[Pick the date]

ANTIBIOTIC USE IN INDIA
WITH ASPECTS FROM A GENDER PERSPECTIVE

Master Thesis in Medicine| Annika Wilbe

Antibiotic use in India

-With aspects from a gender perspective

Master thesis in Medicine

By Annika Wilbe

Supervised by Dr Gunnar Jacobsson, Dr Sujith Ovallath

Institute of Biomedicine, Sahlgrenska Academy

University of Gothenburg

Programme in Medicine

Gothenburg, Sweden 2014

Table of contents

Abstract

Background. Antibiotic resistance is one of the major upcoming health concerns in modern medicine. Bacteria are becoming resistant to antimicrobial therapies at an alarming rate. It is important to understand reasons and trends for prescribing these drugs, and also to see how the tools we have, such as microbial investigations, are being used.

Objective. The aim of this study is to document how antibiotics are used in Kannur, India. To see who receives these drugs and why, and how microbial investigations are being used in the clinical work. The aim is also to see if there is any gender difference in these regards.

Method. This study was conducted at Kannur Medical College in Kerala, southern India, during 8 weeks, February to April 2014. Information regarding antibiotic treatment and microbial investigations for patients admitted to the department for neurology and medicine with hospital stay >1 night was collected from case-sheets at discharge. Patients were also asked by the nurses if they were taking any antibiotics at admission.

Results. 55% of the females and 70% of the males received antibiotic therapy during their hospitalization. 51% of all patients received a Cephalosporin, and 21% a Fluoroquinolone. 29% of the antibiotics were given by oral administration. 33% of the patients on antibiotics had a microbial culture investigated. 75% of these cultures were urine cultures. In 25% of the cultures a pathogen was found. No patients were at admission taking antibiotics without doctor's prescription, and 7% were taking with prescription.

Conclusions. Males tend to receive antibiotic treatment more frequently than females. Cephalosporins are widely used. Most antibiotics are administered IV. Microbial investigations are occasionally used. Patients did not use antibiotics without prescription, making doctor's prescription the most important factor in the antibiotic use of the patient.

Introduction

Background

Antibiotic overuse and resistance is one of the important upcoming health concerns in modern medicine. Bacteria are becoming resistant to antibiotics once sensitive to at a rapid pace. In our global society where infections can travel long distances we all depend on how the antibiotics are used [1]. Indications for antibiotic treatment, rationality in its use, availability, compliance, agricultural use, and pollution from the medical industries are pieces of a puzzle which affects us all[2, 3].

India is a country with over 1, 2 billion inhabitants. Due to reasons such as lack of clean drinking water, malnutrition, lack of improved sanitation, a large population and crowded living areas, there is a high incidence of infections[4]. This combined with socio-cultural factors makes antibiotics commonly used medicines. Studies from the years 2005-2009 showed that sales increased by 40% this period, and more than any others the Cephalosporins increased, by 60%[5].

Many studies indicate that antibiotic have a tendency to be overused and also misused. There are several suggested reasons for this, not only being the doctor's prescribing habits, but also the pressure from drug companies and patients wanting antibiotic treatment, the profit that can be made from selling antibiotics, and the public not being educated in the matter[5] [7-10]. Some studies have also shown that males tend to receive antibiotic more frequently than females.[11]

There have been several studies to measure resistance for different bacteria and antibiotics. Even though differences have been found, they show a common trend, that numbers of bacteria with acquired resistance are becoming more and more common[10, 12-15].

The development in this direction has been rapid, and is a big challenge for the healthcare sector to learn to handle, resulting in both increased costs and patient mortality [16, 17]. Pharmaceutical industry is reluctant to spend on research and development of newer antibiotics, which makes the situation worse [18, 19]. We hardly have any new molecules after 2000[20].

Setting

This study took place at Kannur Medical College which is a private medical college and teaching hospital located in Kannur district in northern Kerala, India. The hospital has 700 beds. The ward of Medicine and Neurology is separated into male, female and private room wards. Beds for these specialties are distributed over 7 locations on 4 different floors.

The hospital patient payment system is divided into three parts called TRUST/CAMP/Private rooms. The patients in private rooms cover the whole cost for their hospitalization. In the TRUST system the patients partially pay. If the patient cannot afford these costs he or she is transferred to the CAMP system where the hospital bed and doctor's cost is free of charge. In this system patients can only be treated with certain predetermined drugs but is receiving medicine free of charge. This system is local and for this hospital only.

The local language spoken is Malayalam, but all students and most of the staff speak English as it is the teaching language.

Education and literacy is high in this region, the highest in all of India with literacy being 96%.The population is one out of two regions in India where the population has more females than males.

Aim

The aim of this study is to document how antibiotics are used in Kannur, Kerala, India.

To see why, in what doses, and to whom antimicrobial therapy is given, to better understand the reasons for prescribing these drugs and see if there is any role for antibiotic overuse.

The aim is also to see if microbial cultures are being investigated, which pathogens are found, what antibiotics they are resistant to, and how these cultures are being used in the clinical work.

Furthermore, the aim is to analyze this by gender to see if there are any differences between men and women in the above mentioned aims.

This will be in regard to both community-acquired and nosocomial infections.

Material and Methods

This cohort study was performed at the department of medicine and neurology under the following criteria:

Inclusion criteria:

- Inpatients >16 years age who is admitted to the department of medicine or neurology during the 8 weeks of the study, and stays for >1 night.

Exclusion criteria:

- Patients <16 years of age.
- Patients who did not finish the recommended antimicrobial treatment, against medical advice.

If a patient was admitted more than once during the study period, he or she is regarded as a new patient at each admission.

Data was collected Monday to Saturday during 8 weeks, February to April 2014.

Patient data was collected at the day of discharge. The data was mainly collected from the case-sheets, and any uncertainties were discussed with the junior doctors or nurses posted at the ward. There is no computerized system, and all information in the case-sheets regarding drugs is hand-written. Microbial culture reports are computer written.

Data was collected regarding gender, age, days of hospitalization, if the patient was taking any antibiotics at admission (and if so, by doctor's prescription or not), information regarding antibiotic treatment (indication for treatment, drugs used, administrations route, daily doses and number of administrations, days of treatment), other diagnostic methods used (urine microscopy, serology, blood routine, x-ray), if a microbial culture was reported, and if so information regarding if the culture was sent before antibiotic therapy was initiated, type of investigation taken, if a pathogen was isolated in the lab, and the culture sensitivity report.

The question on whether patient was taking any antibiotics at admission was asked by the nurses in Malayalam.

