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A STUDY OF ANTIBIOTIC PRESCRIBING PRACTICES IN A TERTIARY CARE HOSPITAL

Health Science

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ABSTRACT

The development and use of antimicrobial agents has been among the most important public health interventions. Antibiotic Policy is an essential step in regulating the antibiotic prescription, prevention of bacterial resistance in the hospital/ community, reduction of hospital acquired infection and controlling the cost incurred on antibiotics. In view of this, a study was undertaken in a tertiary care government hospital to study the pattern of antibiotic prescription. It is a retrospective descriptive, observational and cross-sectional design to study and analyse the antibiotic prescribing practices of the doctors with the help of medical records of discharged patients which were collected from the Medical records department and associated sections of a super speciality Government teaching hospital at Pune. The antibiotic prescribing practices of the doctors were examined against the following criteria derived from the antibiotic policy like Indication for antibiotic -clinical, diagnostic, bacteriological and others, dose and duration, combination of antibiotics given – whether as per policy and associated instructions and legibility. For working out the cost implications those case records were selected out of the sample withdrawn in which the antibiotics were not prescribed in accordance with antibiotic policy of the hospital. For calculation of cost, standard rates were obtained from the Medical Stores of the hospital. It was found from the study that a large proportion of antibiotic prescription was inappropriate as per the Antibiotic Policy of the hospital and the inappropriate expenditure on the antibiotics works out to the tune of 74.93 %. Applying the percentage to the amount spent by the hospital on antibiotic procurement, a colossal amount can be saved, if it is ensured that prescription of antibiotics is in adherence with the antibiotic policy. The study also found that in almost half the cases (47.20%) associated instructions are not present and in the majority of cases (95.8%) empirical criteria are used for antibiotic prescription. The study also analyzed the miscellaneous aspects including availability and format of antibiotic policy and components of the antibiotic policy and compared it with the antibiotic policy of other Healthcare institutions and recommendations of international bodies.

KEYWORDS

Antimicrobial agents, Antibiotic policy, Antibiotic Prescription

INTRODUCTION

The rational use of drugs advocates that patients receive medicines appropriate to their clinical needs, for an adequate period of time, and at the lowest cost to them and the community [1, 2]. Standardised therapy is necessary not only to achieve optimum patient care but also to retard the emergence of drug resistance, bring down the cost of medical care and enable effective utilization of resources [3].

The lack of effective monitoring and enforcement of controls on the sale and use of antibiotics is cited by the World Health Organization (WHO) as one of the main causes of growing resistance of the microbes to antimicrobial drugs [4].

It is necessary that healthcare institutions should have a policy/ guideline according to which antibiotics should be prescribed. Antibiotic policy is a set of guidelines laid down to optimise the use of antibiotics in many Health Care Institutions. The proper use of such policy helps in decreasing antibiotic resistance and to provide maximum benefit to the patients both in terms of clinical as well as economic outcome. The antibiotic policy should take into consideration various clinical, diagnostic, bacteriological and pharmacological criteria [1, 4, 5].

In view of the above, the present study was undertaken in a tertiary care government hospital at Pune to study and analyse the antibiotic prescribing practices of doctors in relation to its antibiotic policy and the cost implications of such practices.

MATERIAL & METHODS

It is a retrospective descriptive, observational and cross-sectional design to study and analyse the antibiotic prescribing practices of the doctors with the help of medical records of discharged patients. The study was conducted at the medical records department and associated sections of a super speciality Government teaching hospital at Pune.

The case records of discharged patients having antibiotic prescriptions initiated by the treating doctors were considered as a study population to draw the sample. The study population was confined to only acute wards as the patients in these wards are frequently subjected to antibiotics. For this purpose, the case sheets of discharged patients from Oct 06 to Mar 07 were examined to collect the sample. Only the broad categories of speciality for example Medical, Surgical, Gynaecology and Paediatrics were considered for the analysis of the prescribing practices.

Initial review of literature indicated that the proportion of cases with a possibility of having prescriptions of antibiotics in accordance with standard guidelines of the hospital was around 75 %. The sample size was then calculated by using following formula by taking a confidence level of 95 %: -

$$N = \frac{4 \times 1.96^2 \times p \times q}{W^2}$$

Where 4 x 1.96 = constant at 95 % confidence level, p = proportion of interest, q = (1-p), W = width of confidence interval

The minimum sample size, thus calculated came out to be 289. However, in order to further improve the precision of the study a sample size of 300 case records was taken for this study. The sample was drawn by adopting a systematic random sampling method. Every 10th medical record was selected. The case record was examined to find out if any antibiotic was prescribed during period of stay of the patient at the hospital. If the antibiotic was prescribed during hospitalisation, the case record was included in the study sample. If no antibiotic was prescribed, immediate next case record was examined for the prescription of the antibiotics. The process was continued till such time the case record had the prescription of antibiotics. Once the case record qualified as a study sample, again the subsequent 10th case record was considered for drawing the study sample as above. A total sample size of 300 was thus collected by this procedure.

