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**Research Article**

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# Study on Adherence to Prophylactic Antimicrobials Use Guidelines in Surgical Wards of an Indian Private Corporate Hospital

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## ABSTRACT

*Surgical site infection is the most common complication of surgery. Antibiotic prophylaxis is indicated to reduce the incidence of surgical wound infection and hence reduce the incidence of morbidity to the patient. The present study was conducted in a private corporate hospital to understand the prescribing practices of surgeon on antibiotic prophylaxis and correlating it with incidences of surgical site infections. The adherence to the hospital guideline was assessed with respect to choice of antibiotic, dose, timing and duration of prophylaxis. The data from the microbiology department and patients' case sheets were the source of information for the present study. The data of period from January 2013 to December 2013 showed 14123 surgeries with 3.65% surgical infection rates. Among infected cases, 8.16% were clean wounds, 10.29% were clean-contaminated types and 81.55% were contaminated types. The isolated pathogens from the infected sites were Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumoniae, Acinetobacter baumanii and Enterobacter species. All of them are sensitive to colistin. The incidences of types of wound have good correlation with adherence of the guidelines. The study has shown the need of developing updated antibiotic prophylaxis guidelines based on sensitivity pattern of pathogens isolated. The dissemination of guideline and sensitization of surgeons along with periodic monitoring are the recommendations to reduce surgical infections.*

**Keywords:** *Surgical site infection, Prophylaxis guideline, Antibiotic sensitivity pattern*

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## INTRODUCTION

Surgical Site Infection(SSIs) are the third (15%) most frequent cause of nosocomial infections among hospitalized patients and the primary cause of nosocomial infection in surgical patients. Prophylactic administration of antibiotics decreases the risk of infection after many surgical procedures and represents an important component of care for this population.[1]Approximately 30–50% of antibiotic use in hospital practice is now for surgical prophylaxis. However, 30% to 90% of this prophylaxis is reported to be inappropriate. Most common issues identified are: the antibiotic is either given at the wrong time or continued for too long or over dosage. Controversy remains on the appropriate duration of prophylaxis and also as to which specific surgical procedures should receive prophylaxis.[2] The study was aimed to measure the adherence of the surgeons on to the hospital specific guidelines on surgical prophylaxis.

## MATERIALS AND METHODS

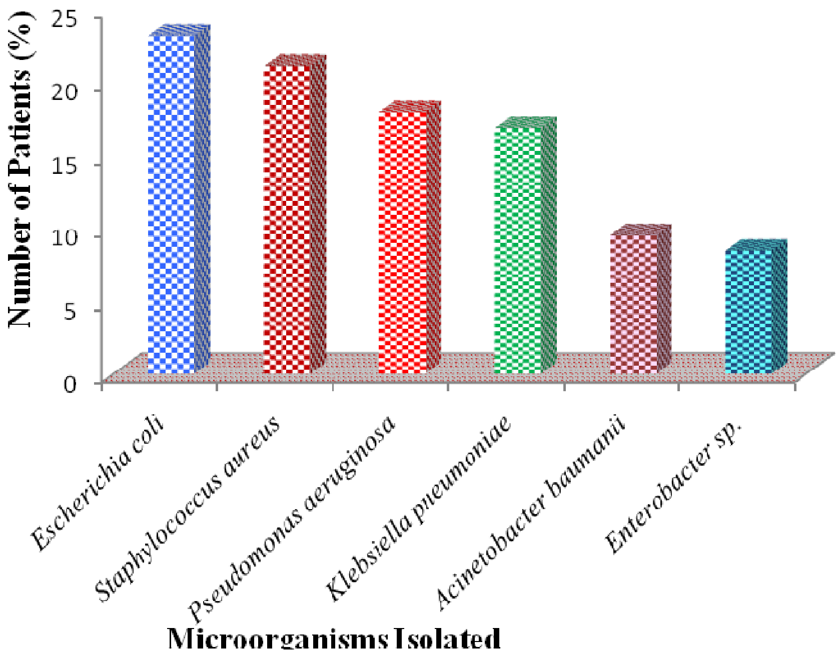
The study was conducted in Kovai Medical Center and Hospital; a modern 750 bedded multi disciplinary super specialty private corporate hospital at Coimbatore, a southern city of India. In a retrospective observation study, data related to microbial culture and sensitivity reports were collected from the hospital's microbiology department. The antibiotic use data were collected in a validated structured format for all cases of surgery with or without antibiotic prophylaxis including cases of surgical infections. The antibiogram reports of microbiology department, patients' demographics from medical record department and the case sheets were the source of data for the present study of the period January 2013 to December 2013.

The adherence to the prophylaxis guideline of the hospital was measured with respect to choice of antibiotic, dose, administration time and duration of antibiotic prescribed.

The human ethics committee's approval and hospital administration's permission was obtained for the study.

## RESULTS

The surgical wounds are categorised into three types: clean, clean contaminated and contaminated. Out of total number of 14123 surgical cases observed during this period, 515 cases had surgical site infection (3.65%). Among the 515 infected cases, 42 (8.16%) had clean wounds, 53 (10.29%) belonged to clean-contaminated types and 420 (81.55%) were contaminated types.




The predominant organism isolated from clean and clean contaminated surgical infection sites was *Escherichia coli* which was found in 23.16% (n=22) cases. The other bacteria isolated were: *Staphylococcus aureus* at 21.05%

(n=20), *Pseudomonas aeruginosa* at 17.89% (n=17), *Klebsiella* pneumonia at 16.84% (n=16), *Acinetobacter* baumanii at 9.47% (n=9) and *Enterobacter species* at 8.42% (n=8).

Out of the 22 isolates of *E.coli*, the highest sensitivity was seen to Colistin with 100% followed by Tigecycline with 95.45%. Carbapenems, Amikacin, Gentamycin and Cefoperazone/Sulbactam were shown to have sensitivity at 81.81% cases. Piperacillin/Tazobactam was found to be sensitive in 72.72% cases while Amoxycillin/Clavulanate and Tobramycin showed sensitivity in lesser number of cases at 22.72%. Third generation Cephalosporins, Cefepime, Ciprofloxacin and Levofloxacin were sensitive only in 18.18% of isolates.