If the patient had been discharged and left the hospital at the time of data collecting, the information regarding microbial investigations and examinations made is lost, and the statistics on these patients will only be reported as part of the antibiotics statistics and general data, but excluded in the analyzes for frequencies of cultures sent and examinations made. Number of patients included for the antibiotic statistics and general data was 131, number of patients included for frequencies of cultures analyzed was 118, and number of cultures analyzed was 24.

Information on antibiotics and generic substances were taken from 2013 CIMS (Current Index of Medical Specialties) India.

When the term “antibiotics” is used, it is referred to as both antibacterials and antimycobacterials.

The section of microbiology has methods for analyzing aerobic cultures, but cannot grow anaerobic cultures at the moment. They use standardized methods to decide MIC on agar plate.

Ethics

The Helsinki declaration was taken in consideration when conducting this study. All data was collected with the inpatient number as identification of the patient. The patient data will therefore be untraceable outside of the hospital. The information was kept in a closed non-see-through file at all times after collection. The files were then kept in my home so no personal information could be lost. All results are presented so the individual patient cannot be identified.

Approval for this study was granted by the Kannur medical college hospital ethical committee.

Statistical Methods

Statistics were analyzed in IBM SPSS statistics 22 using descriptive statistics. Statistical significance was calculated by using Chi-square analyze with a p-value of <0.05. Diagrams were made in EXEL and SPSS. Files were split when analyzed by gender. The data was reviewed a second time to minimize the chance of errors.

Results

General Data

A total of 131 patients were included in this study for the general data and antibiotic use. 13 of these were excluded when analyzing microbial investigation. 51% were female and 49% were male. Age varied from 16 to 85 years with a mean age of 58.9 years. Mean age for women was 59.6 and 58.4 for men. Days of hospitalization varied from 2 to 37 days with a mean of 6.8. The mean days of hospitalization were 6.3 for women and 7.3 for men.

The most common main diagnosis were chronic pulmonary disease (17%), diabetes mellitus (16%), infection (all types) (14%), old cerebrovascular accident (8%), new cerebrovascular accident (8%), musculoskeletal (7%), and movement disorder (6%).

Most common main diagnoses by gender can be found in figure 1 and was within the female group diabetes mellitus (21%), infection (16%), musculoskeletal (10%), chronic pulmonary disease (9%) and old cerebrovascular accident (9%). For males the most common diagnoses were chronic pulmonary disease (25%), diabetes mellitus (11%), infection (11%), movement disorder (9%), and new cerebrovascular accident (9%).

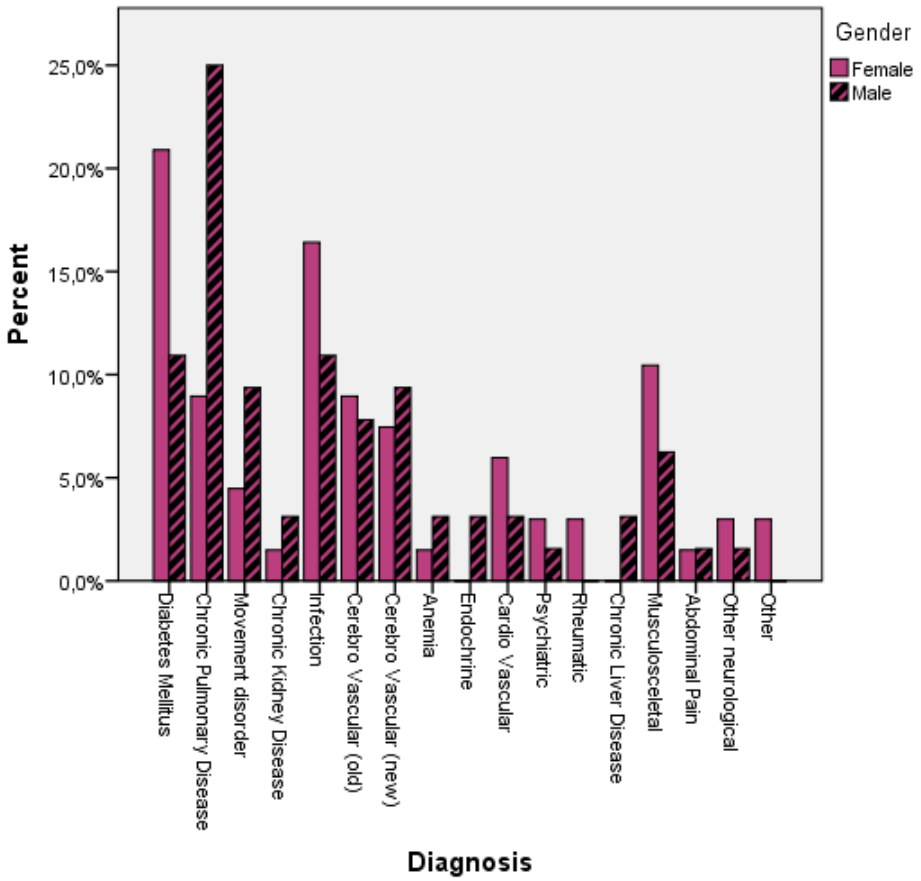

Figure 1. **Showing the main diagnosis for the 131 patients included in the study. The result is shown in percentage of the females respectively males with a specific diagnosis, as percentage of each gender. Most common main diagnosis for males was chronic pulmonary disease, and for females diabetes mellitus.**

Most common diagnostic infectious examinations used (for all admitted patients) were blood routine (61%), urine microscopy (49%), microbial Investigation (20%), and serology (6%).

Antibiotics

Number of patients receiving antibiotics was 63% of all patients admitted to the department of Neurology or Medicine at the time of this study. Analyzed by gender, 55% of the females and 70% of the males received antibiotics during their hospitalization. This was not shown statistically significant with p= 0.074.

Average number of antibiotic drugs per admitted patient was 1.1 for females and 1.2 for males. Average number per patients who received antibiotics was 1.9 (females 2 and males 1.8). Number of drugs ranged between 0-7. Males were most commonly prescribed one antibiotic, and females not prescribed any, as shown in figure 2.

