be used without diagnosis since it can have severe side effects if not used properly.

Dedicated to

Almighty and my parents

Md. Osman Kabir and Nasima Kabir

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I am solely grateful to the Almighty who has given me the strength, attitude, confidence and skills to complete this study. First and foremost, I am grateful to my parents for always having faith in me, loving and supporting me in every aspect of my life.

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Introduction

1. Introduction

1.1 Antibiotics

The invention of antibiotics has revolutionized medical science. Antibiotics are probably the most commonly used drugs in the world. Over the past few years the use of antibiotics has grown into an alarming state, so has the resistance of bacteria resulting in production of superbugs and if not taken, 10 million lives could be lost globally by 2050 (O'Neill, 2018). This figure is higher than the total number of people who died from diseases like cancer, diabetes and diarrhea in 2018 (Wallen, 2019).

Professor Sayedur Rahman, chairman of the department of pharmacology at the Bangabandhu Sheikh Mujib Medcial University (BSMMU) has said that out of approximately 900 patients admitted to the unit in 2018, 400 died, where around 80 per cent deaths were related to a bacterial or fungal infection that was resistant to antibiotics (Wallen, 2019).

A joint initiative of WHO and Drugs for Neglected Diseases initiative (DNDi), GARDP (The Global Antibiotic Research and Development Partnership) is encouraging research and development through public-private partnerships and is aiming to develop and deliver up to four new treatments by 2023 by improving the existing antibiotics and accelerating the entry of new antibiotic drugs. (WHO, 2018)

1.1.1 Mechanism of Action

Antibiotics work by inhibiting one or more activities of bacteria-

1. Antibiotics targeting cell wall: β-Lactam (beta-lactam) and glycopeptide antibiotics work by inhibiting the synthesis of peptidoglycan layer of the target bacteria. Bacteria can develop resistance to β-lactam antibiotics by synthesizing an enzyme called β-lactamase, which attacks the β-lactam ring. β-lactam antibiotics are often given with β-lactamase inhibitors such as clavulanic acid to control the resistance (Boundless Microbiology).

Table 1.1: Adapted from Peach et al., 2013; Bray et al., 2013 and Kapoor et al., 2017)

β-lactams	Penicillins (Amoxicillin, Ampicillin, Penicillin G, Cloxacillin etc.) Cephalosporins (Cefixime, Cefuroxime, Cefaclor, Ceftazidime etc.)	Penicillin-binding proteins
Lipopeptides	Polymyxin B	Disruption of inner and outer membranes through binding to lipopolysaccharide (LPS) in the outer membrane

2. Inhibitors of protein synthesis: These disrupt the process and stops or slows the growth or proliferation of cells (Boundless Microbiology).

Table 1.2: adapted from Peach et al., 2013 and Kapoor et al., 2017

Tetracyclines	Oxytetracycline, Doxycycline, Tetracycline, Demeclocycline, Minocycline	30S ribosome. It acts upon the conserved sequences of the 16S r-RNA of the 30S ribosomal subunit and Prevents aminoacyl tRNA binding to ribosome
Aminoglycosides	Tobramycin, Gentamicin, Amikacin, Streptomycin, Spectinomycin	30S ribosome (mistranslation by tRNA mismatching)
Macrolides	Erythromycin, Clarithromycin, Midecamycin, Roxithromycin, Spiramycin, Azithromycin	50S ribosome (stimulating dissociation of the peptidyl-tRNA molecule from the ribosomes during elongation). It affects the early stage of protein synthesis.

Amphenicols	Chloramphenicol, Thiamphenicol, Florfenicol	50S ribosome (inhibit elongation step)
Lincosamides	Clindamycin, Lincomycin	50S ribosome (stimulate dissociation of the peptidyl-tRNA molecule from the ribosomes during elongation)
Pleuromutilins	Tiamulin	50S ribosome (prevent correct positioning of the CCA ends of tRNA for peptide transferase)

3. Inhibitors of DNA replication: The antimicrobial actions of these agents are a result of differences in prokaryotic and eukaryotic enzymes involved in DNA synthesis (Boundless Microbiology).

Table 1.3: Adapted from Peach et al., 2013 and Kapoor et al., 2017)

Fluoroquinolones	Nalidixic acid, Ciprofloxacin, Levofloxacin, Sparfloxacin, Norfloxacin	Topoisomerase II (DNA gyrase) and topoisomerase IV

4. Inhibitors of folic acid metabolism

Table 1.4: Adapted from Peach et al., 2013 and Kapoor et al., 2017)

Sulfonamides	Sulfamethazine, Sulfapyridine, Sulfamethoxazole, Sulfadiazine, Sulfamerazine	Competitively inhibits dihydropteroate synthase (DHPS) in a competitive manner

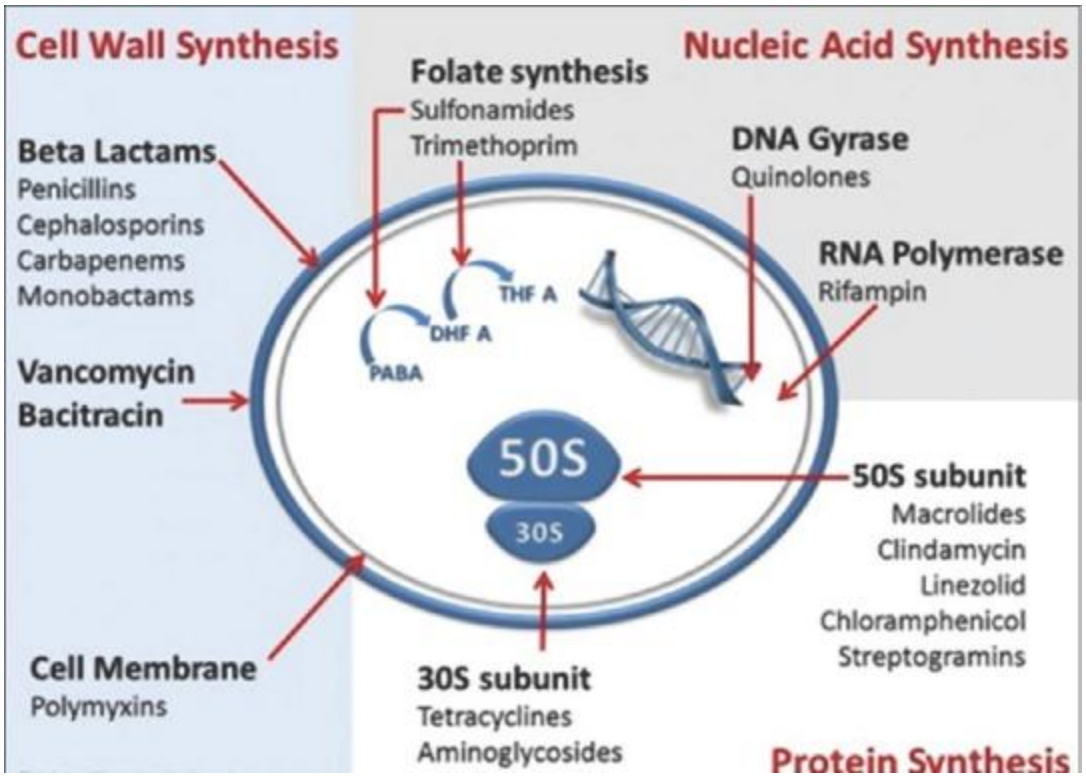

Figure 1.1: Classification of Antibiotics on the Basis of Mechanism of Action (Adapted from Kapoor et al., 2017)

1.1.2 Misuse of Antibiotics

In Bangladesh, a lot of people consume antibiotics without even consulting with their doctors for diseases like fever, common cold, cough etc. without knowing the reason for their disease. A lot of doctors prescribe antibiotics when the disease can easily be cured without it. Most people are unaware of the fact that viral diseases can't be cured by antibiotics and a lot of times people don't complete the dose that they are suggested and they stop when they feel they are relieved from the disease. The poor healthcare system of Bangladesh is mainly to blame for. Also there is a huge gap in diagnosis of diseases. A certain bacteria must be sensitive to an antibiotic for it to be suggested. Pharmacies are promoting antibiotics without perceiving the outcomes. The misuse of antibiotics is decreasing its effectiveness.