Criteria development for collection of data:

The antibiotic prescribing practices of the doctors were examined against the following criteria derived from the antibiotic policy: -

- Indication for antibiotic -clinical, Diagnostic, Bacteriological, Others.
- Dose and duration.
- Combination of antibiotics given – whether as per policy.
- Associated instructions and legibility – The records were analysed to see the presence or absence of associated instructions and whether the instructions given were complete or incomplete. If the signature block was not proper it was accounted for incomplete instructions. The legibility was also examined.

Data Analysis -
The data thus collected was entered in the standard software, MS Excel and analysed with the help of Epiinfo 2002. The case records were analysed in terms of demographic profile i.e., age, sex and status of the patients.

Further analysis was done to see the prescribing pattern of antibiotics in various specialities. For this purpose, only the broad specialities i.e., Medicine, Surgery, Gynaecology and Paediatrics were considered.

RESULTS
The data collection in the study was conducted over a period of 6 months from April 2017 to September 2017. For the purpose of the study the case records of in patients admitted in the acute care areas of the hospital were studied. These case records were obtained from the Medical Records department of the hospital under study.

Study of Antibiotic Policy of the Hospital - The antibiotic policy of the hospital was evolved by the Department of Pathology of the hospital as one of the activities of the Hospital Infection Control Programme in consultation with other members of the Hospital Infection Control Committee.

The policy states that it should be reviewed every 06 months by a committee chaired by Senior administrative officer and all senior specialist officers being the members. It also states that higher and newer antibiotics should be used only after prior consultations with the senior specialists or the unit chief in the respective disciplines

Aim of the Policy -
The policy states that it intends to provide only the guidelines and in no way does it intend to curtail the clinician's judgment to the contrary in individual cases. This in turn will also help rotate the antibiotics in use and prevent emergence of resistant strains. It is also aimed to reserve the newer and stronger antibiotics for cases of overwhelming sepsis or when indicated by culture or sensitivity reports in combination with clinical judgment. No documentary evidence was available that the senior specialists were consulted prior to starting higher and newer antibiotics and in case of treatment failure.

Availability and format: -
The antibiotic policy of the hospital is in the custody of department of pathology, with a copy available with the Senior administrative officers of the hospital. The policy should be more easily available with a copy being kept in all patient care areas, including the wards and outpatient departments.

The policy is printed on A4 size sheets and has 14 pages. It would be preferable to get it printed in the form of a small handy notebook which can be easily carried in the pocket, and is available when required specially by the junior residents who will be requiring it the most.

Demographic profile of the sample population: -
The demographic profile of the sample population was studied as per the age, sex and status category of the patient.

Sex -
The gender wise distribution of case records is as shown in table below: -

Table 1: Gender Wise Distribution of Sample Population

Sex	Number of case records	Percentage
Male	212	70.66%
Female	88	29.33%
Total	300	100%

Age –
The table no 2 shows the distribution of the cases as per various age groups. The maximum number of cases are in the age group of 21 – 30 (40.00 %), followed by the age group of 31- 40 (22.66 %). The minimum numbers of cases were in the age group of > 60 (1.66 %).

Table 2: Age Distribution of Sample Population

Status	Number	Percentage
Offrs	3	1.00 %
Offrs' Dependant	24	8.00 %
JO	32	10.66 %
Others	121	40.33 %
JO/ Other's Dependant	55	18.33 %
Civ	65	21.66 %
Total	300	100.00%

Distribution of cases as per the Speciality -
The distribution of case records as per the speciality is shown in table below. Only the broad categories of speciality, i.e., Medical, Surgical, Gynaecology and Paediatric have been included (Table 3, Figure 1).