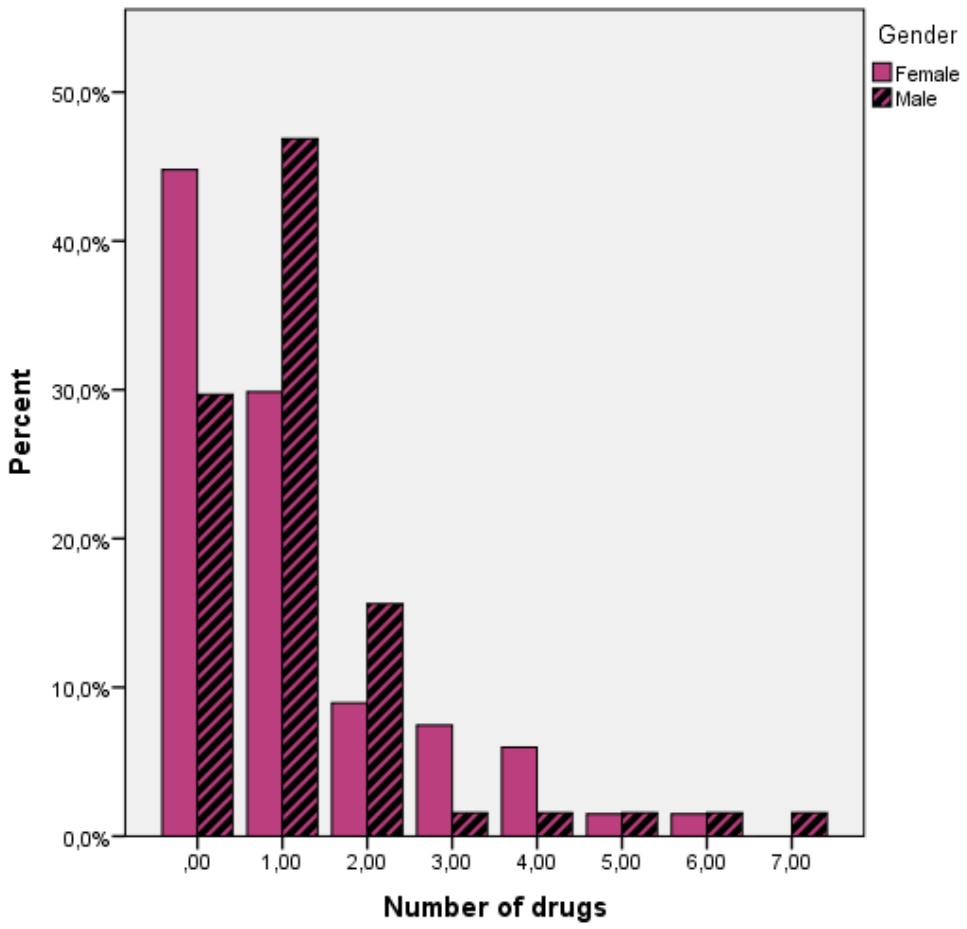

Figure 2. **Number of antibiotic prescriptions made, here shown in percentage of females receiving a certain number of drugs, respectively males. Within the male group it was most common to receive one antibiotic, and in the female group it was most common to not receive any antibiotics. Number of drugs is calculated as number of prescriptions made, combined antibiotics will in this diagram be seen as one drug.**

Mean days of antibiotic treatment were 4.7 days, and days of treatment ranged between 1-12 days per drug.

Most frequently prescribed antibiotics by generic were Ceftriaxone which 29% of the prescriptions were made for. This being followed by Cefixime 8%, Ciprofloxacin 7%, Ofloxacin 7%, Azithromycin 6%, and Levofloxacin 6%.

Perhaps a bit more interesting is to analyze by Antibiotic group. Most frequent antibiotics based on group were the Cephalosporins, which 51% of all the patients admitted to Neurology or Medicine received. This was followed by the Fluoroquinolones which 21% received. Third most common was Penicillin with 12 %. The Azalides (Macrolide) was received by 7%, Nitroimidazole 4%, Tetracycline 2% and Aminiglycocides by 2%. 0.8% each was treated with the groups Carbapenem, Fucidic acid, Folic acid antagonist, Oxazolidinone, Nitrofurantoin and Monobactam (see figure 3).

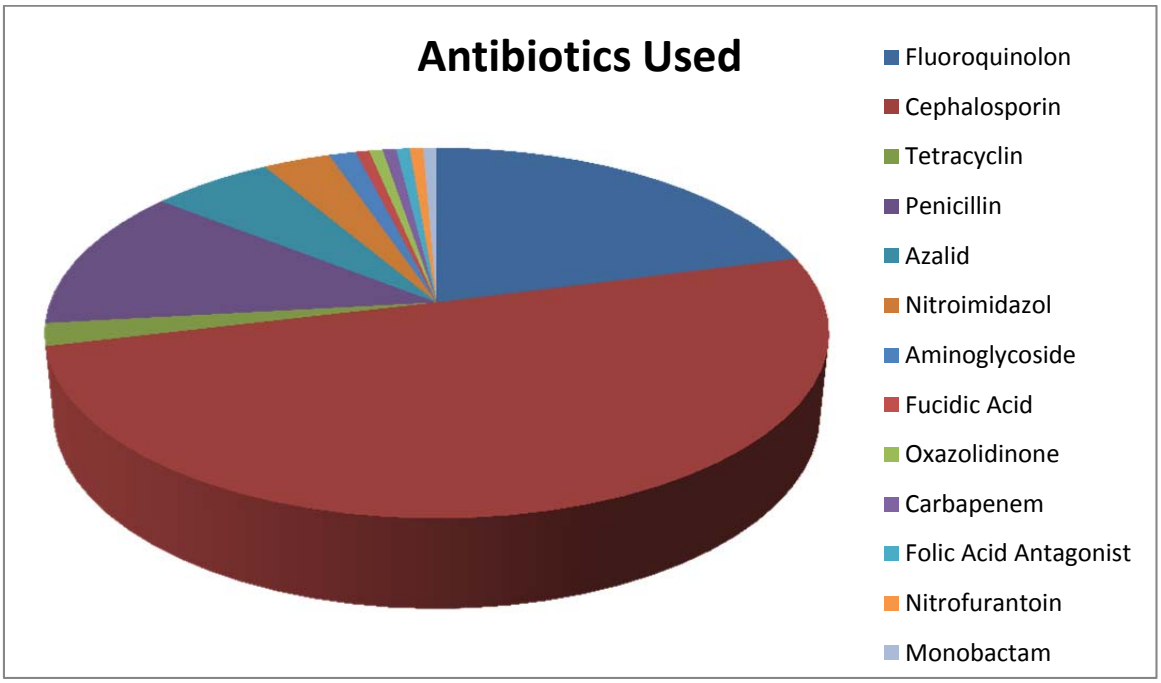

Figure 3. **Showing the antibiotic prescriptions made by antibiotic group, in percentage of the total amount of antibiotic prescriptions made during the study period. Cephalosporins were the most commonly used drugs, followed by the Fluoroquinolones.**

Of the total amount of prescriptions made during this period, 53% were for males, and 47% for females.

The most common daily doses (in percent of all prescriptions made for this brand name) for the most commonly prescribed drugs were Monocef (Ceftriaxone) 1g/day (52%) , Livicef (Ceftriaxone) 2g/day (64%), Cifran (Ciprofloxacin) 400 mg/day (60%), Taxim (Cefotaxim) 3g/day (50%), and Ceftas (Cefixime) 400 mg/day (78%).