In a study published in the European Journal of Scientific Research (2015), the survey found that over one-third of patients in Bangladesh were given antibiotics by people who don't have the authorization to do so (Wallen, 2019). According to Munirul Alam, senior scientist of enteric

infections at International Centre for Diarrheal Disease Research, Bangladesh (icddr,b), the using antibiotics without proper planning in animal feeds, poultry farms including the faulty water management of the city have accelerated the risk of antibiotic resistant bacteria (Hasan, 2019). In a research conducted by Johns Hopkins University, it was found that 67% of hospitalized patients in Bangladesh were givem antibiotics when at least in 50 % cases antibiotics were not required (Chowdhury, 2017).

If the misuse of antibiotics doesn't stop, normal bacterial infections will get hard to treat. There isn't enough data available in Bangladesh to study the use and misuse of antibiotics. Studies have found significant gaps in the availability of data associated with antibiotics, while antibiotic resistance data were unavailable from 58 out of the 64 districts of Bangladesh. (Ahmed, Rabbi & Sultana, 2019).

Table 1.5: Need of antibiotics based on symptoms (CDC, 2018)

Common Condition: What's got you sick?	Common Cause Bacteria	Common Cause Bacteria or Virus	Common Cause Virus	Are antibiotics needed?
Strep throat	✔			**Yes**
Whooping cough	✔			**Yes**
Urinary tract infection	✔			**Yes**
Sinus infection		✔		**Maybe**
Middle ear infection		✔		**Maybe**

Common Condition: What's got you sick?	Common Cause Bacteria	Common Cause Bacteria or Virus	Common Cause Virus	Are antibiotics needed?
Bronchitis/chest cold		✔		**No**
Common cold/runny nose			✔	**No**
Sore throat (except strep)			✔	**No**
Flu			✔	**No**

1.1.3 Antibiotic resistance

Bacterial resistance is growing as one of the vital reasons behind the failure in treatment of infectious diseases, resulting in increased rate of mortality. Antimicrobial resistance occurs naturally over time as microorganisms undergo genetic changes and as they evolve, antibiotics can become less effective at treating an infection (Wallen, 2019). It's getting harder to treat bacterial infections due to misuse of antibiotics.

When any bacteria in the body of a human or animal are exposed to antibiotics, they change to resist the effect of the drug and as the use of antibiotic rises, rendering the drug less effective, they eventually develop resistance which then spreads between humans and animals through direct contact, food, or the environment (WHO, 2017). Stopping antibiotics before the dose ends results in constant bacterial growth causing the infection to deteriorate. The level of resistance to antibiotics is getting higher and more concerning day by day. The scary thing is, antibiotics aren't evolving but the bacteria are. The surge in antibiotic resistance and the growing scarcity for new antibiotics indicates the importance of preserving resistance before we run out of options to battle it. (WHO, 2017)

In this region, the prescription of incorrect medicine by mostly unqualified doctors looking to make a quick buck is seen as a driver of antimicrobial resistance (Wallen, 2019).

According to a study conducted by Poribesh Bachao Andolon (Poba) held in 2016, about 56% of antibiotics prescribed to patients in Dhaka hardly worked since bacteria had already developed antibiotic resistance due to their indiscriminate use. Saidur Rahman, associate professor of Bangladesh Medical College Hospital mentioned about how they have found that typhoid, urinary infection and diarrhea has become resistant in recent years to most of the medicines available in the market (Hasan, 2019). According to a group of UK experts, almost 700,000 people have died due to drug-resistant infections globally in 2016 and the estimated increase in antibiotic use to occur by 2030 is 200 percent. (The Daily Star, 2018)

Figure 1.2: Timeline of Antibiotic Resistance Compared to Antibiotic Development (Adapted from the Centers for Disease Control and Prevention, 2018)

1.1.4 Side effect for too much antibiotic consumption

Side effects of antibiotic includes problems with digestion, photosensitivity,resistance to antibiotics, kidney failure etc. (Huizen, 2018). Antibiotics can sometimes attack bacteria that are useful for the body. Antibiotics can also cause diarrhea.

Amongst commonly prescribed antibiotics, penicillins are known to have side effects. Amoxicillins cause hypersensitivity. These can cause gastrointestinal problems, diarrhea and nausea as well. Since Cephalosporins work in the same way as Penicillins, they can also cause hypersensitivity to the same degree. Tetracyclines, Erythromycins and Macrolides have gastrointestinal side effects. Fever can also develop due to allergic reactions. Study showed that patients are at the risk of allergy (5%), nephritis (3%), hematological problems (2–2.5%), gastrointestinal problems (5.5%), disturbance in the nervous system (2%), signs of allergy on the skin (5.5%), problems with electrolytes displayed in lower percentages (Heta & Robo, 2018).

1.2 Health and economy of Bangladesh

The base of any health system is the value of human life, the value largely determines the resources - human, material and financial that it allocates for the healthcare system (Islam & Biswas, 2014). Every society has to have some determinants of healthcare. Since the 1990s, modern science and technology has developed a lot and with the greater role of United Nations agencies and non-government organizations, the healthcare systems have gradually shifted its emphasis both on health promotion and preventative services whereas earlier the healthcare system in Bangladesh was primarily focused on providing curative services targeting maternal, child and newborn health (Islam & Biswas, 2014).

The Health care system in Bangladesh falls under the control of the Ministry of Health and Family Welfare which means that the government is responsible for building health facilities like, Health Services, Family Planning, Drug Administration, Nursing and Midwifery, Health Economics Unit, etc. in urban and rural areas of the country (Joarder et al., 2019). Healthcare is provided through government and private sectors and the services in both sectors vary greatly. Although primary healthcare services have improved a lot, there still are a lot of deficiencies yet to be filled. The Ministry of Health and Family Welfare (MOHFW) is responsible for

formulating national-level policy, planning, and decision-making in the provision of healthcare and education in Bangladesh (CRI, 2015).

In spite of all the challenges, the health sector has been given little priority in terms of national resource allocation (Islam & Biswas, 2014).