Table 3: Distribution of sample population as per case records

Age Group	Number of cases	Percentage
0-10	15	5.00 %
11–20	35	11.66 %
21–30	120	40.00%
31–40	68	22.66 %
41- 50	45	15.00 %
51–60	13	4.33 %
> 60	5	1.66 %
Total	300	100 %

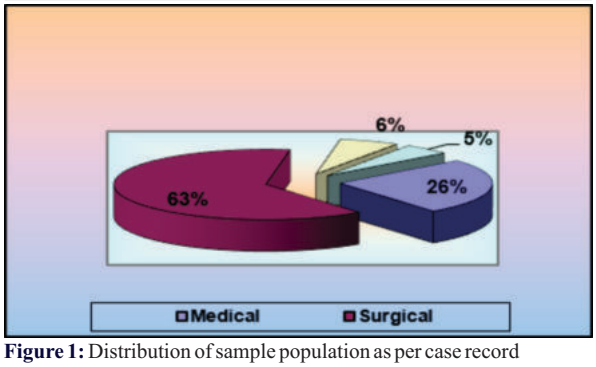

Figure 1: Distribution of sample population as per case record

Status categories - The status category which were considered in the study, include Officers (Offrs), Officers' dependants (Offrs' Dependants), Junior officers (JOs), Other, Dependants of Junior officers & Others (JO/ Other's Dependants) and Civilians (Civ). The distribution of cases as per the status (Table 4, Figure 2) is as shown in the table below:

Table 4: Status of case records selected for the study

Speciality	Number	Percentage
Medical	77	25.67%
Surgical	189	63.00 %
Gynaecology	19	6.33 %
Paediatric	15	5.00 %
Total	300	100.00%

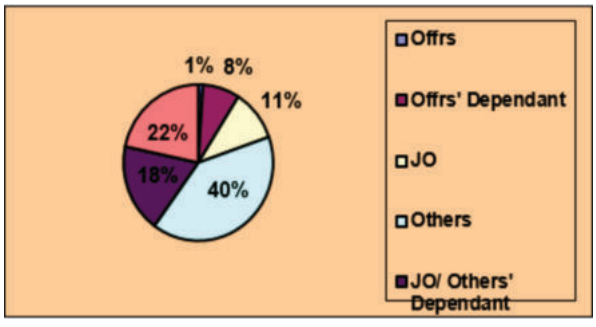

Figure 2: Status of case records selected for the study

Comparison of the antibiotics prescribed in the case sheets in the light of antibiotic policy: -
The antibiotics prescribed were analysed according to the correctness of dose and duration as recommended by the antibiotic policy of the hospital.

Overall adherence to the antibiotic Policy of the hospital – The table below shows the adherence to the antibiotic policy amongst the case records of various specialities, included in the study. The table shows

that the overall percentage of adherence to antibiotic policy amongst various specialities is 19.66% and the incidence of non-adherence to antibiotic policy was 77.00 %. In 10 cases (3.33%) it was difficult to say whether the treatment was given as per the policy. The difference in occurrence of adherence to antibiotic policy amongst broad specialities was not found to be statistically significant ($p > 0.05$) (Table 5).

Table 5: Adherence to the antibiotic Policy of the hospital

Specialty	As per Antibiotic Policy	Not as per Antibiotic Policy	Cannot Say	Total
Medical	13 Row % -16.88 Col % - 22.03	63 Row % - 81.81 Col %- 25.97	1 Row % -1.29 Col % -10.00	77
Surgery	37 Row % - 19.57 Col % - 62.71	147 Row % - 77.77 Col % - 63.63	5 Row% - 2.64 Col % - 50.00	189
Gynaecology	04 Row % - 21.05 Col %- 6.78	13 Row % - 68.42 Col % - 5.62	2 Row % - 5.26 Col % - 20.00	19
Paediatric	05 Row % - 33.33 Col % - 8.47	08 Row % - 53.33 Col % - 3.46	2 Row % - 13.33 Col % - 20.00	15
Total	59(19.66 %)	231(77.00%)	10 (3.33%)	300

chi square = 3.60, df - 3 p > 0.05

Cost of antibiotics –
The cost of antibiotics encountered in the study was obtained from the medical stores of the hospital under study. For the purpose of the study only the cost of generic drugs were taken into consideration. The cost of various antibiotics taken into consideration is enclosed as Appendix.

Cost implications as regards antibiotic policy –
The total cost of antibiotics prescribed in all case records is presented in the table below with speciality wise distribution (Table 6)

Table 6: Cost implication regarding antibiotic Policy

Specialty	Total Cost of antibiotics prescribed	Cost of antibiotic as per Policy	Cost implication of non adherence to antibiotic policy
Medical	Rs 40233.55	Rs 6326.10	Rs 33907.45
Surgical	Rs 196209.00	Rs 32271.00	Rs 163938.00
Gynaecology	Rs 2835.80	Rs 1674.60	Rs 1161.20
Paediatric	Rs 31372.50	Rs 30444.50	Rs 928.00
Total	Rs 270650.85	Rs 70716.20	Rs 199934.65

The above table shows that the total cost of antibiotics prescribed in the case records irrespective of adherence to policy was Rs 270650.85. The cost of antibiotics if the antibiotic policy was adhered to works out to be Rs 70716.20. The apparent cost implication of non-adherence to the antibiotic policy was Rs 199934.65 in respect of 300 cases.