The two most commonly used drugs, Monocef and Livicef, are both intravenous drugs. 40% of all patients in this study received one or more intravenous antibiotics, 14% received both intravenous and oral administration, 8% oral only, and 0.8% received topical treatment.

If analyzed by gender (see figure 4), the most common route of administration was intravenous only for both genders (males 42%, females 37%), second most common was to receive both intravenous and oral (males 14%, females 15%), and third oral administration only (13% of males and 3% of the females). If compared by two groups, 29% of the total amount of drugs prescribed were administered orally and 71% parenteral.

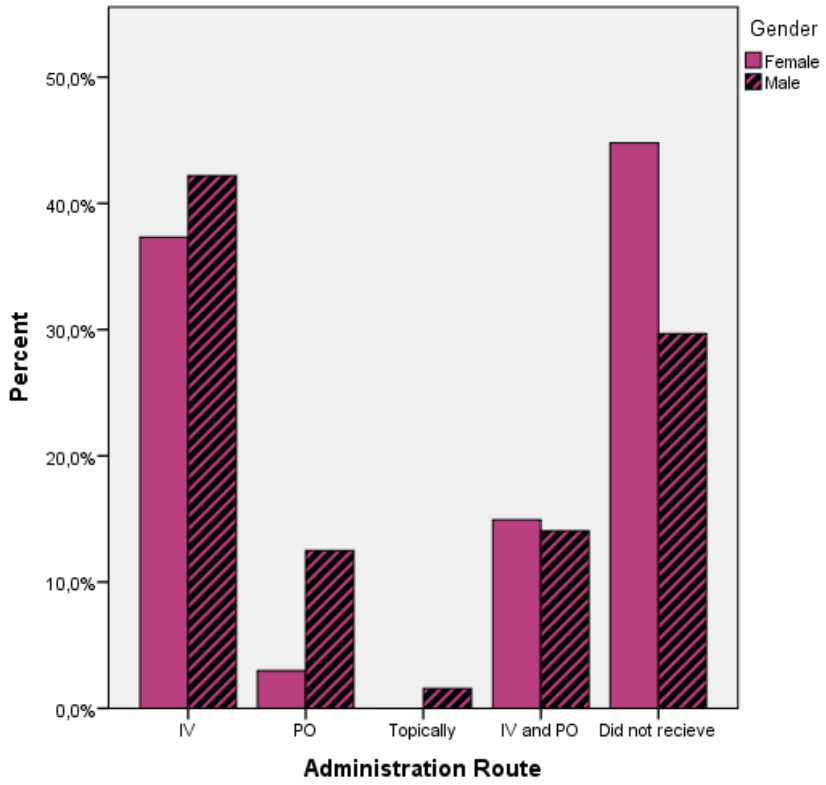

Figure 4. **Showing the percentage of the males and females to receive antibiotic treatment IV (intravenous), PO (per os), topically, both IV and PO, and the patients who did not receive antibiotics during their hospitalization. Most common administration route was IV for both males and females, but it was more common for females not to receive any antibiotics at all.**

Most common indications for antibiotic treatment (here showed in % of the total population of patients in figure 5) were suspected or confirmed urinary tract infection (females 22%, males 16%), respiratory tract infections (females 12%, males 19%) and gastroenteritis (6% females, 13% males).

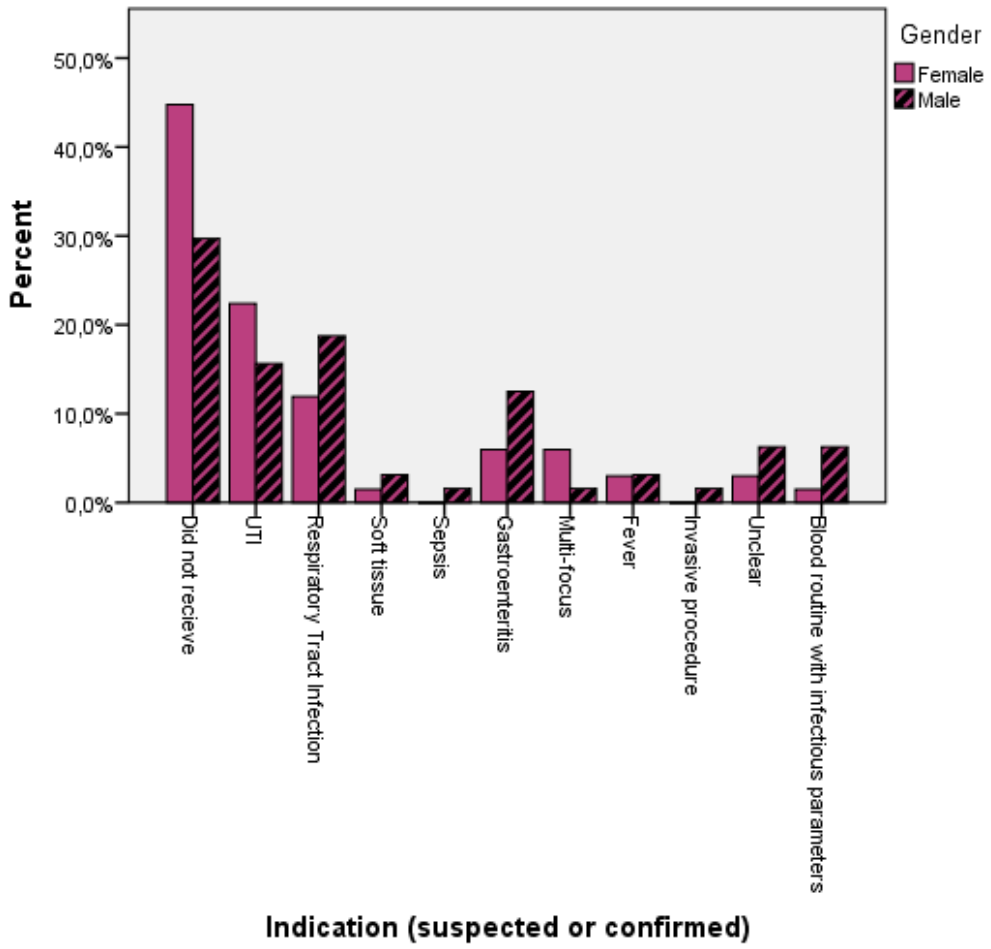

Figure 5. **Showing the diagnosis that indicated the initiation of antibiotic treatment. Diagnoses are either suspected or confirmed. Here shown as percentage of the females and males with a specific diagnosis. Most common indication for males were respiratory tract infection, and for females urinary tract infection.**

Most common antibiotics per infection (here shown as percent of patient with the diagnosis to receive an antibiotic from this group) were for urinary tract infection Cephalosporins (84%), followed by the Fluoroquinolone (56%). For respiratory tract infection most common antibiotics were the Cephalosporins (80%) followed by the Azalid (40%). For gastroenteritis the Fluoroquinolones (75%) and Cephalosporins (67%) were most common.