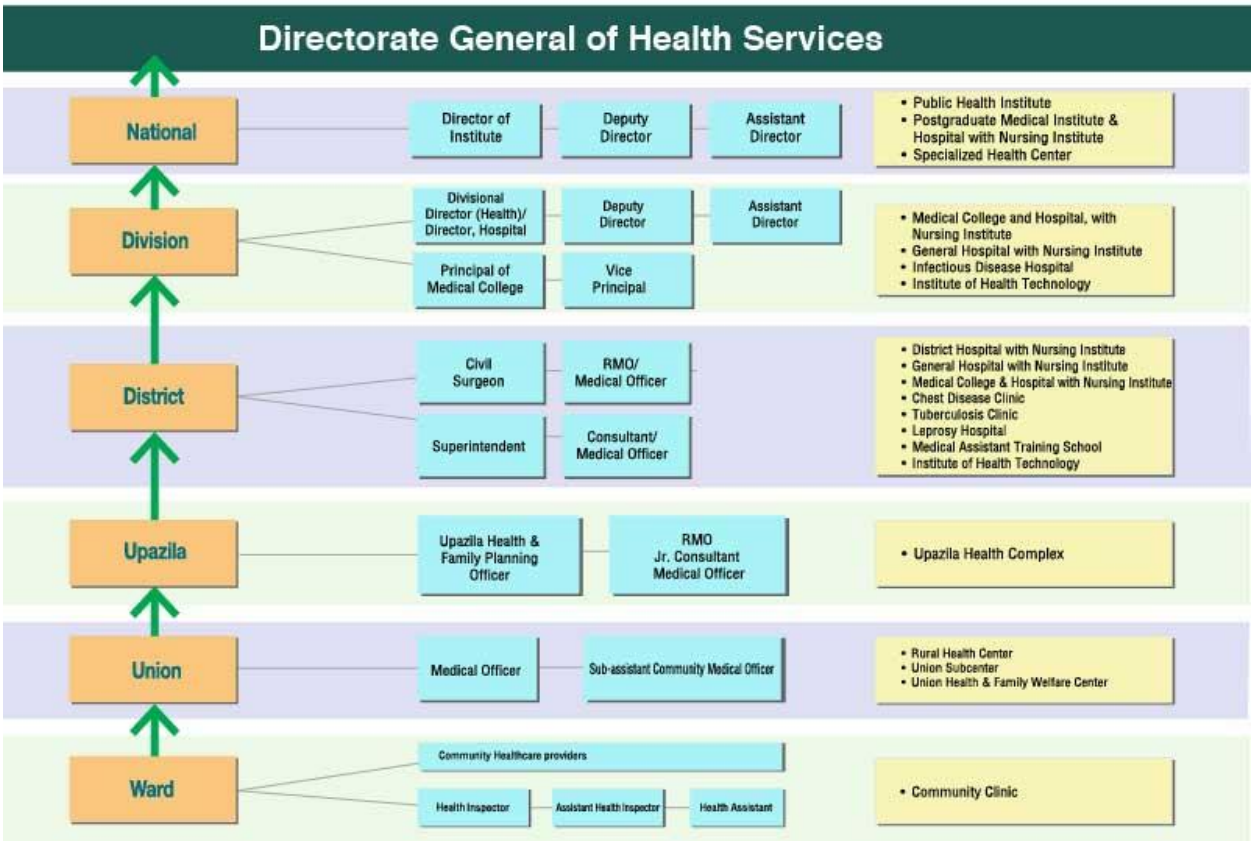

Figure1.3: Types of facilities from national to the ward level, with managerial hierarchy (Adapted from CRI, 2015)

In Bangladesh, based on HRH Data Sheet-2011, Government of the People's Republic of Bangladesh, Ministry of Health and Family Welfare, Human Resources Development Unit, there are an estimated 3.05 physicians per 10,000 people and 1.07 nurses per 10,000 people (WHO, 2012).

Antibiotic resistance is gradually jeopardizing the gains from millennium development goals and endangering the Sustainable Development Goals globally, putting a serious threat into a lower middle income country like Bangladesh (Chowdhury, 2017).

Although human resources for health (HRH) was not considered a priority in Bangladesh with all the other challenges, there have been some successes like increase in the number of graduates and health worker training facilities, and an increased number of rural health facilities (WHO, 2012).

1.2.1 Healthcare in Dhaka city

Urbanization is occurring rapidly in Bangladesh. The urban population expanded by 35 percent between 2001 and 2011, at a growth rate of 3 percent and in 2011, 23 percent of the national population resided in urban areas. It is estimated that by 2050, more than half of the country's population will reside in urban areas (Govindaraj et al., 2018).

The urban healthcare system in Bangladesh lacks effective coordination among the ministries where most regulations are weak and outdated along with limited enforcement. The monitoring and evaluation of health providers is incomplete (Govindaraj et al., 2018).

Table 1.6: An overview of the healthcare system in Dhaka (Adapted from "Health Care in Dhaka")

Component of health care surveyed	Satisfaction %	Level of Satisfaction
Skill and competency of medical staff	43.83	Moderate
Speed in completing examination and reports	44.55	Moderate
Equipment for modern diagnosis and treatment	52.27	Moderate
Accuracy and completeness in filling out reports	43.35	Moderate
Friendliness and courtesy of the staff	35.06	Low
Satisfaction with responsiveness (waitings) in medical institutions	27.63	Low
Satisfaction with cost	35.58	Low
Convenience of location	50.33	Moderate

According to The Centre for Equity and Health System at ICDDR,B, there is an inappropriate distribution of healthcare services in Dhaka city, only 1% of the healthcare is provided in public

sectors and 99% is provided by Private sectors. Amongst 12,809 health facilities in Dhaka, 94% belong to private sectors ("99% healthcare service in Dhaka City is provided by private sectors", 2015)

Since the healthcare policies are mostly focusing on the rural areas, the urban poor are unable to receive the facilities. In 2014, there were 14,000 slums in Bangladesh (Govindaraj et al., 2018). This number is definitely rising due to more and more village people coming to urban cities, like Dhaka in recent years. There isn't enough financing and the options are limited for raising finances for healthcare services and public health initiatives (Govindaraj et al., 2018).

1.2.2 Healthcare access in villages of Bangladesh

Healthcare services in the villages of Bangladesh are still very poor. Almost 80% people of Bangladesh live in rural areas, where fake doctors and traditional healers are very commonly seen, who are actually prescribing irrational medicines, antibiotics, like the newest regiments, like ceftriaxone or meropenem every now and then without knowing the consequences it may cause (Chowdhury, 2017). There are hospitals available in district levels. These hospitals are usually termed secondary care hospitals since these have fewer specialty care facilities unlike the medical college hospitals in cities (Islam & Biswas, 2014).

Shortage of necessary equipment, especially at the Uazila Health Complexes and district hospitals is a common phenomenon in this country, not to mention 65% of ambulances are non-functional (Islam & Biswas, 2014). Since the past 45 years, the health and nutrition policies and programs have largely emphasized on rural health services in the villages of Bangladesh (The World Bank, 2018).

Since 2009 Bangladesh government has taken a massive effort to establish Community Clinics at the village level availing 1 Community Clinic for every 6,000 population to bring services to the doorsteps of the people at large (Islam & Biswas, 2014). Out of 64 districts, 59 have a hospital with secondary care, which includes infectious disease hospitals, tuberculosis hospitals, and leprosy hospitals (Islam & Biswas, 2014).

1.2.3 Development in health sectors

The number of trained healthcare providers has increased in Bangladesh in recent years. Bangladesh government introduced a health and population program in 1998 integrating essential package of health services. The government and development partners funded for this program. This was followed by an integrated health, nutrition, and population program and a similarly-focused follow-on program (Evaluation, 2016)

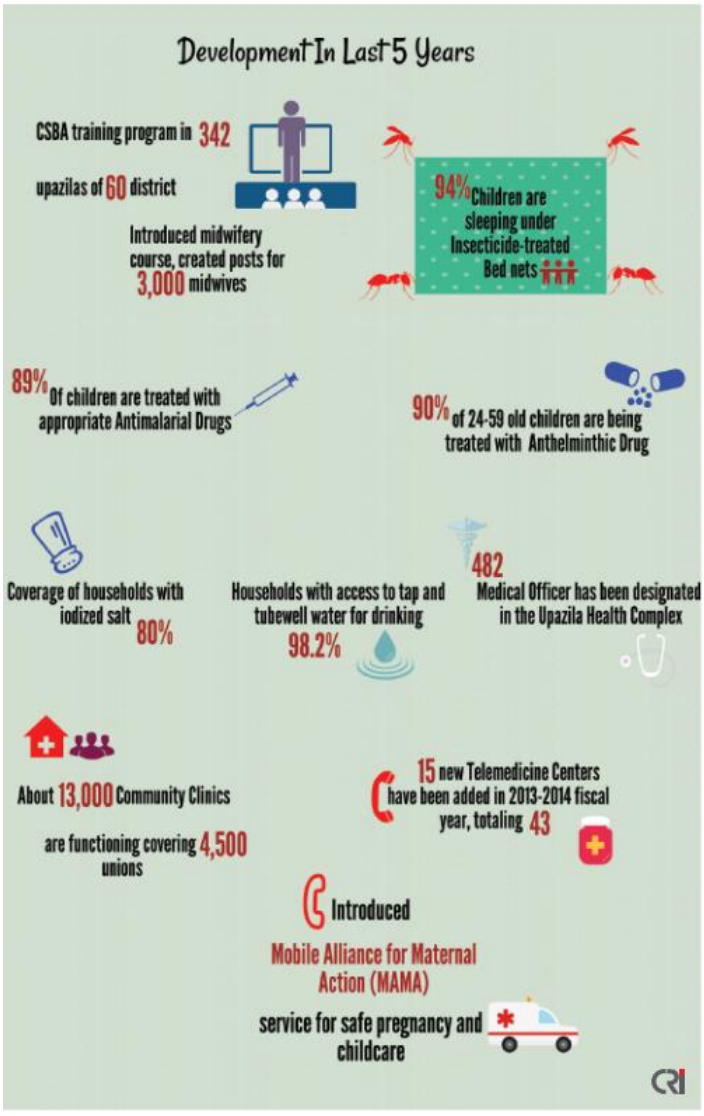

Figure1.4: Developments in health sectors (Adapted from CRI, 2015)

A lot of projects have been planned since the independence to support the healthcare system of Bangladesh. It is a matter of pride that Bangladesh has surpassed many other south Asian countries in terms of achieving health related Millennium Development Goals (MDGs) (Islam and Biswas, 2014). Bangladesh has the top ranking position amongst the countries that provide free services within community level hospitals for poor and underprivileged people (CRI, 2015). New medical college hospitals have been published in regional areas covering several districts (Islam and Biswas, 2014).