Cost Implications related to Antibiotic Prescribing Practice: -
For working out the cost implications those case records were selected out of the sample withdrawn in which the antibiotics were not prescribed in accordance with antibiotic policy of the hospital.

For calculation of cost, standard rates were obtained from Medical Stores of the hospital. Only the costs of generic drugs were taken into consideration.

Cost implications of the antibiotics was worked out only, when the cost of the antibiotic prescribed was equal or more as compared to the cost of antibiotic prescribed in accordance with antibiotic policy.

DISCUSSION

Antibiotic Policy of the hospital: -
Although the policy states that it should be reviewed every six months, it was observed that the policy is being revised on paper but a systematic review based on surveillance of micro-organism sensitivity pattern is not being undertaken. This may result in decreased compliance by clinicians.

Peter GM Mol et al [6] in a time series intervention analysis, carried out at a university teaching hospital in Groningen, Netherlands, showed that updating the antimicrobial guidelines in close collaboration with the specialists and distributing it in a paperback and electronic format improved the prescribing compliance by 15.5%.

The aim of the policy states that "it intends to provide only a guideline and not curtail the clinicians' judgement". However, the aim of antibiotic policy should have been promotion of rational use of antibiotics and to discourage the emergence of new strains and reduction of existing resistant strains of microorganisms.

The section dealing with surgical cases is quite comprehensive, however if the exact dose in per kg body weight and duration in each case was also given it would have been more informative and helpful for the junior residents.

It is observed from the ENT protocol in the policy that the division of cases as per OPD and Inpatient or routine, minor and Head and neck is very arbitrary. The policy should have been more specific as regards the type of cases, the suspected diagnosis, the exact doses and durations should also have been mentioned

In ophthalmology protocol, the division of cases is as adult patients (minor/ major procedures, OPD, intravitreal) and paediatric cases and topical preparation. Here also the exact doses, durations and exact diagnosis are not mentioned.

The paediatric protocol is broadly divided into neonate and patients beyond one month of age. This section is fairly comprehensive although a flowchart/ tabular form of guidelines would have been preferable.

The section on medicine protocol is the only section in the policy which deals with likely organisms for particular diseases. However, the exact doses and durations along with associated instructions, for example when and what sample to be sent for culture and sensitivity tests, when to review the antibiotics in light of clinical findings etc. should also have been mentioned in the policy.

The section on dermatology protocol deals with all common diseases encountered. It gives the recommendation for the dose and duration of antibiotics for adult patients. However the doses in per kg body weight would have been preferred along with the doses given for an average adult.

There are no recommendations available either for patients of renal failure or other such compromised metabolic or immune states found in the antibiotic policy of the hospital under study. However, in many countries the antibiotic policy also includes the recommendations and precautions to be observed while prescribing for renal failure and other miscellaneous diseases [7].

Many hospitals in other countries display their antibiotic policies on their website. One may also download it on request. Christian Medical College, Vellore has published its antibiotic policy in the form of a small booklet, which is laminated and easily fits inside a pocket. This allows the antibiotic policy to be carried easily by the junior residents and is thus easily accessible. The policy has incorporated a number of flowcharts and clinical guidelines which allows easy referral (8).

Philip and Richard [8] in a study conducted over 41 hospitals under trust of NHS, found that the policies provided had a wide range of presentation styles ranging from an interactive computer programme to a single folded card. The most popular formats were A4 (11 policies), pocket size (12 policies) or A5 (11 policies).

The policy should also be giving the antibiogram or the culture and sensitivity patterns of organisms isolated diagnosis wise. The Healthcare Infection Control Practices Advisory Committee (HICPAC) has recommended that institutions to have a multidisciplinary process in place to review local antibiograms and incorporate it in antibiotic policies to enhance appropriate antimicrobial use [9]. It may not be part of the handy pocket size document referred to earlier, but may certainly be included in the master document kept in the custody of the pathology department and senior administrative officers

The appropriateness of antibiotics prescribed in the case records was examined in light of the antibiotic policy of the hospital. It was found that the overall adherence to antibiotic policy was 19.66 %, whereas in

77.00 % of cases the antibiotic policy was not followed. In 3.33 % cases it was difficult to determine whether the antibiotic policy was followed or not due to exceptional circumstances or vagueness at the part of the antibiotic policy.

