

Antibacterial Sensitivity Profile of Bacteria Isolated from Solid Dump Waste of Hetauda Hospital, Nepal

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ABSTRACT

Introduction: Lack of knowledge and awareness about hospital waste has been a concern amid inadequate hospital waste management facilities and ineffective policies.

Objectives: To isolate the bacteria from the waste sample collected from the different departments of the hospital and study the sensitivity profile of the isolated bacteria.

Method: Cross-sectional study was conducted for a period of 3 months examining the solid waste of Hetauda hospital of Bagmati Province. Untreated hospital solid waste samples were collected from Hetauda hospital from different departments like general wards, ICU/HDU, Emergency, OPD, Pharmacy, Laboratories. Battery of biochemical were performed according to the guideline of the Bergey's Manual of Determinative Bacteriology. At the end, sensitivity pattern of the isolates was determined by measuring the zones of inhibition with a calibrated ruler, also interpreted according to Clinical and Laboratory standards institute (CLSI) criteria.

Result: A total of 540 bacteria were isolated. Among them higher number of bacteria were isolated from the emergency department and general wards. Both gram positive and negative bacteria isolated from different wards/department has shown a higher percentage of resistant to different antibiotics; Ciprofloxacin, Ceftazidime, Cefotaxime, Gentamycin, Penicilin, piperatazobactam, imipenem, linezolid and cephalixin.

Conclusion: Antibiotic resistant to different antibiotic isolated from the hospital has shown greater public health threats. The facilities/waste management in the hospital should be properly handled and regular monitoring should be performed.

Keywords: Hospital; sensitivity pattern; waste management.

INTRODUCTION

The global spread of antimicrobial resistant organisms and antibiotic resistance genes (ARGs) has been described as one of the greatest threats facing humankind in the 21st Century. To put this threat in perspective, it is estimated that during the period between 2014 and 2016 \approx 1 million people died due to antibiotic resistant infections and current

projections suggest that resistance will cause \approx 300 million premature deaths by the year 2050.^{1,2}

Serious infections caused by bacteria that have become resistant to commonly used antibiotics have become a major global healthcare problem.³ Since gram negative bacteria can cause serious public health problem, it is important to conduct more research in order to create public awareness. Due to irrational application of antibiotics in last few years, the number of antibiotic resistant bacteria is increasing day by day and the condition is becoming worse in developing country like ours.^{4-6,19}

Hospital waste management is a serious issue because of its intrinsic toxic and infectious nature; therefore, mismanagement or unsafe disposal of

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hospital wastes poses risks to all front-line workers. Improper healthcare waste management might lead to the pollution and contamination of soil, air, and surface and groundwater,⁹ which may pose a great of developing antimicrobial resistance.

METHOD

Cross-sectional observational study was conducted for a period of 3 months from July 15, 2022 to October 28, 2022 examining the waste water of Hetauda Hospital, Madan Bhandari Academy of Health Sciences, Bagmati Province, Nepal. Ten untreated hospital solid waste samples were collected from each department; general wards, Intensive care unit/ High dependency unit (ICU/HDU), Emergency, Out Patient Department (OPD), Pharmacy, Laboratories. From each waste sample, the bacteria were isolated in two different containers for further analysis.

The waste samples collected from hospital were inoculated on selective and differentiate media including MacConkey agar, Eosin-methylene blue (*EMB*) agar for the presumptive isolation and identification of *E. coli*. Then the plates will be incubated at 35 °C±2 for 24 hours. The obtained selective colonies on selective and differential agar media were applied for different biochemical tests according to the guideline of the Bergey's Manual of Determinative Bacteriology.¹³

The antibiotic sensitivity pattern was examined by the disc diffusion method.¹⁴ The isolated and identified 10 *E. coli* isolates will be spread on a

Mueller-Hinton agar plate by rubbing the cotton bud thoroughly on the surface of the plate. 10 different types of antibiotic discs as Ciprofloxacin (5µg), Ceftazidime (30µg), Cefotaxime (30µg), Gentamicin (10µg), Penicillin (10µg), Piperacillin-tazobactam (100µg/10µg), Imipenem (10 µg) Meropenem (10 µg), Linezolid and Cephalexin antibiotics discs were placed on the inoculated. Mueller-Hinton agar plates then incubated for 24 hours at 35 °C. The sensitivity patterns of the isolates were determined by measuring the zones of inhibition with a calibrated ruler, also interpreted according to Clinical Laboratory standards (CLSI) criteria.¹⁵ The tested organisms were then organized into 'sensitive' (S), or 'resistant' (R).