1.2.4 Drug policies in Bangladesh

Bangladesh government first proposed the National Drug Policy in 1982. It ensures safe, effective, good quality drugs. Before almost 80% medicines were imported. Although more than 97% medicines are produced in Bangladesh. The National Drug Policy follows a 'Code of Pharmaceutical Marketing Practices' to prevent false, misleading information (National Drug Policy, 2016).

In spite of all these improvements made through drug policies, there still are some lackings. Some antibiotics are sold at varying prices. Many physicians suggest medicines due to their personal interest and promotional activities of many pharmaceutical companies, which is not only unethical, but illegal as well (Chowdhury et al., 2006)
More regulations must be imposed the communication of pharmaceutical companies (icddr,b, 2014)

1.2.5 Village doctors in Bangladesh

Bangladesh is a predominantly rural country with 70% of the population living in rural areas (Alamgir et al., 2013). In comparison to the population in villages, there is a huge scarcity of trained doctors in the villages of Bangladesh. In villages, these are a lot of doctors who are informal community based healthcare providers, not trained medically (icddr,b, 2014).

According to a recent Bangladesh Demographic Health Survey, there are less qualified doctors in village areas with almost 74% of MBBS doctors working in urban areas (Chaity, 2017). Most doctors don't prefer working in rural areas because they don't want to risk their career opportunities and higher studies (Chaity, 2017).

Whilst they are committed to their community patients, there have been concerns that harmful medical practices were carried out by village doctors and other informal providers. Sadly, there has been little research on the practices of village doctors in Bangladesh although it is very important. Two studies published by Dr Mohammad Iqbal, Dr Abbas Bhuiya and other colleagues from icddr,b's Centre of Equity and Health Systems examine the relationship has shown that the medicines village doctors prescribe are strongly influenced by medical representatives, since they don't get opportunities to learn about new medicines; and it urges the need to educate and train village doctors properly (icddr,b, 2014).

1.2.6 Limitations of the healthcare system

In a country of 164.7 million people, there are only 536 public hospitals with 37,387 beds providing inpatient care services. Unavailability of drugs, medical supplies is a common problem throughout Bangladesh probably resulting from lack of effective supply chain management, lack of funds or timely release of available funds to pay for supplies (Islam & Biswas, 2014). The health system of this country is in a double burden of diseases, low service coverage, and a lack of effective financial risk protection mechanism. The review of Bangladesh's Demographic and Health Survey 2014 reveals favouritism in most of the health indicators in terms of economic status, level of education, gender, urban vs. rural area. Also the overall healthcare expenditure is increasing which will result in need of huge amount of funding (joarder, Chaudhury and Mannan, 2019).

There is still a fine line between the services provided to privileged and underprivileged people. Moreover, brokers are selling essential drugs and family planning commodities meant for free distribution to patients and users to the private sector vendors (Islam & Biswas, 2014). There are some villages in Bangladesh where even on this date; people have to get to far places or to the towns to get healthcare services. There is still a huge lack of community empowerment in Bangladesh.

Part 2
Materials and Methods

2. Materials and Methods

Data were collected through a survey carried out to study and compare the antibiotics prescribed for fever and diseases associated with fever between Dhaka city and different villages. The study was carried out from May 2019 to August 2019 among 150 prescriptions where 75 were collected from different village and the other 75 from Dhaka city.

2.1 Study area and study period

The selection of area was very important for this survey. So, prescriptions were collected from various places all over Bangladesh for getting a valid result. For preciseness, the prescriptions collected from different areas of the capital city of Bangladesh, Dhaka as Dhaka is known for having the best healthcare facilities in Bangladesh.

Table 2.1: Number of prescriptions by Area in Dhaka city

Area	Number of Prescriptions
Mirpur	15
Eskaton	7
Segunbagicha	2
Mohammadpur	3
Shahbagh	5
Maniknagar	1
Dhaka Cantonment	3
Pallabi	3
Dhanmondi	7
Rampura	2
Goran	2
Motijheel	7
Khilgaon	5
Kakrail	4
Banasree	3

Uttara	5
Panthapath	1

For better comparison, village prescriptions were collected from different villages of different districts all over Bangladesh.

Table 2.2: Number of prescriptions by Districts

Districts	Number of Prescriptions
Madaripur	6
Brahmanbaria	4
Chittagong	12
Mymensingh	2
Faridpur	4
Noakhali	7
Comilla	7
Narsingdi	3
Feni	8
Jamalpur	1
Jessore	1
Kishoreganj	1
Rangpur	4
Sunamganj	5
Tangail	5
Shariatpur	2
Manikganj	3

The study was held for four months starting from May 2019 until August 2019. Within May and August, the season in Bangladesh turns from a humid summer towards a rainy monsoon season (Weatheronline.co.uk). This season comes with seasonal diseases like fever, cough, diarrhea etc. due to fluctuating temperatures (Akter, 2016).

2.2 Data collection

Data was collected through collection of prescriptions from different villages and sub districts all over Bangladesh. Collected prescriptions were analyzed searching for antibiotics that were prescribed for fever or cough/tonsillitis/sinusitis/RTI/diarrhea in association with fever. The classes of antibiotics and their usage were also observed.

Secondary sources like newspaper articles; books, official records, websites, research papers were used for any additional data required for the study.

Part 3

Results

and

Discussion

3. Results and Discussion

The survey was designed mainly to compare between the antibiotics that village doctors/ general practitioners suggest to those that are suggested by doctors in Dhaka city. Antibiotics suggested for fever and other diseases associated with fever, like RTI, tonsillitis, sinusitis, diarrhea etc. were used for comparison, which are one of the most common diseases in Bangladesh.

3.1 Respondents

In the study a total of 150 prescriptions were collected from people all over Bangladesh. Amongst the 75 villagers from whom the prescriptions were collected, 40 (53%) were male and 35 (47%) was female, including all ages.

Table 3.1: Percentage on basis on gender in villages

Gender	No. of Participants	Percentage
Male	40	53%
Female	35	47%

Out of 75 prescriptions collected from Dhaka city, 36 (48%) were from males and 39 (52%) were from females.

Table 3.2: Percentage on basis on gender in Dhaka

Gender	No. of Participants	Percentage
Male	36	48%
Female	39	52%

3.2 Prescription Analysis

The prescriptions were classified depending on the diseases. Only the prescriptions containing antibiotics were collected. Fever and other diseases that are correlated were taken into consideration. In the prescriptions collected from villages, fever was the most common (27%).

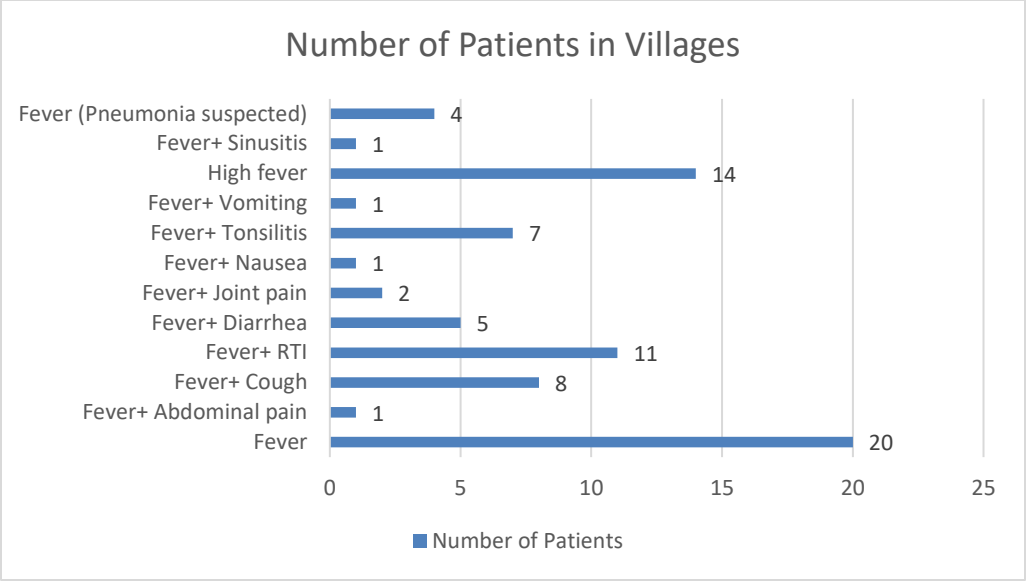

Figure 3.1: Number of patients in villages by symptoms

Prescriptions that were collected from Dhaka city also contained high amount of patients with fever (almost 25%).