Studies by authors in other countries have shown a much higher prevalence of adherence to antibiotic policy. Zulal ozkurt et al [10] in a study conducted in a Research hospital of the Atakurk University Medical School in Turkey showed an overall prevalence of adherence to antibiotic policy as 47.3 %.

Fijn R et al [11] in a multi-centric retrospective explorative cohort study found that in 24.3% cases the antibiotic prescribed was not indicated and in 55.2% case the antibiotic prescribed was not the first drug of choice. In a prospective, multi centre audit of elective procedures, carried out in 13 Dutch hospitals with a sample size of 1763, by Van Kasteren et al [12] the overall adherence of antibiotic guidelines was found to be 28 %. It was seen that antibiotic choice, duration, dose, dosing interval and timing of the first dose were concordant with the hospital guideline in 92%, 82%, 89%, 43% and 50% cases respectively.

In the study conducted by Zulal ozkurt [10] it was found that appropriateness of antibiotics was 45.3 % and 21.7 % in surgical wards and medical wards respectively.

The data obtained from the present study on further analysis has shown that in 14 cases the antibiotics prescribed were inadequate in terms of dose and duration. Thus, resulting in an apparently lower cost of treatment than what was recommended by the antibiotic policy of the hospital. Although such inappropriate prescription results in increased chances of antibiotic resistance, but the immediate or short-term effects are not very conclusive. These cases were excluded from the cost analysis which was carried for the remaining 286 cases. The data of these 286 cases was analysed according to the cost implications, status of the patients, the indications for starting the antibiotic, and availability of the associated instructions for starting the antibiotic.

Detailed analysis of cost implication regarding antibiotic prescribing – Out of 300 cases undertaken for study, the expenditure incurred on the cost of antibiotic prescription in 14 cases (in which antibiotic given was of less duration/ dose) was worked to be Rs 2260.00. However, the cost of antibiotics for these cases if given as per antibiotic policy would have been Rs 3437.00. Thus Rs 1177.00 was spent less. These 14 cases were excluded from further analysis which was progressed for 286 cases (300 -14). These 286 cases included 76 medical, 176 surgical, 19 gynaecology and 15 paediatric case records.

Cost analysis of case records in which antibiotics were not indicated - The table below shows the cost analysis of the cases in which although antibiotics were not indicated but prescribed. This was observed in the cases of two specialities, i.e. medicine and paediatric. The cost implications in such cases included Rs 11880.75 for the medical cases and Rs 238.50 for the paediatric cases.

Speciality wise cost analysis of cases in which antibiotic were indicated and given– The table below shows the cost analysis of case records in which antibiotics were indicated and given either in accordance or not as per the antibiotic policy. The breakdown as per various specialties shows that the extra cost incurred in such cases was Rs 188992.40.

Subsequently the cases were categorized in 4 grades as mentioned below and these grades were further analysed in terms of status structure and in accordance with four major specialities to see if any correlation exists:-
Grade I – Antibiotics indicated and given as per Policy.
Grade II - Antibiotics indicated but not given as per Policy.
Grade III - antibiotics not indicated but given.
Grade IV -antibiotics indicated but cannot say whether as per policy/ not specified in the policy.

Analysis of case records belonging to Grade I as per speciality – The analysis of case records belonging to 'Grade I' (antibiotics indicated, and given in accordance with the antibiotic policy) was done as per the broad specialities. The same is presented in table below. It is observed that the maximum expenditure per patient was incurred in case of surgical cases, i.e., Rs 167.46 per patient (Figure 12). The case records belonging to paediatric speciality comprised 33.33 % of the total number of paediatric cases considered for the study. The difference in occurrence of cases between various specialities was not statistically significant.

Cost Analysis of Grade II category case records (antibiotics indicated, but not given in accordance with the Antibiotic Policy) as per speciality— The analysis of 'Grade II' category of cases show (Table No 25) that out of 179 cases, the cases pertaining to medical, surgical, gynaecology and paediatric speciality were 19, 141, 14 and 5 with per patient expenditure of Rs 1371.04, Rs 1330.10, Rs 158.77 and Rs 258.10 respectively. The extra cost incurred per patient is Rs 1164.14 for medical, Rs 1170.80 for surgical, Rs 82.94 for gynaecology and Rs 125.90 for paediatric cases. It is seen from Table No 10 that the extra cost incurred was maximum in case of surgical cases followed by medical cases.