Data were entered in the MS-Excel. Pie charts, table and bar diagram were plotted to identify the percentage of sensitivity in different antibiotic. The result was used to assert whether antibiotic resistance level is significantly different among the three monitored systems and antibiotic resistance level varies in the course of wastewater treatment progress.

RESULT

During the study period, a total of 60 samples were collected from 10 sampling locations. A total 544 bacteria were isolates. Of these, 94 were *Escherichia coli*, 52 were *Klebsiella spp.*, 120 were *Pseudomonas aeruginosa*, and 154 were *Staphylococcus epidermidis*, 94 were *Staphylococcus aureus* and 33 were *Acinetobacter spp.* (Table 1).

Table 1: Number of samples and bacterial isolates.

Site	No. of sample	Number of isolates						Total
		<i>E. coli</i>	<i>Klebsiella spp.</i>	<i>P. aeruginosa</i>	<i>Staphylococcus epidermidis</i>	<i>Staphylococcus aureus</i>	<i>Acinetobacter spp.</i>	
General wards	10	15	11	26	32	21	8	113
ICU/HDU	10	11	5	16	16	14	5	67
Emergency	10	22	8	29	25	19	6	109
OPD	10	16	9	18	38	13	4	98
Pharmacy	10	14	8	14	21	12	6	75
Laboratories	10	16	11	17	22	15	4	85
Total	60	94	52	120	154	94	33	

ICU: Intensive care unit, HDU: High dependency unit, OPD: Outpatient department

Out of all the samples collected from different wards/department, higher number of bacteria were isolated from general wards (113) followed by emergency (109), OPD (98), laboratories (82), pharmacy (75) and ICU/HDU (67).

From figure 1, it shows that the higher number of percentage bacterial isolated from different department of hospital was found to be *Staphylococcus epidermidis* (28%) followed by *P. aeruginosa* (22%). *E. coli* and *Staphylococcus aureus* has equal number of isolation that is 17%. The least number of the isolate among all was found to be *Acinetobacter spp.*(6%).

As from figure 2, almost all the gram negative bacteria have shown more than 50% of resistant to except Imipenem and Meropenem which is slightly less than 50%. *P. aeruginosa* and *Acinobacter spp.* have shown greater resistant in Ceftazidime and Cefotaxime antibiotic which is more than or around 90%.

Among all the gram negative bacteria isolations, except linezolid has shown greater percentage of resistance to all antibiotic tested (Figure 3). Bacteria has shown highest resistance in Cefalexin which is more than 90%. Others have a percentage resistance of around 60-80% except Linezolid which has a resistance of around 6-9%.