No major gender differences were found regarding drug of choice.

The patients were also asked whether they were taking any antibiotics at admission to the hospital. 77% answered that they were not taking any antibiotics, 7% were taking antibiotics

by prescription from a doctor, none were taking any antibiotics without prescription, and 16% were either uncertain or could not be asked/or understood the question. No major gender differences regarding if the patient already was on antibiotic at admission were found.

Microbial investigations

The frequency of cultures being sent for all admitted patients was 20%. The number for females was 20% and for males 21%. For the patients receiving antibiotics this number was 33% (24 cultures). Out of these, 25% (6 cultures) found a pathogen.

The type of investigations taken were in 75% of the cases urine sample, blood and stool sample being 4% each, sputum or both sputum and urine being 8% each (see figure 6).

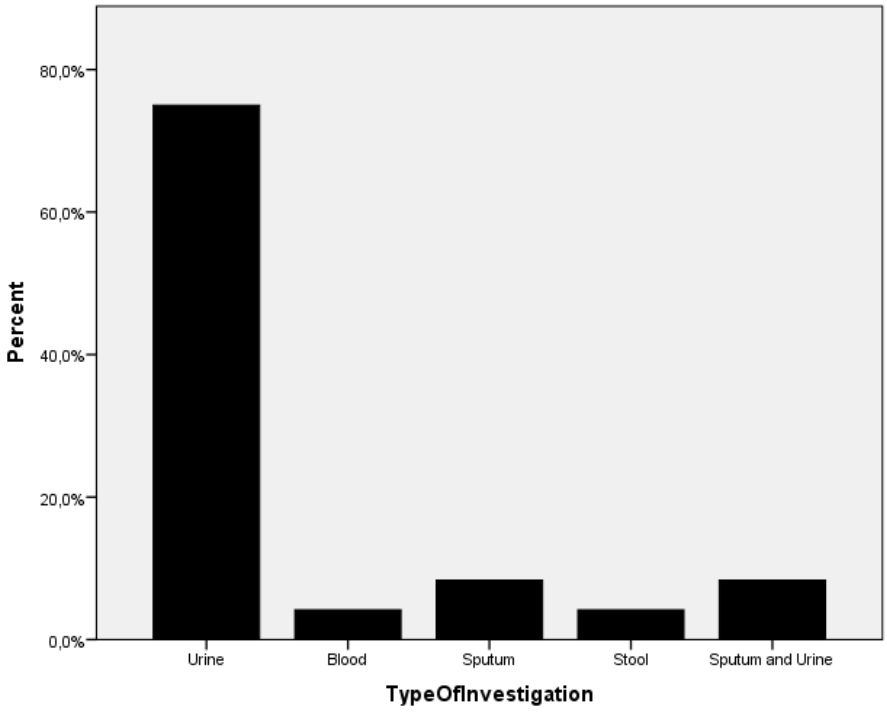

Figure 6. **Percentage of the 24 cultures investigated being urine, blood, sputum, stool, or both sputum and urine. Women and men are here shown in the same statistics due to the small number of cultures investigated. Urine sample was most common, being 75% of the cultures.**

In 16% of the cases the investigation was taken before antibiotic therapy was initiated. In 46% of the cases antibiotics were given before the culture was taken, and in 29% it was uncertain if the antibiotics had been administered before the therapy or not. This is shown by gender in figure 7.

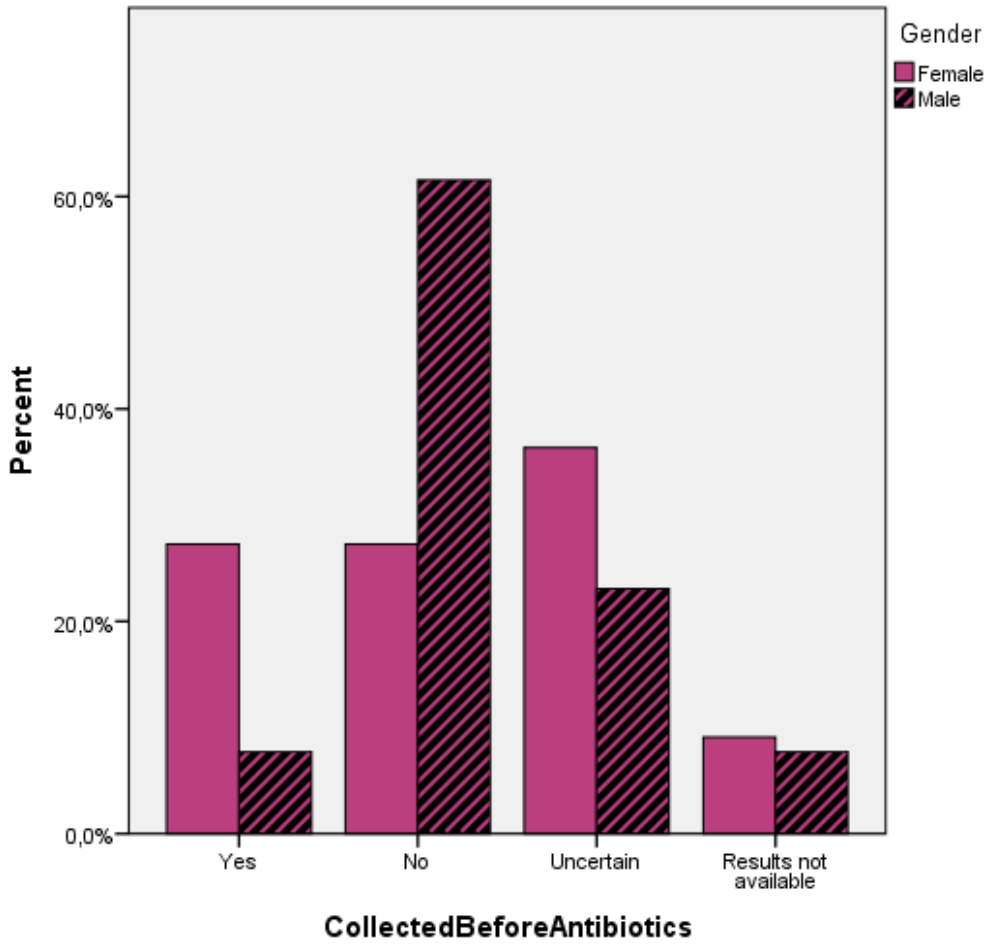

Figure 7. **Showing percentage of cultures sent for investigation before antibiotic treatment was initiated, by gender. It was most common for males not to have the culture collected before antibiotics were administered. Reasons for results not being available is the sensitivity report not being ready at the time of discharge, and the date of arrival to the lab was therefore not available. In the cases where it was uncertain, the information could not be found in the case sheets, nor did the junior doctors have the information.**

In those 6 cases where a pathogen was found, 3 came from the group that had their culture sent before antibiotic therapy was initiated, and only one pathogen was found from the group that had already been initiated on antibiotic therapy (with the group consisting of totally 11 patients). Two of the 6 cases came from the group where it was uncertain when the culture had been sent. Due to lack of numbers to do statistically testing these figures will not be further analyzed. However, the pathogens found were 2 cases of Klebsiella Pneumoniae, one Klebsiella SPP, one Escherichia coli, one Pseudomonas Aeruginosa, and one Staphylococcus Aureus.