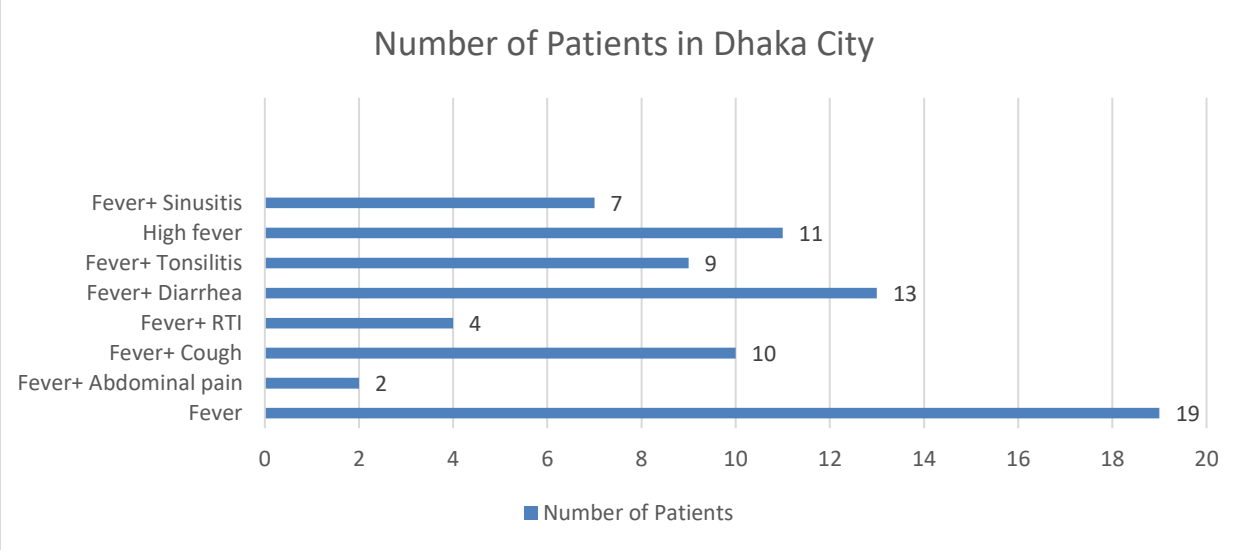

Figure 3.2: Number of patients in Dhaka city by symptoms

Comparing prescriptions collected from the city to the village prescriptions, the city people seemed to visit doctors mostly when there are other complications not only fever, probably because a lot of people self-medicate when they don't face complications.

3.2.1 Diagnosis of diseases

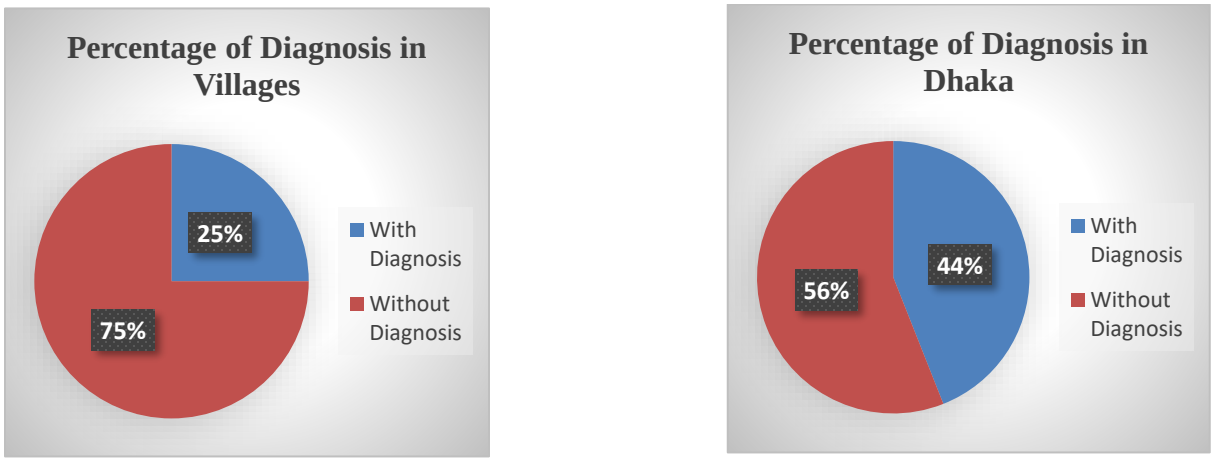

Figure 3.3: Percentage of diagnosis in villages and in Dhaka city

A microbial sensitivity test can determine which antimicrobial agent is required against a pathogen. It is very important to have a diagnosis before suggesting any kind of antibiotic- broad or narrow spectrum. It was found that 75% of antibiotics were suggested without any kind of diagnosis in villages and only 25% were advised for diagnosis. On the contrary, 44% prescriptions collected from Dhaka included a diagnosis, 56% didn't. Antibiotics are supposed to be suggested when there is a bacterial infection in the body otherwise it can harm one's health. Although the diagnosis rate is higher in Dhaka city, it is still not good enough since more than half are still prescribed without diagnosis. The condition in villages is worse since only in one fourth of the cases, a diagnosis was suggested.

3.2.2 Antibiotic classes used in Villages:

In the present study it was found that antibiotics like Cephalosporins, quinolones, macrolides, penicillins and sulfonamides were mostly used for the treatment of fever in villages. Amongst these, 3rd generation Cephalosporins were used mostly in villages (28%) followed by Macrolides

(almost 25%), 2nd generation Cephalosporins (almost 23%), Quinolones (almost 13%) and Penicillins (8%). 1st generation Cephalosporins and Sulfonamides were found to be used in the least amount of cases, both nearly 1%.

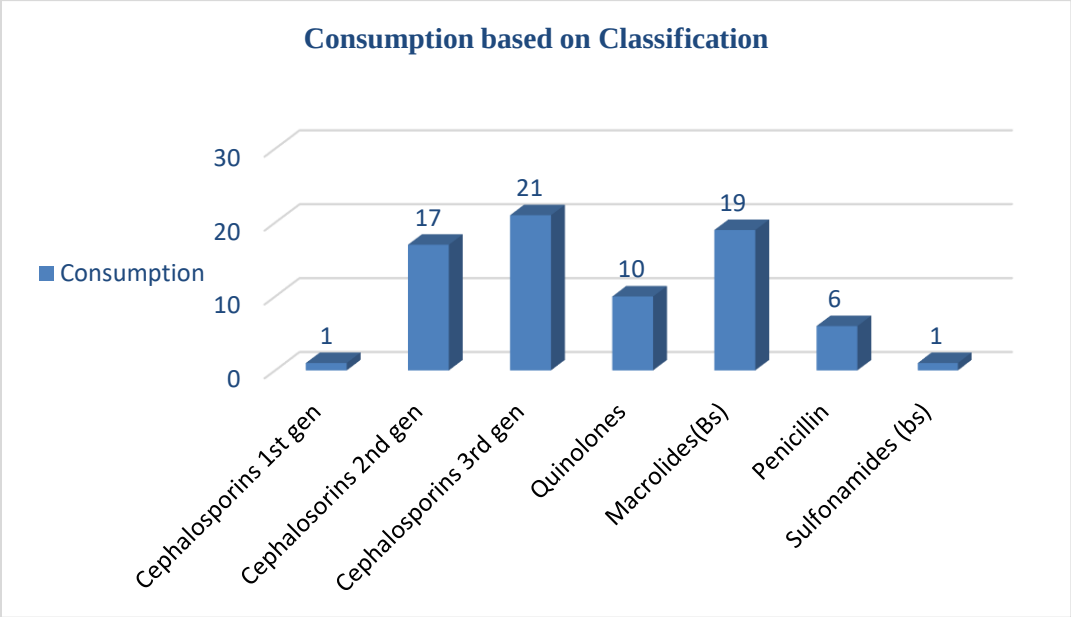

Figure3.4: Classes of antibiotic drugs that were suggested for fever in villages

Amongst these prescribed 3rd generation cephalosporins, Cefixime Trihydrates were suggested in 57% of cases, the highest amount of times. Third generation cephalosporins are more active against gram negative bacteria compared to the 1st and 2nd generations but less active against gram positive bacteria compared to previous generations (Seladi-Schulman, 2019). Following, Macrolides were also seen to be quite common. Sulfonamide was suggested in one of the cases. Although it has effectiveness against both gram positive and negative bacteria, it's resistance is known to be widespread (Anderson, 2019).