*Pseudomonas aeruginosa* was found in 17 isolates. *Pseudomonas aeruginosa* was found to have the highest sensitivity to Colistin with 100%. This was followed by Fluoroquinolones: Ciprofloxacin and Levofloxacin and Aminoglycosides: Amikacin and Gentamycin with 88.23%. β-lactam inhibitor combinations: Cefoperazone/Sulbactam and Piperacillin/Tazobactam showed very good sensitivity with 88.23%. Carbapenems showed a sensitivity in 70.59% (due to resistance of Efflux reaction) isolates. Third generation Cephalosporins and Cefepime showed a lower sensitivity, sensitive in 29.41% cases while Cotrimoxazole was sensitive only in 5.88% cases.

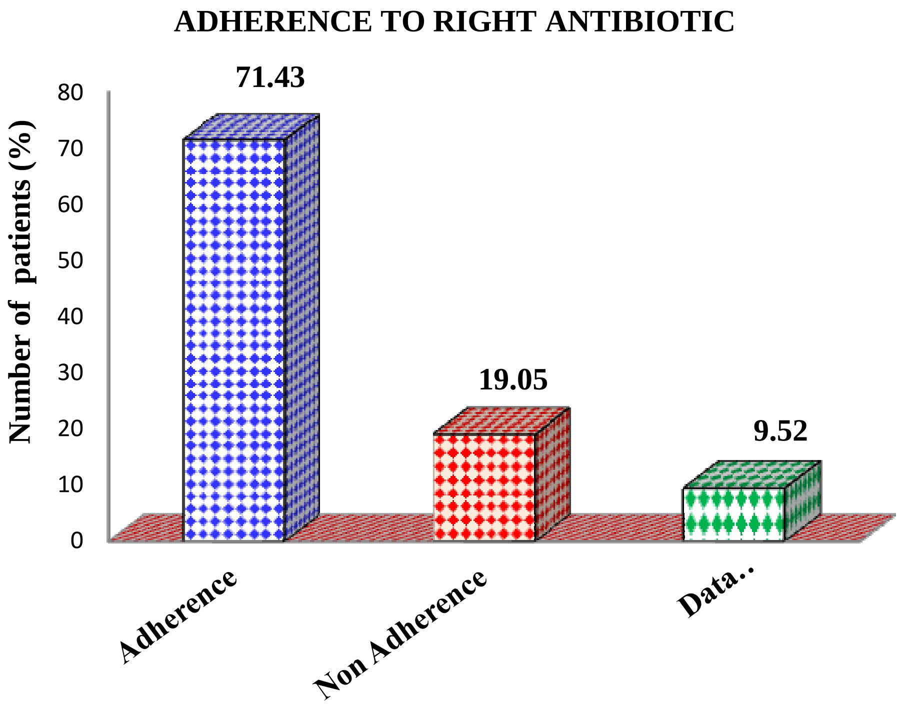
*Klebsiellapneumoniae*, was isolated in 16 cases and all were sensitive to Colistin (100% sensitivity). Tigecyclin was sensitive in 87.5 % isolates. β-lactam inhibitor combinations: Cefoperazone/Sulbactam and Piperacillin/Tazobactam were sensitive in 75% and 62.5% cases respectively. The 75% isolates were susceptible to Carbapenems and 56.25% to Aminoglycosides. Third generation Cephalosporins, Cefepime and Amoxycillin/Clavulanate showed to have sensitivity in 25% cases and Fluoroquinolones in just 12.5%.

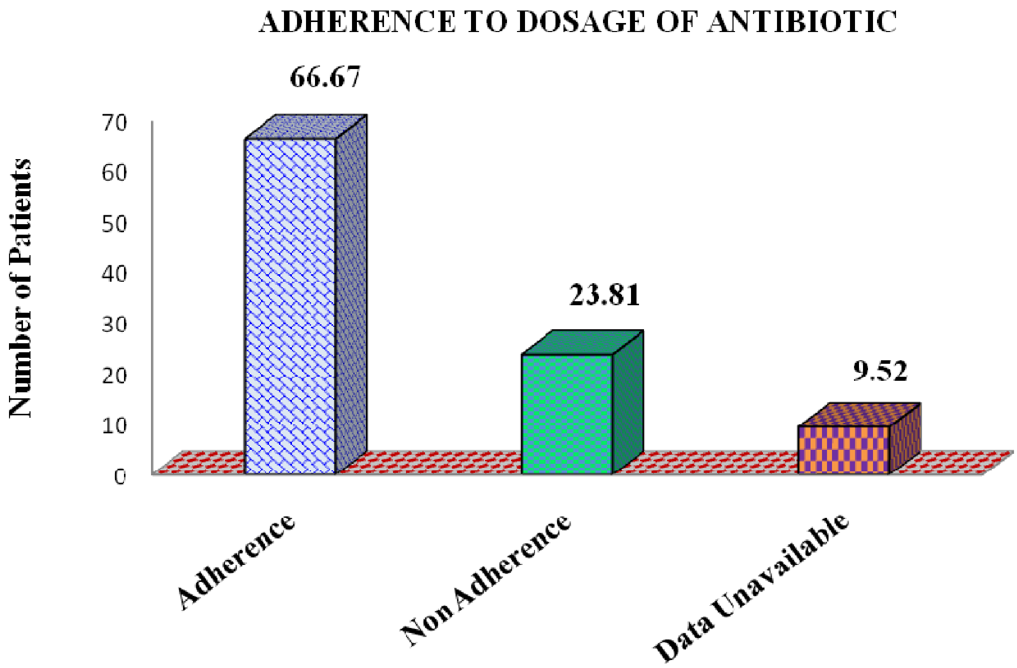
The susceptibility profile of other isolated pathogens is given in the table:

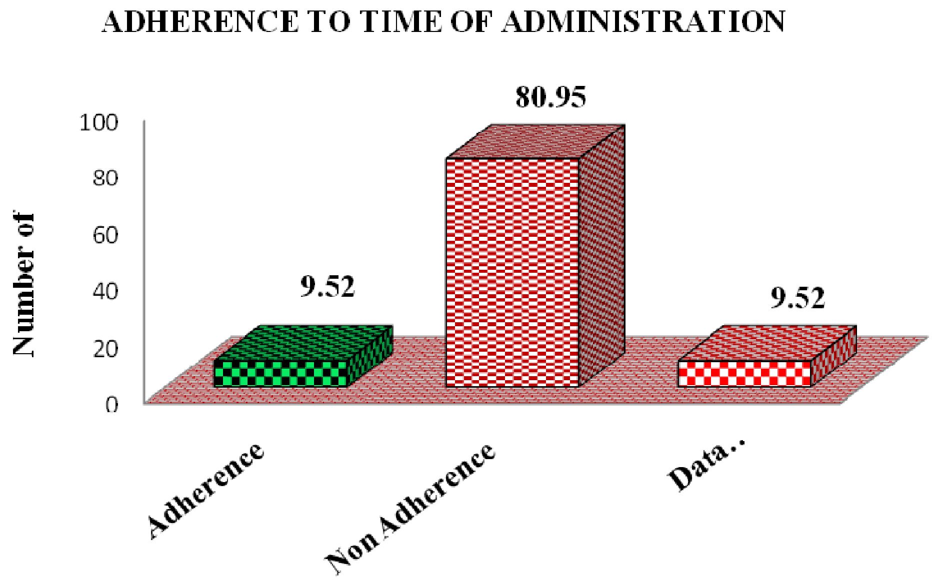
| Bacteria | Antibiotic (s) | % of isolates sensitive |
|---|---|---|
| *Acinetobacter baumanii* | Colistin | 100 |
| | Tigecycline and Carbapenems | 88.88 |
| | Cefoperazone/Sulbactam and Piperacillin/Tazobactam | 66.66 |
| | Third generation Cephalosporins, Cefepime, Amoxycillin/Clavulanate and Fluoroquinolones | 11.11 |
| *Enterobacter species* | Colistin | 100 |
| | Tigecycline, Carbapenems and Aminoglycosides | 87.5 |
| | Cefoperazone/Sulbactam | 87.5 |
| | Piperacillin/Tazobactam | 75 |
| | Fluoroquinolones | 62.5 |
| | Cephalosporins and Cefepime | 50 |
| *Staphylococcus aureus* | Vancomycin, Teicoplanin, Linezolid and Tigecycline | 100 |
| | Rifampin | 95 |
| | Fluoroquinolones and Quinipristin | 65 |
| | Oxacillin, Methicillin, Cefoxitin, Aminoglycosides, Macrolides and Lincosomide | 60 |
| | Doxicycline | 55 |

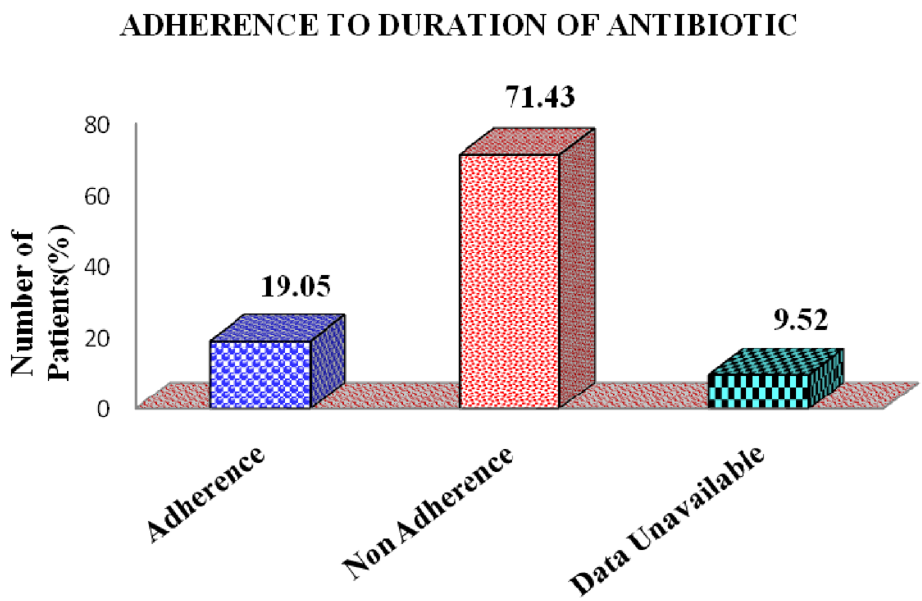
The antimicrobial resistance among the isolated bacteria is in the following pattern: Extended Spectrum β-lactamases (ESBL) antibiotic was resistant in 81.82% of *Escherichia coli*, 75% of *Klebsiella pneumonia* and Carbepanamase producing *Escherichia coli* 18.18% and *Klebsiellapneumoniae*shows 25% of resistance. *Pseudomonas aeruginosa* shows 29.41% of ESBL + Carbapenamase production and *Acinetobacterbaumanii*showed an unsafe resistance pattern that is 89.89% of ESBL + Carbapenamase production.

The adherence to surgical prophylaxis is too described under three groups: clean wounds, clean contaminated wounds and contaminated wounds. Analysis of clean wound cases shows the adherence at 71.43% of right antibiotic (n=30) and 66.67% of right dose (n=28) based on Hospital guidelines. The data also reveals that only 9.52% of surgical patients (n=4) given their first pre-operative doses during the appropriate time frame and majority of patients 71.43% (n=30) received prophylaxis for extended duration.