All of the Klebsiella were resistant to Cefotaxime, Norfloxacin and Cefoperazone Sulbactum. One of these was Pan-resistant Klebsiella Pneumoniae (including Meropenem). All cultures except Escherichia coli were resistant to Norfloxacin.

No major differences between gender and type of investigation taken was found.

Within the male group, a pathogen was found in 8% of the cases and in 46% of the females. We can also see that for males, that in only one case, or 8% it was certain that the culture had been sent before antibiotic therapy was initiated. The same number for females was 27% (see figure 8).

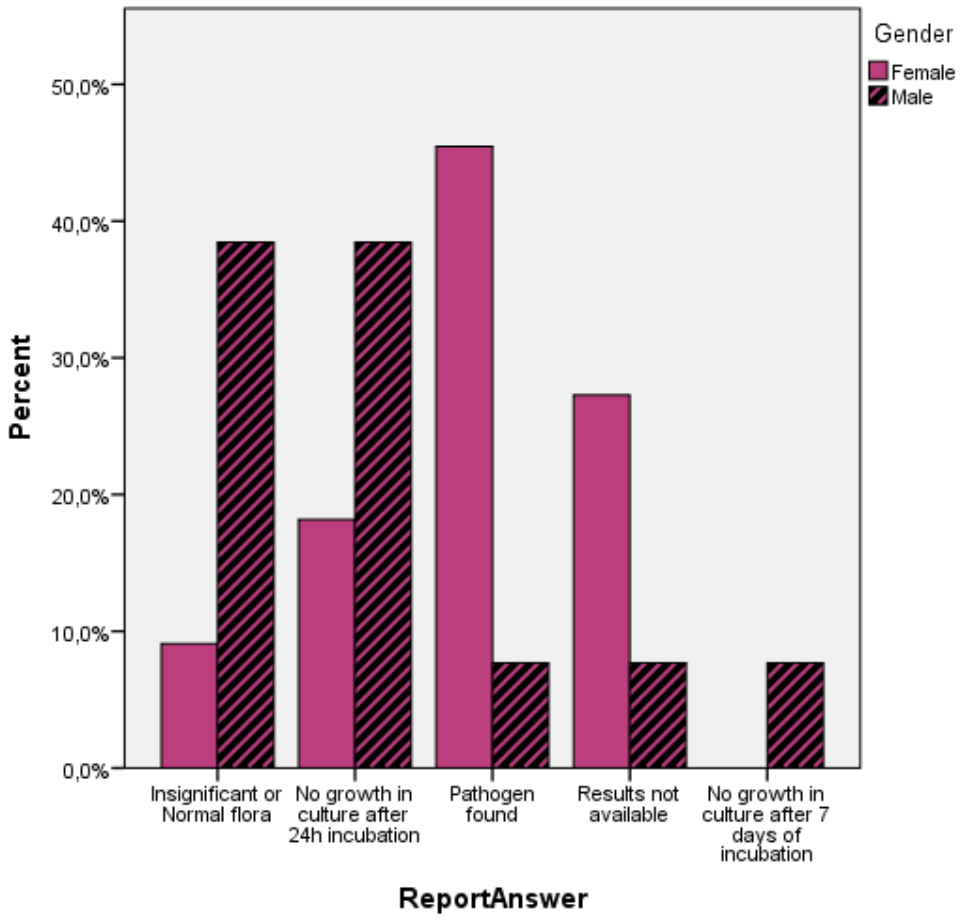

Figure 8. **Showing the results from the section of microbiology for the cultures investigated. Here divided into males and females, showing the percentage of each group with a specific report answer. It was more common to find a pathogen within the female group.**

Discussion

Limitations

There are several limitations of this study. One is the possibility of mistakes in the information gathering process. There is the possibility to miss a drug due to unrecognizing the brand name, even with the CIMS aid. The case-sheets were also hand-written, and in some cases there were difficulties in reading the handwriting correctly.

The question if antibiotics being used at admission were asked by nurses and there is the chance of the question being asked in different ways and therefore not getting the same answers. Furthermore, there is the chance of patients under reporting if he or she has used antibiotics without prescription.

Further limitations of this study is that only the patients admitted to the medicine or neurology wards were included in the study, and therefore a greater number of patients could not be achieved. If to include more wards, more patient information could be included, and statistical significance could be found. This reasoning is also applicable to the culture sensitivity report. Not enough numbers of cultures was sent to perform significant analyzes, they were however demonstrated to show trends, as perhaps a subject for further investigation. If to analyze cultures further, a future study would preferably have the microbiological lab as starting point and trace the patient back to the wards for additional information and find susceptibility pattern for the most common microbes.

Many patients had more than one diagnosis, and the case-sheets did not always have the field for main diagnosis filled out, and in such a situation the junior doctors were asked, making room for insecurities and possible errors.

This study did not take the TRUST/CAMP system into consideration. The fact that not all drugs are permitted in the CAMP system could influence the results, and further studies should take this into consideration if analyzing what drugs are being used. Other approaches could have been to analyze results in regard to defined daily doses, which would have made interesting comparisons to several other studies. Another approach would have been to analyze rationality in the antibiotic use. This would however require a different study approach, and is a suggestion for future studies.

To put in a perspective - a Swedish comparison

To get some perspective on these statistics the following section will be a comparison to a Swedish study that have been published by the institute of public health and is a point prevalence study on antibiotic use on inpatients in Sweden[21]. This is a much larger study, but might still shed some light on the differences. The figures presented are from 2010.

In the Indian study, 63% of all admitted patients received an antibiotic during their hospitalization. To compare to Sweden these figures are 34% and includes all specialties, including surgery. Compared to an Indian study from another teaching hospital, 82% of the inpatients received antibiotics, making the antibiotic use in this study lower in comparison to its own country[11, 22].