Cost analysis as per status of case records in which antibiotics not indicated but given (Grade III) – The 'Grade III' category case records were analysed to determine whether any correlation exists for various status categories of patients and for this type of prescription pattern. It was interesting to note that all the officer category case records observed in the study belonged to this pattern of prescription. Amongst the officers' dependant also this pattern of prescription was most prevalent, i.e. 11 (45.83%) out of 24 (Table 26). In case of civilians, this pattern was seen only in 1(1.66%) out of 60 patients. On statistical analysis it was observed that the difference in occurrence of Grade III type of prescription amongst various status categories was highly significant ($p< 0.01$) (Table 11), The total extra expenditure incurred in Grade III cases was Rs 12119.25.

Cost analysis of Grade IV case records (antibiotics indicated but not certain whether as per Policy/ or otherwise) status wise – The detailed analysis of cost as per various rank structure in the category of 'Grade IV' is presented in the table below. The total expenditure in this category was Rs 31628.50, with the maximum per patient expenditure amounting to Rs 9681.50 in case of Officers' dependant and the minimum (Rs 66.00) in case of patients belonging to the others category.

The 3 cases belonging to Officers' dependant category included a case of Pyrexia of Unknown Origin (PUO), End Stage Renal Disease with Pneumonitis (Left) Lower Lobe and Pregnancy with fever. In the case of PUO, the first antibiotic started was Vancomycin and continued for a period of 16 days. Other antibiotics which were administered in this case included Inj Gentamicin (09 days), Inj Ceftazidime (18 days), Inj Meropenem (18 days), Inj Flagyl (16 days). In the case of Pregnancy with fever, the first antibiotic started was Inj Omnatax (02 days). In view of this it is highly essential that standard evidence-based guidelines be included in the antibiotic policy.

Cost analysis of cases belonging to the Grade IV category as per speciality - The detailed cost analysis of case records belonging to Grade IV, as per various speciality is shown in the table below. The maximum number of patients belonged to the surgical speciality with an average per patient expenditure of Rs 329.80. However, the maximum per patient expenditure was in case of paediatric cases, i.e., Rs 14427.00 (Figure 12).

The paediatric case included besides the case of PUO (as mentioned above in para 16), a case of Nephrotic syndrome in which Inj Amikacin, Amoxycillin and Omnatax were administered. This has resulted in the high cost of treatment in this category.

Analysis of case records according to the clinical indication of antibiotic prescription - On examinations of the records it was seen that only clinical and empirical criteria were used to start antibiotics in the cases. The table below shows the analysis of case records as speciality wise which had clinical criteria for antibiotic prescription. There were only 12 cases out of the 286 case records considered in the study in which clinical criteria were used for prescription of antibiotics (Table 13).

Analysis of case records which used empirical criteria for antibiotic prescription - It is observed that in all gynaecology and paediatrics cases, empirical criteria were used for antibiotic prescription. Amongst medical and surgical cases the prevalence of empirical criteria for antibiotic prescription was 90.78 % and 96.59 % respectively. There was no significant difference statistically (Table 14).

However, Zulal ozkurt [10] conducted a study in Turkey and found that in medical and surgical disciplines in 20 % and 51.3% of cases empirical and in 31.2% and 39.4% cases clinical criteria were used respectively.

It is observed from Table 14 and 32 that out of 286 cases only in 12 cases clinical criteria were used for commencing with antibiotics. Remaining cases were treated empirically with antibiotics. This finding was very alarming and indicates that there is an urgent need to commence a training programme for increasing the awareness about the rational use of antibiotics and adherence to antibiotic policy.

Analysis of case records having prescription of antibiotics with associated instructions or otherwise – The case records considered in the study were also analysed as to whether associated instructions were mentioned clearly. The duration, dose, date of starting/ stopping the antibiotics, other instructions like duration to continue after discharge and legibility of prescription were taken into consideration. The table below shows the presence or absence of such instructions in the case records. It is seen that no specific pattern was found between rank structure and prescription pattern (Table 15).

The maximum prevalence of associated instructions including legibility was seen in the case of paediatrics (80.00%) followed by surgical speciality (55.68%). The overall prevalence of associated instructions in the case records was 52.80 % (Figure 18). The difference in the prevalence of the associated instructions including legibility between paediatric and other specialities was found to be statistically significant ($p < 0.05$).