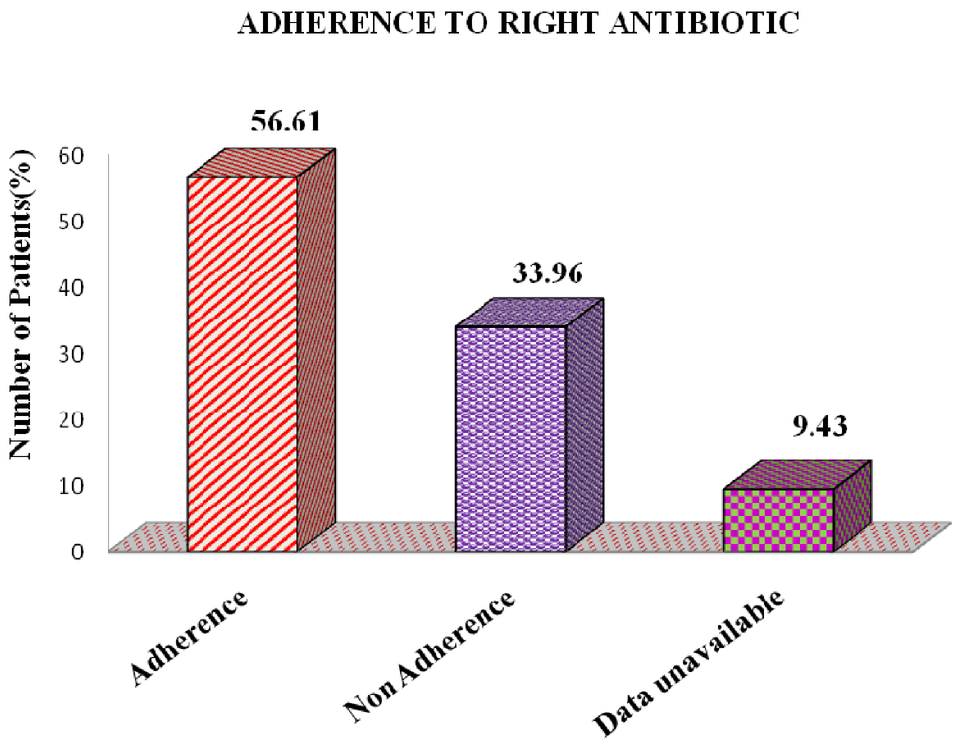

ADHERENCE TO RIGHT ANTIBIOTIC
Number of patients (%)
80
70
60
50
40
30
20
10
0
71.43
19.05
9.52
Adherence
Non Adherence
Data..

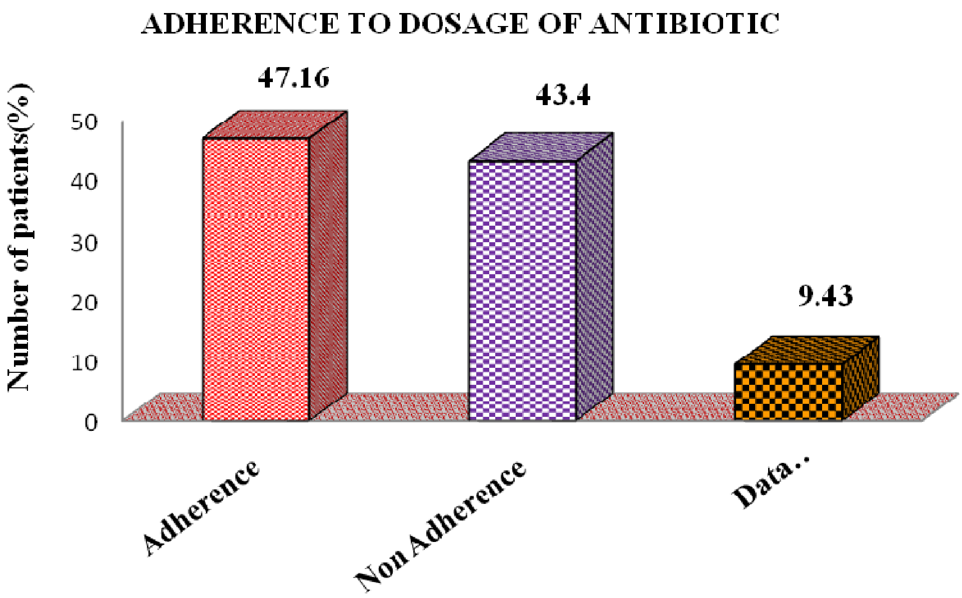

ADHERENCE TO DOSAGE OF ANTIBIOTIC
Number of Patients
70
60
50
40
30
20
10
0
66.67
23.81
9.52
Adherence
Non Adherence
Data Unavailable