Cephalosporins were in the Swedish study 18% of the drugs administered compared to 50%, and the Fluoroquinolones were in the Swedish study 11% compared to 21%. While in Sweden the use of Cephalosporins decreased over the past years, the trend has been the opposite in India. The most commonly administered drugs in hospitalized patients 2010 in Sweden were also Cephalosporins followed by the Flouroquinolones, but the trend has in later years been a shift towards decreased use of Cephalosporins and Flouroquinolones and towards

Piperacillin/Tazobactam and more narrowed spectrum Penicillins[21]. The total use of antibiotics has decreased in Sweden, but the number of inpatients receiving antibiotics has increased. Cephalosporins and Fluoroquinolones have been found to be the most commonly prescribed antibiotics in other private facilities in India[23].

If to compare administration route in Sweden, where 49% received treatment orally, and 51% parenteral to the Indian figures we can see that 29% per oral and that 71% were parenteral, making parenteral treatment a much more common administration route. It was more common for a patient to receive an intravenous antibiotic than no antibiotic at all.

As for the cultures being sent we can also compare this to Swedish figures. In the Swedish study 73% did send for a relevant culture before therapy was initiated, 22% did not, and 5% it was unclear. If to compare this to the data collected in this study where 16% were sent before antibiotic therapy was initiated, 46% were already on antibiotic treatment when the culture was sent for investigation, and 29% were unclear, we can see that there are major differences regarding if a culture is sent before therapy. However, previous studies in India have found a much lower incidence of cultures being analyzed[7]. There is room for analyzing more cultures, and also to find more possible pathogens by sending the cultures before treatment is initiated.

These figures have here been used as an example to put in a perspective to demonstrate differences. When analyzing these figures we need to recognize the difference in circumstances surrounding the countries. India being a highly populated nation with a climate which is beneficial for many bacteria, having an already high resistance pattern for the bacteria, and reasons such as difference in hygiene routine when in contact with patients. Many resistant bacteria can already be found within the hospitals. Microbiologically speaking, the hospitals around the world have become a dangerous place for the patients to be at.

Antibiotic Resistance

The increased use of Cephalosporins in later years can generally be seen as problematic. The most commonly used Cephalosporin in this study was Ceftriaxone, which has a broad spectrum[24]. Where the clinician is found in a place where the number of drugs to be used is limited, it is in conflict with the Swedish recommendations to decrease the use of broad-spectrum Cephalosporins and Flouroquinolones to minimize the chance of developing antibiotic resistance[25].

Sub therapeutic concentrations of antibiotic drugs are one factor that increases the chance of the development of resistance[26]. However, the drugs most commonly prescribed were in optimal doses. The most common dose for Ciprofloxacin was lower than the Swedish recommendations, but in accordance with the Indian guidelines.[27]

No patients answered they were taking antibiotics without prescription at admission, which is also an important factor for the drugs being used for the right indications and in optimal doses. This makes the doctor's prescribing habits the most important factor in the antibiotic use of the patient.

The finding of Pan resistant Klebsiella Pneumoniae as one out of six pathogens could be a coincidence, but could also be an indicator of commonness. This could however be a subject for future studies to investigate further.

Gender issues

The slight trend towards more female being admitted reflects the overall population in Kerala with 52% Female and 48% male population.

Interestingly, more females than males had infection as the main or only diagnosis, still more males then females received antibiotic treatment. Men tend to receive antibiotics more frequently, which is in accordance with other studies conducted in India[11]. However, men and women received the same drugs once treatment was initiated. Females also had slightly more prescriptions made, but no major differences were found. Males also had one day's longer hospitalization. Reasons for this could be many. One suggestion is that male patients might be more ill once they attend medical care and therefore need longer time to get well once hospitalized. More males also had chronic pulmonary disease as main diagnosis, perhaps getting more susceptible for infection. Another possibility is for it to be a gender issue, that males receive more medical care for possible reasons such as expectations from patient and his family. It could also be that males were longer hospitalized and therefore possibly had an increased risk for nosocomial infection, and therefore received antibiotics although the main diagnosis not was infection. Another possibility is that it could be a bias since this study is based on a small population.

More pathogens were found in the female cultures. This might be attributed to the fact that the females in more cases had their cultures sent before the antibiotic therapy was initiated, and therefore had a bigger chance of finding a pathogen. Although the small number of cases cannot show any significance, it is an interesting trend, if correct, that males were more commonly on antibiotic treatment when a culture was investigated, and the results for the sensitivity report being negative. Further subjects for investigations could be to compare the culture reports and resistant findings by gender.

Clinical implementations

Improved infectious control and vaccination programs have been suggested as ways to combat antibiotic resistance as a method for preventing infections[28]. Most patients did not get admitted for infection as the main diagnosis, yet had infectious symptoms during their hospitalization, and therefore received antibiotics. Hospital hygiene routine such as the use of disinfectants could be a part of a clinical routine to limit the need for the use of antimicrobials. Furthermore, suggestions from other studies have been to when possible decrease the use of catheterization, intubation and other possible risk factors for bacterial infection[28].

The cultures for anaerobic bacteria would be found negative, wherefore the real number of microbiologically verified pathogens possibly could be higher. Increased use of microbial testing[7], and to certify that cultures are taken before antibiotic therapy is initiated, could also be one way of limiting the use of broad-spectrum antibiotics and decrease the use of Cephalosporins and Fluoroquinolones[25, 29].

The problem is complex in its nature. All areas, from pollution when the antibiotic is produced, limitation of the fields of use outside of medicine, when and how it is used in medicine, and who gets to receive these drugs needs to be addressed. Perhaps prevention has a major role to play as part of the answer [5, 10, 16, 30].

Complex problems never have easy solutions. But we can all agree upon that major actions need to be taken to make sure we don’t end up in the post-antibiotic era.

At least not at a more rapid pace than would be necessary.

Populärvetenskaplig sammanfattning på svenska

Infektion kan orsakas av bakterier och virus. Om det är en bakterie som ligger bakom infektionen kan sjukdomen ibland behövas behandlas med antibiotika.

Bakterier som blivit okänsliga (resistenta) för antibiotika de ursprungligen var känsliga för har blivit allt vanligare världen över. Detta gör att det blir allt svårare att behandla infektioner när patienter blir sjuka. Att bakterier blir resistenta är egentligen en naturlig process, men överdriven användning av antibiotika är en viktig faktor som gör att utvecklingen går långt mycket snabbare än den egentligen borde. Dessutom har det knappt forskats fram nya sorter på senare år.