It is obvious from Table 15 that in almost half the cases the associated instructions were not written with the antibiotic prescription. This finding is very significant considering the increasing awareness of clientele and in view of the Consumer protection act and legal issues pertaining to Right to Information Act.

Cost implications of inappropriate prescription of antibiotics– It is seen from Table 29 & 30, that the total expenditure on antibiotics in 286 case records considered in the study was Rs 268390.85. Out of this Rs 201111.65 was incurred as additional cost in case of Grade II (antibiotics indicated but not given as per policy) and Grade III cases (antibiotics not indicated but given). This additional cost was worked out as under: -

(a) Grade II cases – The cost of antibiotic as per antibiotic policy and the antibiotic given on ground was worked out. The difference of the two costs was accounted for additional cost.
(b) Grade III cases – The cost of antibiotic given was worked out and accounted for additional expenditure.

It is further stated that out of the total expenditure incurred on antibiotics in 286 cases, (i.e., Rs 268390.85), 74.93 % (Rs 201111.65) was not given in accordance with the antibiotic policy and was not justified. The antibiotics amounting to Rs 67279.20 was justified to be given as per the policy. It is therefore obvious that the cost of antibiotic which was actually administered was about 4 times more than required (268390.85/ 67279.20 x 100 = 398.92 %).

Cost implications of inappropriate prescription of antibiotics as regards the total hospital budget

From the analysis of the records, it was found that the hospital incurred on expenditure of Rs 4218229.32 on procurement of antibiotics in six months from April 2017 to Sep 2017. If the same proportion is applied, we may assume that for 12 months period the hospital will incur an expenditure of Rs 8436458.64.

In present study, the inappropriate expenditure on the antibiotics works out to the tune of 74.93 %. Applying the percentage to Rs 8436458.64, we may infer that Rs 6321438.45 will be incurred as inappropriate expenditure by the hospital on the antibiotics annually, which is a colossal amount and can be saved if it is ensured that prescription of antibiotics is in adherence with the antibiotic policy.

Zulal ozkurt et al [10] has documented that after restriction on antibiotic prescription was imposed in the hospital under study and with the formulation of antibiotic policy, the antibiotic prescribing declined by 13.9 % and the expenditure by 18.5 %. The total savings were shown to be US $ 322,000.

Sigmund R et al [13], in a study conducted in Kantonsspital Schaffhausen, Switzerland, found that the total antibiotic consumption per patient admitted, was decreased by 36% ($p<0.001$) by inducting an intervention programme. Overall expenditures for antibiotic treatment decreased by 53% (US$100 per patient admitted).

Another study was conducted by Salama S et al [14] in a Canadian hospital based on a three-component, multidisciplinary, hospital-based antimicrobial use program to cut costs and reduce inappropriate antimicrobial use. The program resulted in a reduction in the antimicrobial portion of the total pharmacy drug budget from 41.6% to 28.2%.

In another study conducted by Apisarnthanarak A et al [15] in a study conducted in a tertiary care hospital in Thailand found that the incidence of inappropriate antibiotic uses significantly reduced from 42% to 20% ($p < 0.001$) and the total costs saving were found to be US$32,231 during the study period. In the light of the above noted studies and the findings of the present study, it is certain that a large amount of the budget may be saved if the guidelines pertaining to antibiotic policy are adhered. The saved amount may be fruitfully utilised in other lifesaving endeavours.

The findings of the study indicate a compelling necessity for the following measures: -

(a) Promotion of awareness for rational use of antibiotics by users through a hospital wide training programme.
(b) Periodic review and easy accessibility of antibiotic policy to all users.
(c) Periodic audit of antibiotic prescriptions.

Recommendations

The following recommendations are proposed for the antibiotic policy of the hospital: -

The aim of antibiotic policy of the hospital should be promotion of rational prescribing practices and prevent emergence of new and reduction of existing resistant strains of pathogens.

The policy should be reviewed 06 monthly on the basis of the micro-organism sensitivity pattern. The clinicians pertaining to major disciplines must be an integral part of committee formulating the antibiotic policy.

The policy should be as comprehensive as possible and nothing should be left to imagination as it is used by the senior most to the most junior doctors of the hospital.

The policy must cover all the common diseases and also important uncommon conditions for different age groups.

The policy should include the dose, duration and schedule of antibiotics for an average adult and also mention the per kg dose of the medicine.

It is recommended that the latest drug of choice specific to the micro-organisms on the basis of the sensitivity pattern pertaining to a particular diagnosis should be mentioned than on the basis of the type of cases like OPD/ IPD or major/ minor case etc.