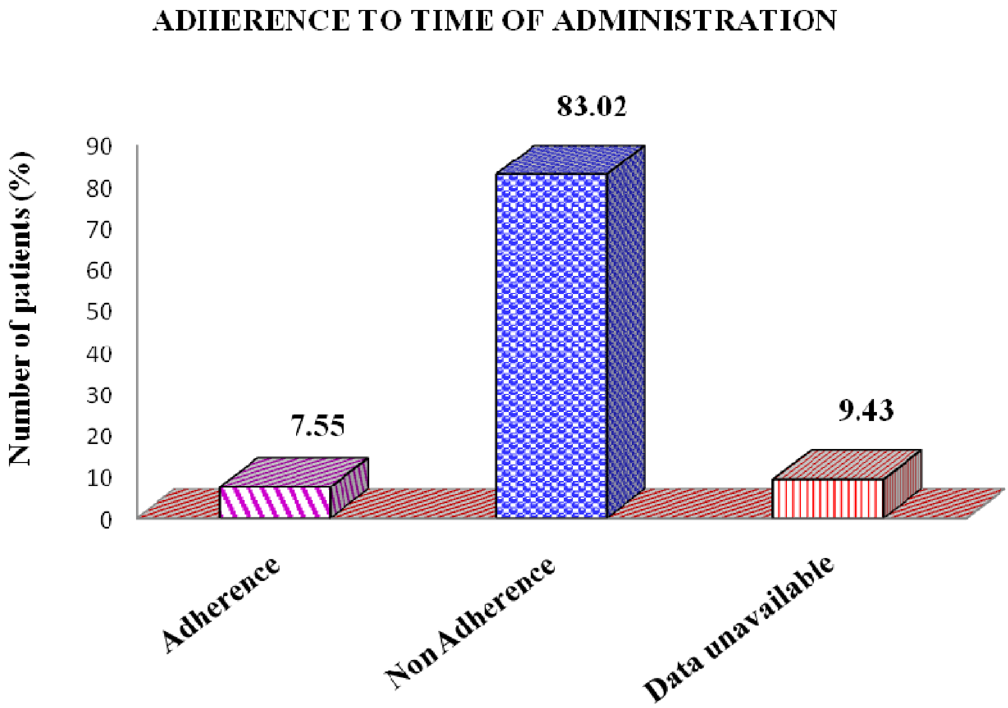


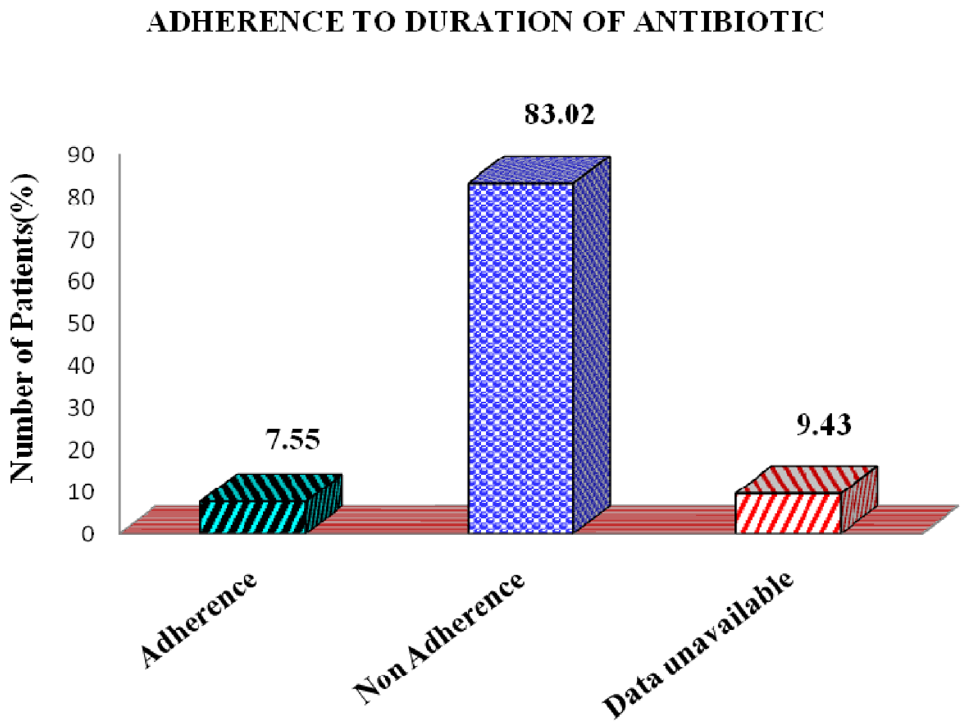




Evaluation of clean-contaminated wounds shows adherence to hospital guideline with respect to right antibiotic at 56.61% (n=30) and right dose at 47.16 % (n=25). The data points out that only 7.55 % of surgical patients (n=4) given their first pre-operative doses during the appropriate time frame and majority of patients 83.02 % (n=44) received prophylaxis for extended duration.

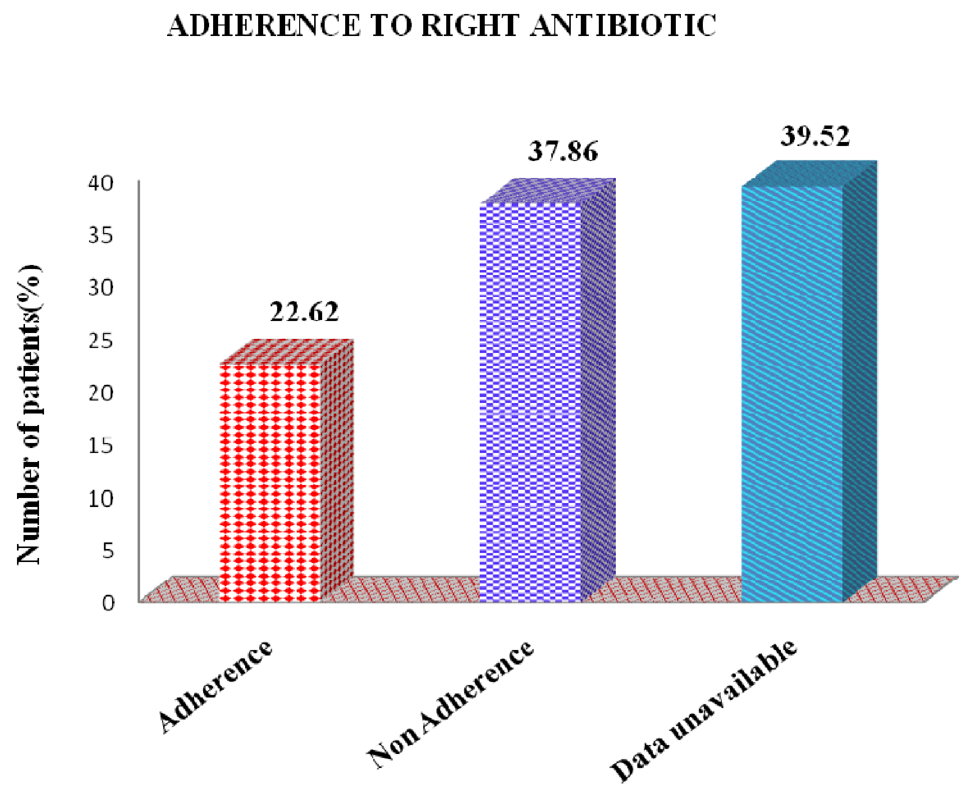

ADHERENCE TO RIGHT ANTIBIOTIC
Number of Patients(%)
60
50
40
30
20
10
0
56.61
33.96
9.43
Adherence
Non Adherence
Data unavailable