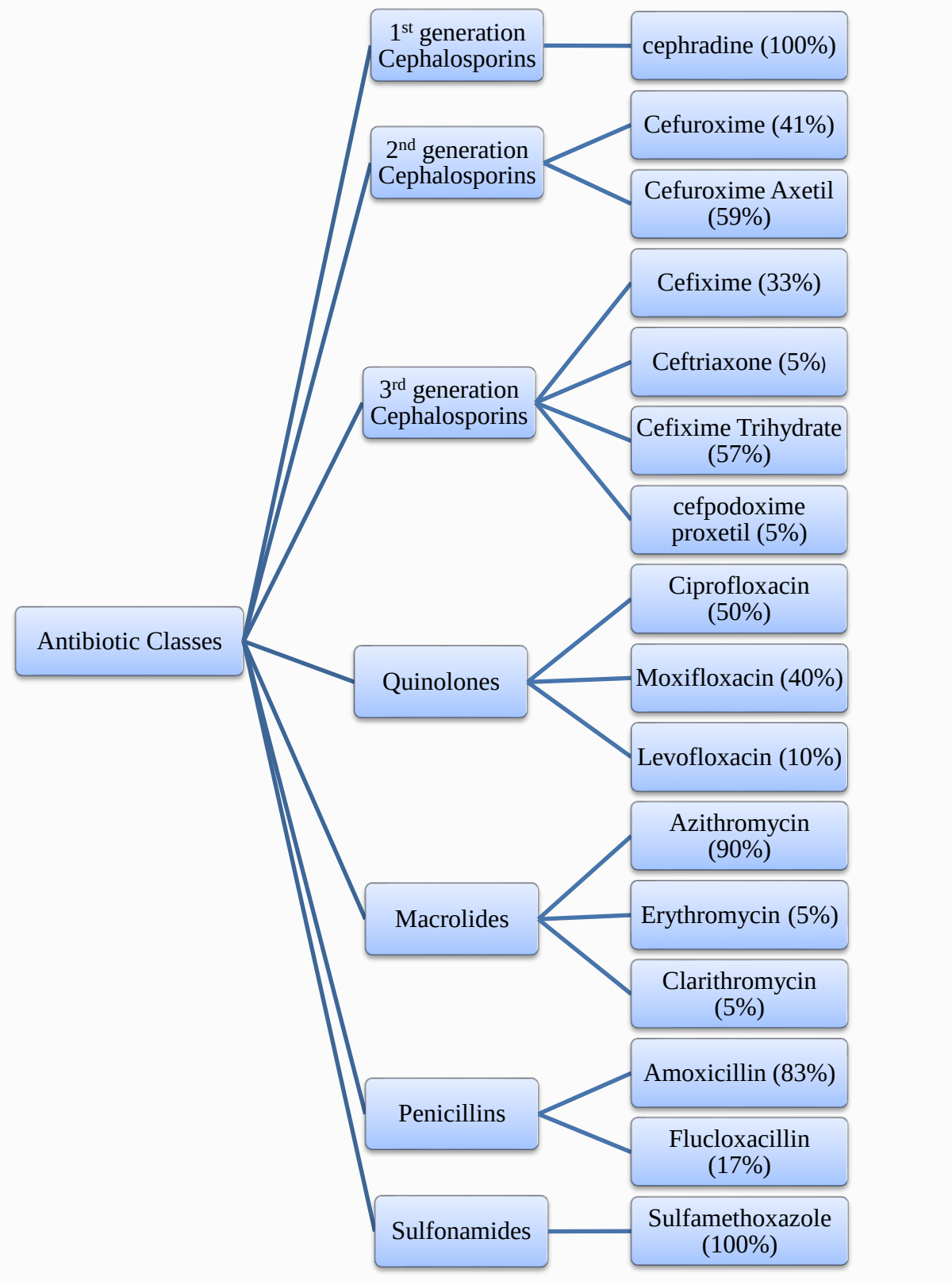

Figure3. 5: Percentages of antibiotics that were prescribed in different villages listed by their generic names

3.2.3 Antibiotic classes used in Dhaka

In Dhaka city the antibiotics found to be used for fever are Penicillin, Macrolides, Quinolones and Cephalosporins. From these, prescriptions showed that Quinolones were used in the highest amount (almost 29%) followed by Penicillins and 3rd generation cephalosporins (20%), then 2nd generation cephalosporins (almost 15%) and Macrolides (13%). 1st generation Cephalosporins and Ansamycins were found to be used in the least amount of cases here as well, nearly 1%.

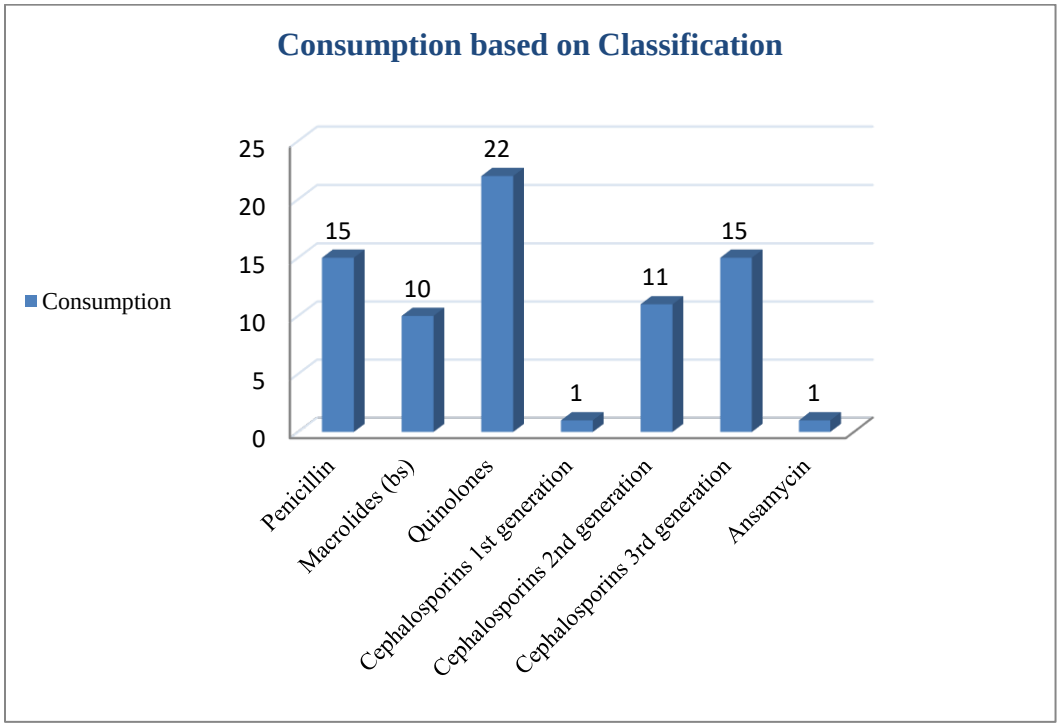

Figure3.6: Classes of antibiotic drugs that were suggested for fever in Dhaka city

All the Quinolones that were suggested are Fluoroquinolones. Amongst Quinolones, Ciprofloxacin was prescribed mostly, 41% of the time. The good thing is that Quinolones are broad spectrum antibiotics, which are effective against a wide range of bacteria. But quinolones come with a lot of side effects like arrhythmia, tendon ruptures, changes in blood sugar levels etc. (Pavliv & Booker, 2019). There have been warnings from FDA (Food and Drug Administration) against the use of Quinolones due to these damaging side effects (Anderson, 2019).