DISTRIBUTION OF BACTERIA FOUND IN SOLID WASTE

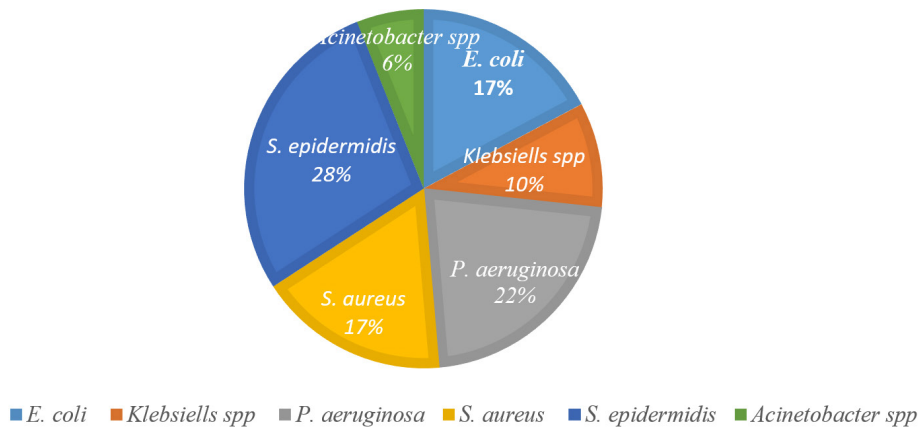


Figure 1: Bacterial Distribution found in Solid Waste

GRAM NEGATIVE BACTERIA SENSITIVITY PROFILE

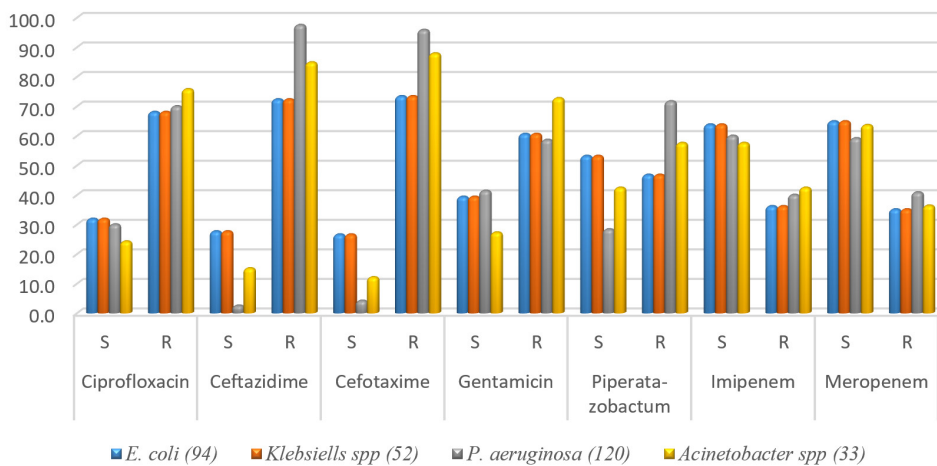


Figure 2: Gram Negative bacteria sensitivity isolated from hospital solid waste

GRAM POSITIVE BACTERIA SENSITIVITY PROFILE

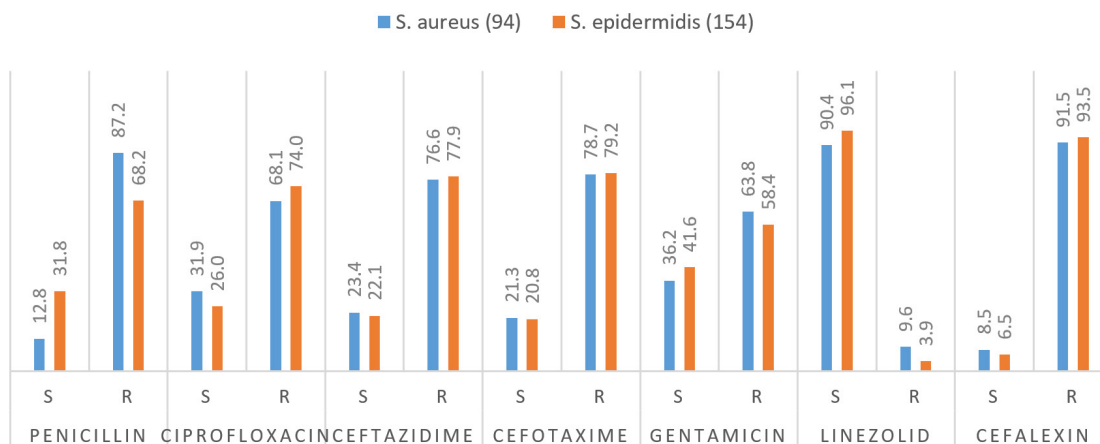


Figure 3: Gram Positive bacteria sensitivity isolated from hospital solid waste

DISCUSSION

Antibiotic resistance has become one of the major public health problem. Polypharmacy and irrational use of antibiotics has led to higher number of antibiotic resistance; as a result, the health conditions are becoming worse specially in developing countries ^{20,21} like Nepal.

In this study, different types of bacteria were isolated from the waste collected from the different parts of the hospital. Hospital are one of the sources of bacteria and hospital acquired bacterial infection as well as resistance ^[18], which is the reason for the antibiotic treatment failure. Hospital has different types of waste and proper waste management plays vital role. Solid as well as liquid waste are the places where bacteria can grow as well as have resistance to antibiotic that has been used in the hospital. As per the literature, ^{8,9} solid waste are more prone to antibacterial resistance as it is not stored in closed system like liquid waste. The present study shows the abundance and resistance pattern from the hospital waste. Among the diverse bacterial isolates, all gram negative bacteria shows more than 50% of resistance to Imipenem and Meropenem while P.aeruginosa and acinobacter spp. have shown greater resistant to ceftazime and cefatoxim antibiotic.

The study shows the resistance to gram positive bacteria as well. Except linezolid gram positive bacteria shows resistance to all the antibiotics used for the sensitivity profile. Out of them highest resistant was shown in cephalixin. Gram positive bacteria are the common cause of bloodstream and other infection in the hospital.²¹

The isolated bacteria from waste collected from different hospital parts of hospitals shows the higher risk of hospital acquired infection. The hospital is generally regarded as the source of diseases and the result shows the same. Besides bacterial infection, the disease acquired from the hospital shows greater risk of antibiotic treatment failure as the maximum number of the bacteria isolated has already shown a higher amount of antibiotic resistance to different antibiotics. Therefore, all the department of the hospital should be properly and routinely cleaned. The hospital should adopt more effective policies on cleanliness, environmental hazards and proper disposal of the waste material.

CONFLICT OF INTEREST: None



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