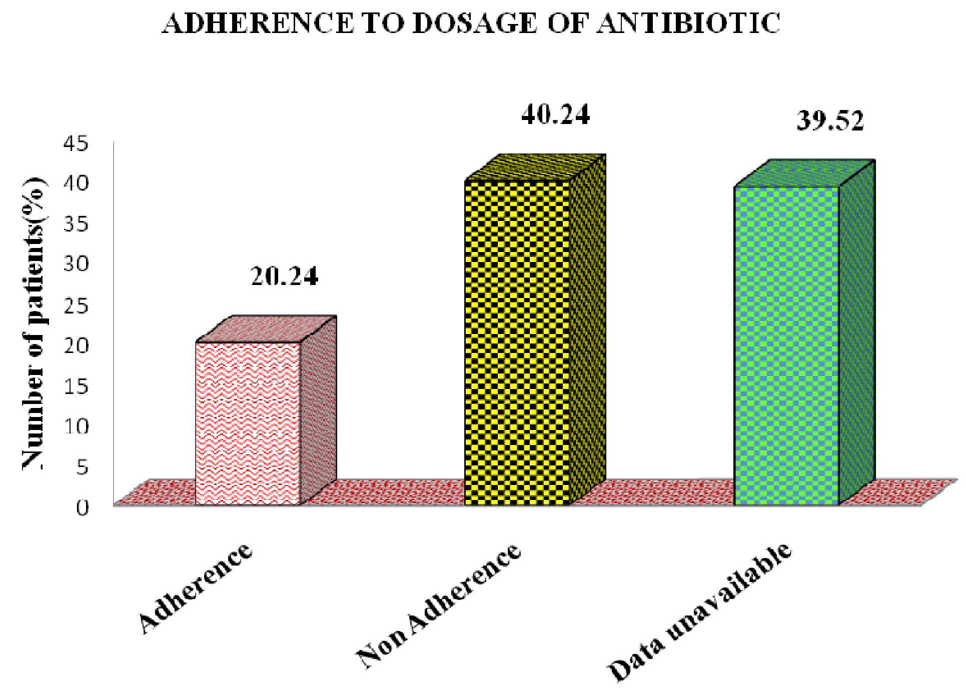

ADHERENCE TO DOSAGE OF ANTIBIOTIC
Number of patients(%)
50
40
30
20
10
0
47.16
43.4
9.43
Adherence
Non Adherence
Data..

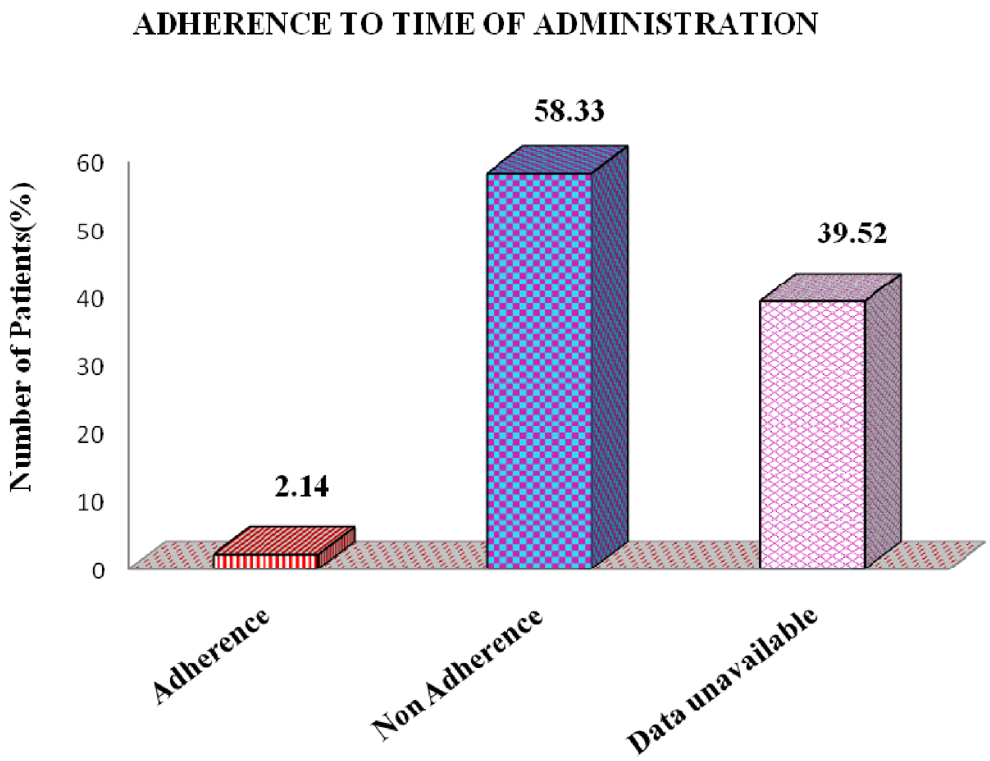


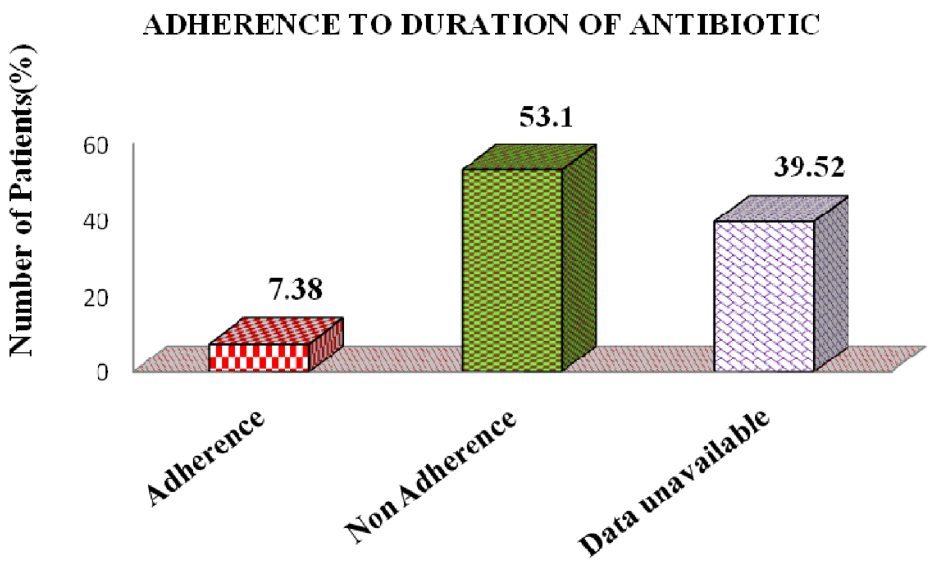




Data of 420 contaminated wounds shows only 22.62% (n=95) cases had right antibiotic and 20.24 % cases with right dose (n=85). The data points out that only 2.14 % of surgical patients (n=9) were given their first pre-operative doses during the appropriate time frame and most of the patients 53.10% (n=223) received prophylaxis for extended duration.