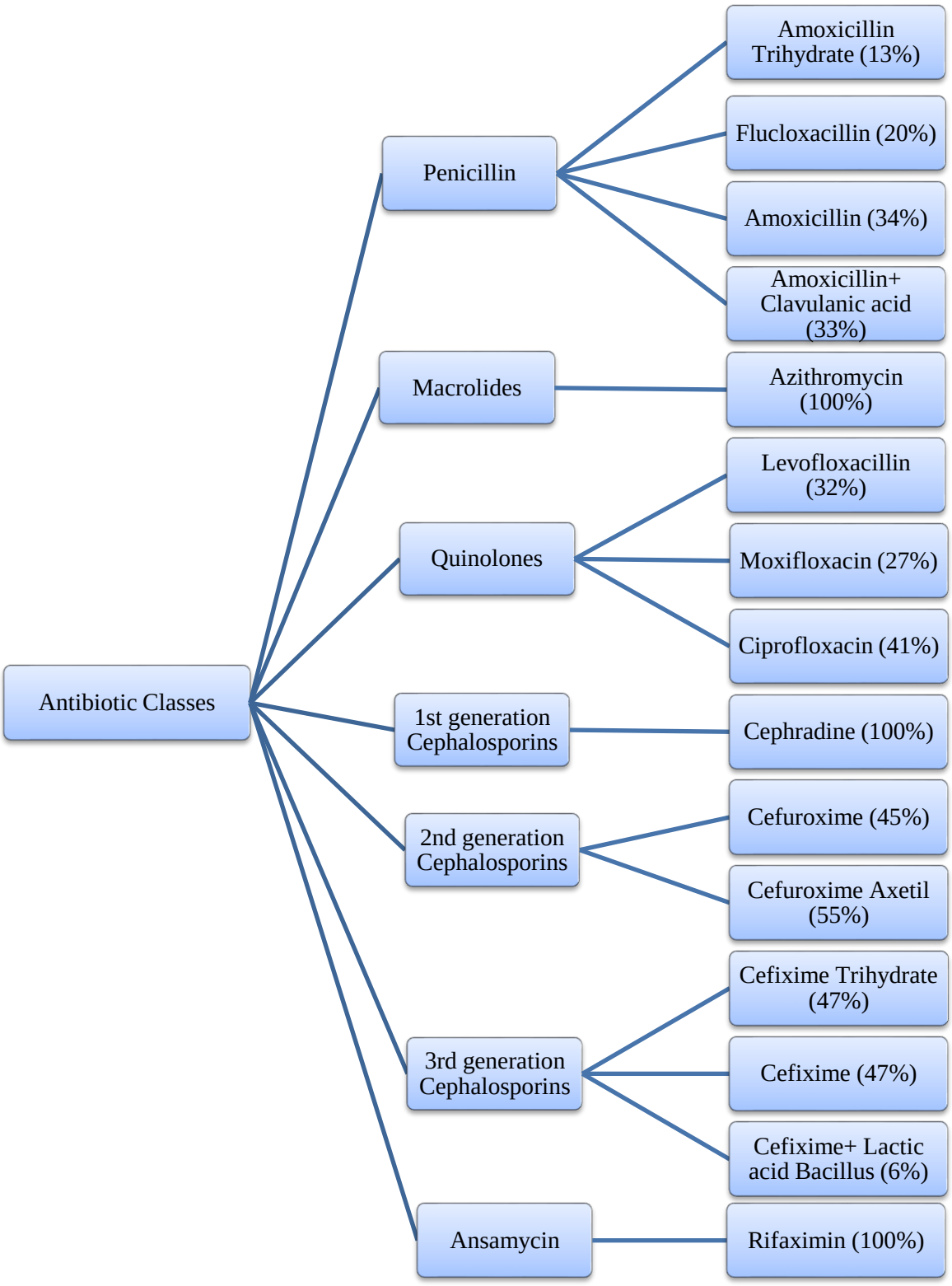

Figure3.7: Percentages of antibiotics that were prescribed in Dhaka city listed by their generic names

3.3 Antibiotics by their mechanism of action

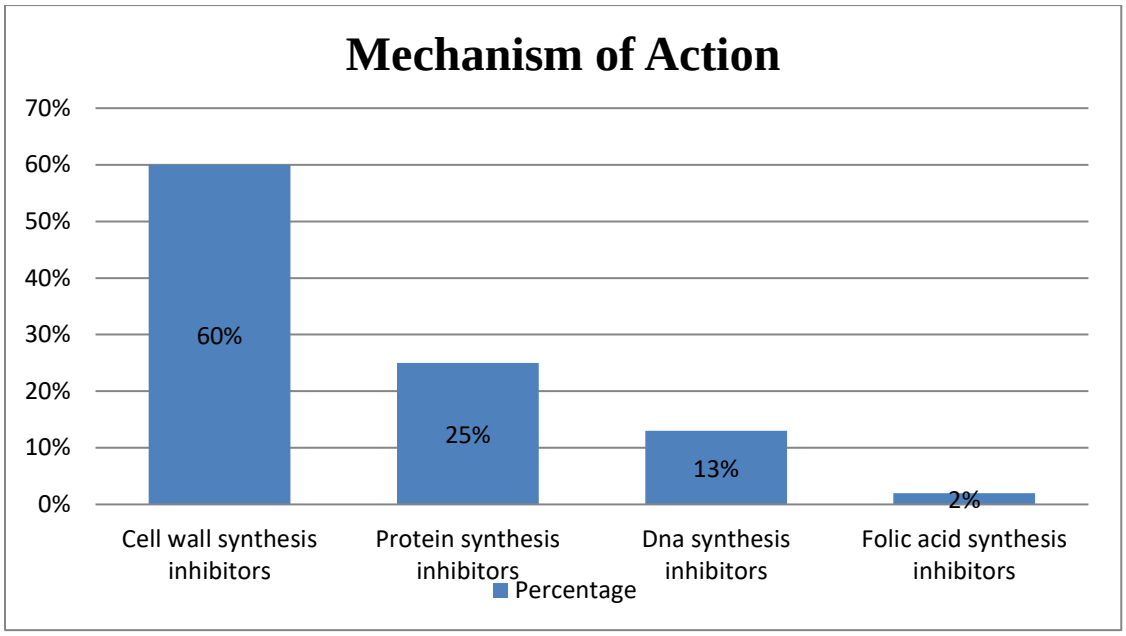

Figure 3.8: Percentage of antibiotics from villages based on the Mechanism of action

In both cases, cell wall synthesis inhibitors were used which are the most common classes of antibiotics.

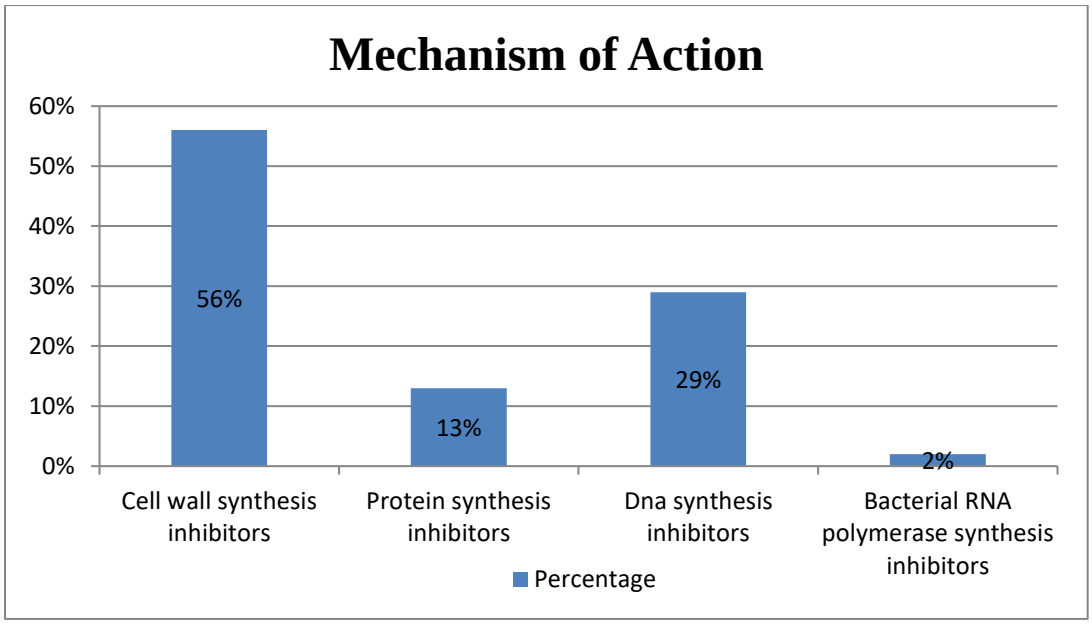

Figure3.9: Percentage of antibiotics from Dhaka city based on the Mechanism of action

3.4 Comparison of Antibiotics

From analyzing the prescriptions, it was found that there is a difference between the prescribing patterns in Dhaka city and Villages. Compared to villages, there was a higher rate of microbial diagnosis for infection, which is a must if the cause of infection is unknown.