I Indien är det vanligt med infektioner, landet har en hög antibiotikaanvändning, och även många resistenta bakterier. Olika antibiotikasorter är mer eller mindre lämpliga att använda mot olika bakterier, och vissa antibiotikasorter är viktiga att använda så lite som möjligt för att inte bakterier ska bli resistenta. Några av dessa sorter heter Cefalosporiner och Kinoloner. Den här studien har därför undersökt antibiotikaanvändningen på ett sjukhus för att se hur många av patienterna som får antibiotika, vilka sorter de får, varför dom får det, och i vilka doser. Dessutom har studien tagit reda på om de hjälpmedel som finns för att se vilka sorters antibiotika som bakterien är känslig för används. Detta har sedan analyserats för att se om det finns någon skillnad mellan kvinnor och män.

Resultaten blev att 63% av alla patienterna fick antibiotika, vilket är en ganska hög siffra om man jämför med Sverige, men inte lika hög som i andra studier som gjorts i Indien. Det var dessutom vanligare att en man fick antibiotika på sjukhuset än en kvinna. Utöver detta var det mycket mer ovanligt än i Sverige att man försökte ta reda på vilka sorters antibiotika bakterien var känslig mot. Dessutom fick de flesta patienter som blev inlagda på sjukhuset behandling med just Cefalosporiner.

Detta är viktigt för att få en översikt över vilka sorters antibiotika som används, att förstå varför en person får antibiotika, och om de mest lämpliga sorterna används. Detta för att kunna påverka hur antibiotikan används, och undvika att bakterier blir okänsliga i möjligaste mån, för att vi ska kunna fortsätta behandla infektioner när det behövs även i framtiden.

Acknowledgement

I would like to thank Kannur Medical College for all their help. Dr Ovallath and Dr Gufran for their guidance. All the junior doctors who assisted me and answered my many questions, especially Dr Anamika Krishnan who always helped me in locating missing files. The neuro technicians Sujana and Suhana for their support. And Mr Ebrahim for helping me with just about everything else.

I would also like to thank University of Skövde who granted my Minor field studies-application, and of course MFS SIDA. Also Jenny Lönnström for her help in the application process.

References

1. Kumarasamy, K.K., et al., *Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: a molecular, biological, and epidemiological study.* Lancet Infect Dis, 2010. **10**(9): p. 597-602.
2. Chang-Ro Lee, I.H.C., Byeong Chul Jeong, Sang Hee Lee, *Strategies to Minimize Antibiotic Resistance.* Int J Environ Res Public Health, 2013(10(9)): p. 4274–4305.
3. Erik Kristiansson, J.F., Anders Janzon, Roman Grabic, Carolin Rutgersson, Birgitta Weijdegård, Hanna Söderström, and D. G. Joakim Larsson, *Pyrosequencing of Antibiotic-Contaminated River Sediments Reveals High Levels of Resistance and Gene Transfer Elements.* PLoS One, 2011(6(2): e17038).
4. WHO, *Country profiles on environmental buren of disease, India.* 2009.
5. Ganguly, N.K., et al., *Rationalizing antibiotic use to limit antibiotic resistance in India.* Indian J Med Res, 2011. **134**: p. 281-94.
6. Kotwani, A., et al., *Factors influencing primary care physicians to prescribe antibiotics in Delhi India.* Fam Pract, 2010. **27**(6): p. 684-90.
7. Khan, F.A., et al., *A prospective study on the antimicrobial usage in the medicine department of a tertiary care teaching hospital.* J Clin Diagn Res, 2013. **7**(7): p. 1343-6.
8. WHO, *Interventions and strategies to improve antimicrobial use in developing countries.* 2001.
9. Eurobarometre, *Antimicrobial resistance.* 2010.
10. Raghunath, D., *Emerging antibiotic resistance in bacteria with special reference to India.* J Biosci, 2008. **33**(4): p. 593-603.
11. Sharma, M., et al., *Antibiotic prescribing in two private sector hospitals; one teaching and one non-teaching: a cross-sectional study in Ujjain, India.* BMC Infect Dis, 2012. **12**: p. 155.

12. WHO, *Antimicrobial resistance, global report on surveillance.* 2014.

13. Dalhoff, A., *Global Fluoroquinolone Resistance Epidemiology and Implications for Clinical Use.* Interdiscip Perspect Infect. Dis. 2012; 976273 October 14. doi:10.1155/2012/976273, 2012.

14. Mandal, J., K.P. Dinoop, and S.C. Parija, *Increasing antimicrobial resistance of Vibrio cholerae OI biotype E1 tor strains isolated in a tertiary-care centre in India.* J Health Popul Nutr, 2012. **30**(1): p. 12-6.

15. Akram, M., M. Shahid, and A.U. Khan, *Etiology and antibiotic resistance patterns of community-acquired urinary tract infections in J N M C Hospital Aligarh, India.* Ann Clin Microbiol Antimicrob, 2007. **6**: p. 4.

16. Bhattacharya, S., *Early diagnosis of resistant pathogens: how can it improve antimicrobial treatment?* Virulence, 2013. **4**(2): p. 172-84.

17. de Kraker, M.E., P.G. Davey, and H. Grundmann, *Mortality and hospital stay associated with resistant Staphylococcus aureus and Escherichia coli bacteremia: estimating the burden of antibiotic resistance in Europe.* PLoS Med, 2011. **8**(10): p. e1001104.

18. Gould, I.M. and A.M. Bal, *New antibiotic agents in the pipeline and how they can help overcome microbial resistance.* Virulence, 2013. **4**(2): p. 185-91.

19. Organization, W.H., *Global strategy for containment of antimicrobial resistance.* 2001.

20. Spellberg B, G.R., Gilbert D, Bradley J, Boucher and S.W. HW, et al., *The epidemic of antibiotic-resistant infections: a call to action for the medical community from the Infectious Diseases Society of America.* Infectious Diseases Society of America., 2008(46): p. 155-64.

21. STRAMA, *Statistik från stramas PPS-2003(2010-fohm2014).* 2011.

22. Kamat, U., et al., *Antimicrobial resistance among nosocomial isolates in a teaching hospital in goa.* Indian J Community Med, 2008. **33**(2): p. 89-92.

23. Kotwani, A. and K. Holloway, *Trends in antibiotic use among outpatients in New Delhi, India.* BMC Infect Dis, 2011. **11**: p. 99.

24. RAF, *ceftriaxon.* 2010.

25. Smittskyddsinstitutet, *ESBL-producerande tarmbakterier.* 2013.

26. Sten Ivarson, S.f., *Infektionsmedicin, epidemiologi, klinik, terapi.* 2011.

27. Limited, U.M.I.P., *Current Index Of Medical Specialites*. 2013.

28. STRAMA, *10 punktsprogrammet 2014 med referenser.* 2014.

29. RAF, *ciprofloxacin.* 2010.

30. Kochar, S., et al., *Success of an infection control program to reduce the spread of carbapenem-resistant Klebsiella pneumoniae.* Infect Control Hosp Epidemiol, 2009. **30**(5): p. 447-52.