The policy should also indicate if the choice of antibiotics differs in case of OPD patients for the same diagnosis. However as far as possible, the clinical and more preferably the bacteriological reports to be kept in mind prior to any prescription of antibiotics.

The policy should include associated instructions as following (16,17):-

For the clinicians –

In terms of dose, duration, sample/ repeat sample with intervals to be sent, interactions with other drugs or combinations of drugs to be used and precautions to be used in case of compromised metabolic/ immunocompromised status of the patient.

For the patients –

These instructions should be conveyed by hospital staff to the patients and should be pertaining to the timing of the dose, duration, relation with meals, side effects and interaction with other drugs.

For the nurses –

In addition to the relevant information given at serial (i) above, instructions to include any side effects which is to be monitored. The antibiotic policy of the hospital should be easily accessible preferably on its website. It should also be made available in the form of a small booklet to all concerned.

Prescribing Practices –
The supportive investigative results should be made available as early as possible in the hospitalised patients if technically feasible. This will enable the clinicians to reach a conclusive diagnosis earlier and to start treatment based on bacteriological or investigative results rather than empirical therapy. The administrator and senior specialists should stress upon all the clinicians to endorse the necessary associated instructions and prescribe legibly duly endorsing their signatures and stamps wherever necessary.

Sensitising the undergraduate students and post graduate students to antibiotic policy -
It is recommended that undergraduate and post graduate medical students must be sensitised about the concepts of antibiotic policy and importance of maintaining a discipline in prescribing practices as they are at the most impressionable age.

Continuing Medical Education –
It is strongly recommended that a continuing medical education programme should be developed by the hospital incorporating various departments on regular basis to promote the adherence to antibiotic policy. More stringent efforts should be made for adherence to the policy by medical and surgical division as their compliance to adherence was minimum and they are supposedly the maximum users (18).

The hospitals and healthcare institutions should try to organise conferences and seminars wherein the latest surveillance studies and evidence-based treatment of various diseases/ conditions may be discussed and subsequently incorporated in the antibiotic policy. The hospital pharmacists and administrators may give data and feedback on prescribing behaviour without any intention of fault finding or pin pointing any particular person or speciality.

Surveillance Studies –
There should be surveillance procedure to monitor the rate of healthcare associates' infections. Following steps are recommended for surveillance procedure (19): -
(a) Constitution of an antibiotic use committee in the hospital which should participate in surveillance activities.
(b) Antibiotic susceptibility testing of appropriate micro-organism.
(c) Antimicrobial testing for selected resistant isolates.
(d) Monitor the trends in prevalence of bacterial resistance to antimicrobial agents.
(e) To notify Hospital Infection Control Committee if there is any unusual resistance pattern.

Monitoring Antibiotic Use –
It is recommended that antibiotic use of the hospital should be monitored by the medical stores/ pharmacy department. It should be reported to a committee responsible for appropriate utilization of medicines.

Weekly Bulletins should be circulated to all wards and regarding the availability of antibiotic in the stores.

Audit of Antibiotic Prescribing Behaviour –
It is recommended that periodic audit should be undertaken to examine the appropriateness of antimicrobial use. The audit committee should comprise of clinicians from all major discipline amongst others and the committee should analyse following aspects (19, 20, 21): -
(a) Use of antimicrobials as per the guidelines.
(b) Resistance pattern of pathogens in consultation with microbiology department.
(c) Reasons for poor outcome of patients if any.

Liaison and Collaboration with Local and Regional Healthcare institutions and Laboratories -
The hospitals and laboratories of a region should be organised in the form of a body wherein data about surveillance studies, resistance patterns, and antibiotic use can be shared between the members of the group. The antibiotic policy of all hospitals/ healthcare institutions should be made in collaboration with each other, as resistance patterns and disease outbreaks are likely to be similar in a defined region. The use of software like WHONET for surveillance reporting and antibiotic prescription should be utilised. The government healthcare authorities should take a proactive approach in this regard. (19)

Use of Information Technology -
In the present era, it is recommended that a conscious effort should be made to utilise the information technology tools for spreading awareness about the antibiotic policy and to make it available easily, through smartphones, hospital website, computers in the wards etc. If the hospital has a Hospital Information System, there should be provision for inbuilt prompting of prescription.

In order to save the colossal amount of funds and gainfully utilise the resources it is strongly recommended that there should be multidisciplinary approach to streamline the antibiotic prescribing practice with key pillars comprising of medical and antibiotic audits and surveillance studies supported by periodic training programmes.

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