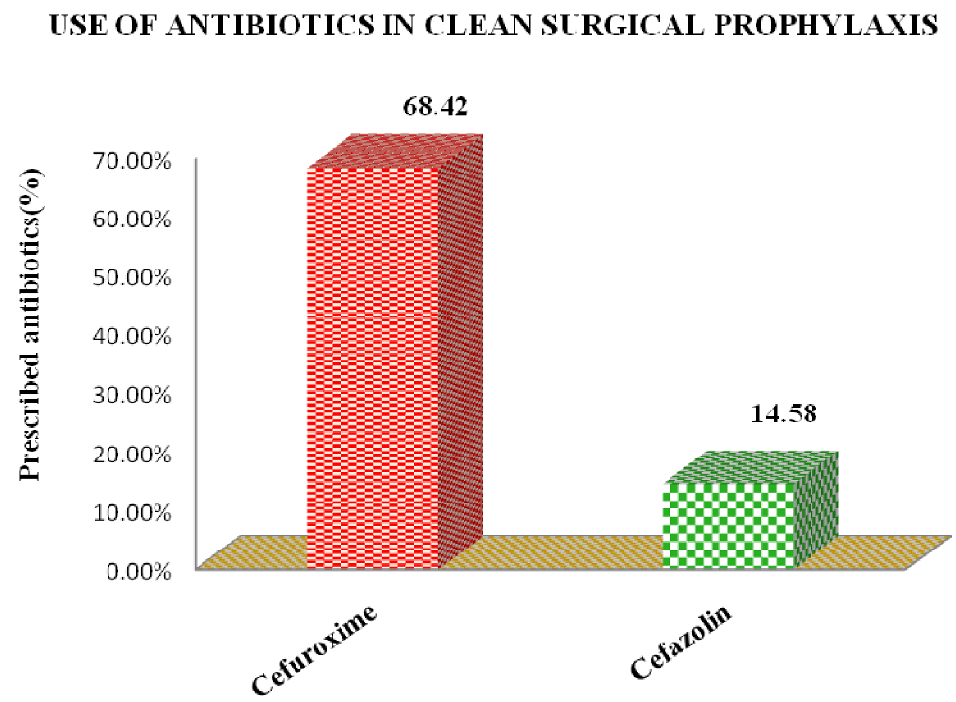


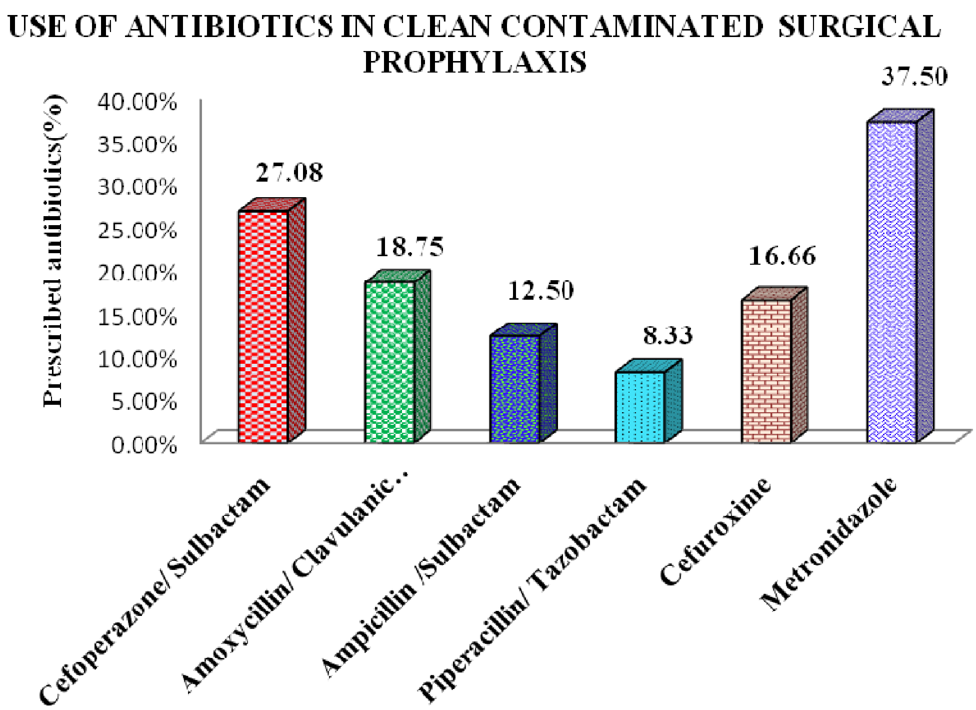



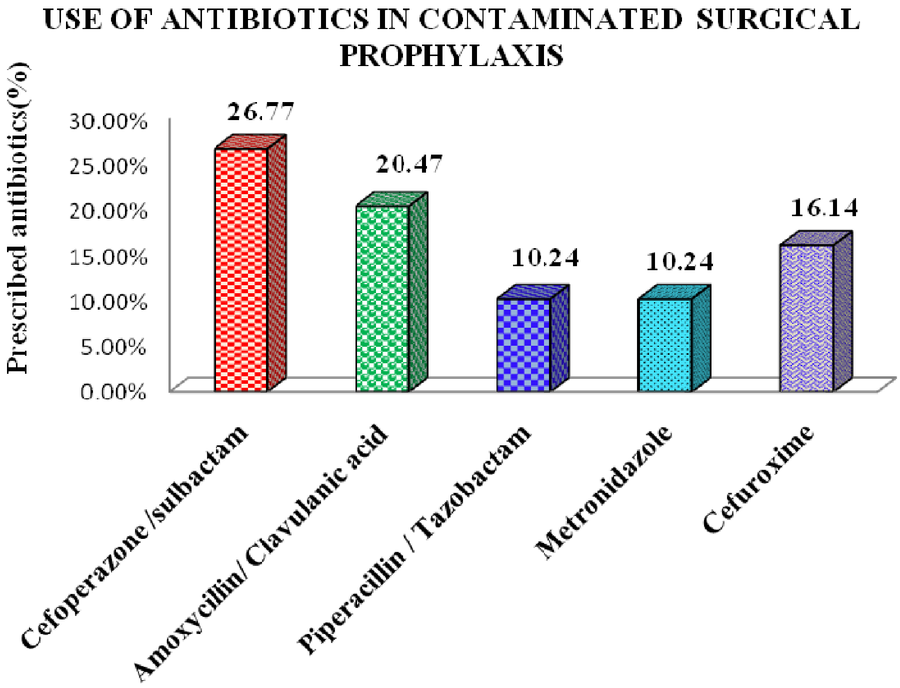



The study showed that Cefuroxime is the most common antibiotic used in prophylaxis. However, in 68.42% patients with cefuroxime had clean wounds, 14.58% with Cefazolin. Cefaperazone/Sulbactum use had 27.98% clean-contaminated wounds and 26.77% contaminated wounds. Similarly the use of Amoxycillin/Clavulanic acid resulted in 18.75% and 20.47% clean – contaminated and contaminated wounds respectively.


USE OF ANTIBIOTICS IN CLEAN SURGICAL PROPHYLAXIS
Prescribed antibiotics(%)
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
68.42
14.58
Cefuroxime
Cefazolin


USE OF ANTIBIOTICS IN CLEAN CONTAMINATED SURGICAL PROPHYLAXIS
Prescribed antibiotics(%)
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
27.08
18.75
12.50
8.33
16.66
37.50
Cefoperazone/ Sulbactam
Amoxycillin/ Clavulanic…
Ampicillin /Sulbactam
Piperacillin/ Tazobactam
Cefuroxime
Metronidazole




## DISCUSSION

The study finding is a reflection of data relating to prophylaxis use of antibiotics and surgical infections of a tertiary care multidisciplinary hospital over a period of one year: January2013 to December 2013. The surgical site infected pus samples' culture and sensitivity reports were collected from the hospital microbiology department. The data includes 515 sensitivity reports of total 14123 surgical patients drawn from various surgery cases: General surgeries, Orthopaedic surgeries, Plastic surgeries, Cardio Thoracic and Vascular surgeries, ENT, Urology, Obstetrics and Gynaecology, Neurology and Paediatric surgeries.

Of the 515 patients, 69.9% (n=360) were males and 30.09% (n=155) were females. The age distribution shows 22.71% belonged to 51 – 60 years and 18.05% to 41-50 years group. Further gender analysis of the prominent age group (51-60 years) showed the male were in higher numbers. This indirectly concludes that the need of surgery increases with increasing age in male population and this finding is in consistence with reports of Elbur *et al*.[3] In the present study, the higher female population was seen in the age group 21-30 years at 18.71% due to large number of caesarean surgeries. Similar findings were also reported earlier in which 78% (n=401) of caesarean surgeries was performed in this age group.[4]

The surgical site infection was observed in 3.65% patients (n=515) out of 14123 surgeries performed during this period. It is considerably less than reports of other studies in Greece (5.3%)[5], Spain (5.3%)[6], Italy (4.7%-5.2%)[7], Scotland (4.8%)[8] and in United Kingdom (4.2%)[9]. But it is slightly higher than the rates reported in France (3.4%) [10], the Netherlands (3.2%)[11] and United States (2.6%)[12].

Data related to clean wounds showed the adherence to right antibiotic and right dose was in 71.43% and 66.67% cases respectively. The result is similar to the results reported earlier where adherence to right antibiotic was at 73.4% and adherence to right dose at 65.6%[3]. With respect to time of administration, it showed 9.52% of surgical patients were given first pre-operative antibiotic during the appropriate time frame and 71.43% patients were with extended duration. This poor compliance of prophylactic antibiotic administration at appropriate time is also reported earlier.[13]