The findings from this study showed that in the city, maximum respondents suffered from fever, diarrhea, sinusitis, tonsillitis and in villages, 45% of patients were suffering from fever only, with no other infections. This leads to an assumption that most people in cities visit doctors when their fever is associated with other diseases. The study revealed that Cephalosporins, Quinolones, Penicillins and Macrolides were common antimicrobial agents prescribed against fever and sinusitis, tonsillitis, RTI, cough when fever was related.

A total of 150 prescriptions were examined in this study collected from rural areas and Dhaka city. In both cases, antibiotics were suggested on the basis of presumptive diagnosis mostly. In rural prescriptions, in 75% of cases, medicines were suggested without any diagnosis and in Dhaka city, 56% prescriptions contained no diagnosis. Without specific diagnosis, it is hard to identify which bacterial species might have caused the infection. So, in this case, broad spectrum antibiotics were their choice in spite of all of its side effects.

Prescriptions found in Dhaka used higher amount of Quinolones, which is a broad spectrum antibiotic. Then Penicillins and Cephalosporins, which are also broad spectrum antibiotics, had a higher percentage. 3rd generation Cephalosporins came out to be the most frequently prescribed antibiotics by doctors in villages. These are also broad spectrum antibiotics. 2nd and 3rd generation Cephalosporins are active against gram negative bacteria whereas 1st generation cephalosporins are active against gram positive. Though these are broad spectrum, cephalosporins don't have as much side effects compared to other ones (Fookes, 2018). Macrolides were also suggested in a lot of cases. Macrolides are bacteriostatic, which means they only resist the growth of bacteria, doesn't kill it (Anderson, 2019). People with serious infections should be suggested with bactericidal antibiotics since those can kill the bacteria. But bacteriostatic antibiotics stop the growth and let the body's immune system to get rid of it.

Azithromycin was the most frequently used antibiotic, in 23% of cases in Dhaka city and in rural areas as well (13%). A wider variety of antibiotics were used in rural areas compared to Dhaka

city. Azithromycin was the only Macrolide that was used in city prescriptions whereas rural prescriptions also included Erythromycins and Clarithromycins. A lot of bacteria are more susceptible to Azithromycins compared to the other two classes and that is why doctors suggest it instead of the other ones. Amoxicillin, in spite of being a comparatively older antibiotic, is still used in both Dhaka city (34%) and in villages (83%).

The study showed that the care provided by village doctors is quite questionable since they are prescribing antibiotics for mostly fever, without any diagnosis of whether it is a bacterial infection or not. The present investigation showed that a lot of rural prescriptions were prescribed without any fees. Whereas city doctors are prescribing antibiotics mostly when other infections like tonsillitis, diarrhea etc. are related. They have also provided diagnosis for high fever (103°/104°) in most cases. In most cases, antibiotics were used appropriately in respect of duration.

A lot of prescriptions in villages showed the same pattern of antibiotics suggested. Because of the dishonest policies of some pharmaceutical companies, rural practitioners prescribe antibiotics that they are suggested by the medical promotion officers. This scenery is seen in city hospitals as well but the doctors are much more efficient in terms of knowledge.

Part 4

Conclusion

4. Conclusion

The objective of this study was to see whether there was any difference in antibiotic prescribing patterns between Dhaka city and other villages. Significant amount of differences were visible in the antibiotics suggested and in pattern of prescribing.

The present survey reported that in villages only 25% prescriptions showed suggested diagnosis whereas the number is a little higher in Dhaka, 44%. In both cases broad spectrum antibiotics were used in higher amounts. Since there are many specific antibiotics that can be used after a diagnosis, broad spectrum antibiotics might not be necessary in this case since it also comes with a lot of risks. Without any culture sensitivity test, broad spectrum antibiotics were mostly used since they are supposed to work against a wide range of bacteria. Fever can be caused by viruses as well, so it is very important to have a diagnosis before suggesting any antibiotics. Antibiotics were even suggested for certain cases where they were not even necessary like cough, viral fever etc. Antibiotics have side effects like diarrhea, nausea and antibiotics can also interact with other medicines. Due to this indiscriminate misuse of antibiotics, antibiotic resistance is growing day by day (Norton, 2018). A lot of antibiotics have become out of date because of antibiotic resistance. Taking wrong antibiotics can cause severe damage to the body and resistance to antibiotics can lead to death.

3rd generation Cephalosporins were the highest used antibiotics in rural areas (28%) and Quinolones were used in higher amount in Dhaka city (29%). These are broad spectrum antibiotics. 3rd generation antibiotics were used in higher amounts nowadays because most bacteria have developed resistance to first and second generation. Still it is very important to check whether a person can be cured with first/ second generation of antibiotics or not. 1st generation antibiotics are mostly out of market these days, but the second generation antibiotics can be prescribed since these both are active against gram negative bacteria. Using antibiotics of such wider range will result in multidrug resistance bacteria.

With diagnosis doctors can learn about the characteristics of bacteria and can prescribe accordingly. Diagnosis of diseases might not always be possible in the context of Bangladesh

due to the high number of patients and limitations in the laboratories. But through diagnosis, narrow spectrum antibiotics can also be suggested for a specific class of bacteria. Doctors and village practitioners should prescribe antibiotics only when a patient needs them.

Village doctors have quite a significant role in providing healthcare services to a huge proportion of people in Bangladesh. In most rural areas, informal healthcare providers write prescriptions. It is very important to educate them properly to ensure a standard quality of healthcare services. Technologies can be used to teach them what to prescribe and when for common illnesses. Supervision and governance must be provided to these physicians. While collecting prescriptions, it was seen that some village practitioners were not willing to share the medicines they prescribe since they were scared to get caught. This somehow shows the lack of their knowledge on the use of correct medications

Since the paper only included 150 prescriptions, it is very important to analyze more prescriptions to get a better understanding of the situation. It is a very important issue now, antibiotic resistance is getting higher. So, more studies should be conducted on the prescribing pattern of village doctors and city doctors. Otherwise, a huge proportion of the country's people will be affected.

It is also very important to educate the general public on the proper use and misuse of antibiotics, that if antibiotics are needed, they need to take them regularly. In Bangladesh, it is very rare for villages to have a diagnostic center. Most people are referred to hospitals in either Dhaka or other big city hospitals whenever the disease gets serious. Until then, they work without any diagnosis. So, more diagnostic centers should be established in different districts and villages and also in Dhaka city to meet the demand of the healthcare system.

It is also very important to make improvements in the healthcare system of Bangladesh. Although it has made progress in recent years, there is a big gap in the amount of facilities provided. Increasing and strengthening contribution in local levels and responsibilities must be taken by urban government officials (Govindaraj et al., 2018). Due to inadequate logistics, the system can't function properly to its full potential. There's a high need for better training initiatives and education for village doctors and other unlicensed providers if we want them to serve their communities better (icddr,b, 2014).

According to Public health specialist and Gonoshasthaya Kendra founder Dr Zafrullah Chowdhury, to lessen the pressure at public hospitals, interns should be distributed properly among Dhaka and other upazila health complexes (Chaity, 2017). Incentives must be taken to train doctors properly. They must know the importance of doing a diagnosis before prescribing an antibiotic. According to experts, medical students should keep the mindset to treat people at rural areas from the very beginning of their training for an equal distribution of service (Chaity, 2017).

Part 5

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