The right choice of antibiotic was observed in 56.61% and the right dose in 47.16% patients of clean contaminated wounds and the similar practice was already reported[3]. The timing of the first dose and extended period of prophylactic antibiotic use is similar to the earlier study report.[13] The adherence to appropriate antibiotic, right dose, time of administration was much less in contaminated cases compared to clean and clean contaminated cases. The poor adherence to hospital guideline is perhaps the reason for contaminated wounds.

Cefuroxime is most commonly used and found to have used in 68.42% of clean wound cases followed by cefazolin in 14.58%. Single dose administration of first and second generation cephalosporin is sufficient for optimal prevention of surgical site infections in absence of high rate of resistance.[14] Cefaperazone/Sulbactum was most frequently used: 27.08% in clean-contaminated and 26.77% of contaminated cases. Amoxycillin / Clavulanic acid was used in 18.75% and 20.4% of clean – contaminated and contaminated respectively. The high rate of infection shows the need updating β-lactam inhibitor combinations as prophylactic in surgery. The hospital guideline needs a revision. The poor adherence of first dose to the appropriate timing and extended duration of use of antibiotics as prophylaxis prior to surgery is perhaps lack of awareness of the guideline among the surgeons. There are different views on the time of administration of first dose ranging from less than 60 minutes[15], within 30 minutes to as close as possible to skin incision[16] .

In most of the surgical cases showed the extended use of prophylactic antibiotic beyond one dose. This can contribute to the emergence of resistant bacterial strains and also contribute to secondary infections, such as those caused by *Clostridium difficile*. Fortunately *clostridium difficile* was not reported during the study period. Single-dose prophylaxis, or prophylaxis ending within 24 hours after the incision, is recommended by several guidelines[14, 17]. Further, SIGN[18] recommended the use of single dose of antibiotic with a long half-life.

## CONCLUSION

The study illustrated that the clean surgical infection rates were within the acceptable limits but total cases showed an increased rate. This is attributed to the lower rate of adherence with respect to choice, dose, time and duration of prophylactic antibiotic. The susceptibility pattern of pathogens should be the guiding force for developing guidelines. The infection control committee consisting of representatives from surgery, microbiology, nursing and pharmacy should be established to design the new evidence based prophylactic antibiotic use guidelines. The dissemination of the guidelines along with sensitizing each surgeon and periodic audit / monitoring the prophylactic practice would help promoting best antibiotic prophylactic practice. This is in the interest of the patients as well the community combating antimicrobial resistance.

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