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Incremental expenditure for hospital care associated infections

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Abstract: *Background:* Hospital care associated infections [HAI] are time varying and they substantially increase the burden for the patients, relatives, Payers, Third party Administrators and Hospital Administrators. An incremental cost / expenditure is the difference in total costs as the result of a change in some activity. *Objectives:* To find out the incremental cost in the hospital and the total number of beds in each ward. *Methods:* Cross sectional retrospective data was collected for all the in - Patients admitted to Ramaiah Medical College Hospital for the period of 2013 to 2015 (3 years). To find out the incremental cost in the hospital, the total number of beds in each ward were taken into consideration. Extra cost calculated department wise for all different types of commonly occurring HAI. The wards of the hospital have been categorized into Medicine and Allied wards, Surgery and Allied wards, Intensive Care Units and Paediatrics wards and data was analysed using simple tabular form. *Results:* Incremental cost of different types of Health care associated infections calculated based on Medicine and Allied departments, Surgery and Allied departments, Paediatrics and Intensive care units. The incremental cost forover all Medicine and allied departments for urinary tract infections [UTI] - 3,995/-, Blood stream infections [BSI] - 7641/- and ventilator associated pneumonia [VAP] - 1386 /- per day / patient. The incremental cost for Surgery allied urinary tract infections [UTI] - 4832 /-, blood stream infections BSI - 9241 /-, ventilator associated pneumonia VAP - 1677/- and SSI - 336/- per day / patient. The incremental cost of Paediatrics UTI - 1677 /-, BSI - 12340 /- and VAP - 5284 /- per day / patient. *Conclusion:* The analysis showed that the incremental cost related to the health care associated infections was more common among the patients who had nosocomial infection when compared with the patients who had not suffered from any of the nosocomial infection.

Keywords: Hospital Economics, Cost benefit analysis, Health expenditures, Cost-Benefit Data

Introduction

Healthcare-associated infections / Hospital acquired infections (HAIs) are additional burdens on individual hospitals and healthcare systems [1]. Excess costs of Health care associated infections are related to the additional diagnostic tests and treatment, additional hospital days, and post discharge complications, pharmacy charges, loss of man power days and mental stress related to more number of hospital stays [2-4]. Hence the economic burden related to HAI still remains a challenging issue.

The main aim of this study was to calculate the incremental cost of commonly acquired nosocomial infections such as urinary tract infections [UTI], blood stream infections [BSI], ventilator associated pneumonia [VAP] and surgical site infection [SSI].

Material and Methods

Setting: This study was performed in Ramaiah medical college hospital which is a 800-bed tertiary care hospital that contains 24 Departments of general speciality and super speciality services, 85 - bed adult Medical /Surgical / Paediatric / Neonatal Intensive Care Units which are headed by a consultant anaesthesiologist / intensivest, 12- Hybrid operation theatres and other supportive departments.

Design: Retrospective data collected for the period of 3 years from January 2013 to December 2015 for the inpatients who got admitted for more than 48 hours of duration, the data collected included the parameters for major category of health care associated infections like urinary tract infections, blood

stream infection, ventilator associated pneumonia and surgical site infection. The data collected showed the extra amount paid by all the patients and also the cost to the instution / hospital.

Methodology: Health care setting can be considered as a ecosystem which consists of many components with in the hospital. It compromises of multiple components like wards of different specialty like Medicine and Allied, Surgery allied, Paediatric wards, Intensive Care units, emergency wards. The patients who are admitted to any kind of these wards are susceptible to health care associated infections. These infections causes significant increase in the cost for treating the Hospital Care Acquired infections [HAI]. The percentage of various HAI calculated, the extra cost of all the HAI calculated, the extra cost / bed is calculated considering all other parameters. The hospital wards were divided into Medical and allied, Surgical and allied, intensive care units and the Paediatrics department, this was done for the easy calculation of the cost related to the particular departments. Extra cost paid by all the health care associated infections were calculated who had any kind of HAI. Total beds allotted to all the above department were taken into consideration. Cost per bed in one year and cost per day was calculated.

Results

A systematic review of study suggest that patients who are admitted to any kind health care setting, there are chances that the patient might experience any one of the health care associated infection, which the patient, caregiver, relatives have never thought of getting this type of infection during their stay in the hospital. Many a time's health care associated infections can be preventable by using standard guidelines, standard precautions, correct protective measures, Personal protective equipment's by health care workers. Study indicates the most commonly occurring health care associated infections in a teaching hospital occurs in a General Ward when compared to Private wards. The total in-patients were taken into consideration, the devices inserted and the device days were taken from hospital infection control committee [HICC] reports, common types of HAIs like UTI, BSI, VAP, SSI.

Overall burden of HAI in a selected medical college hospital as follows;

- UTI- 10.2% of infections per 100 patients
- BSI-10.1% of infections per 100 patients
- VAP-7.3% infections per 100 patients
- SSI - 0.8% of infections for 100 patients

With this high burden of HAI (approximately 28%) appropriate measures to be taken for the management of the above infections, appropriate standard protocols to be followed for the continuous monitoring the quality of patient care. Average cost paid by all patients for 3 years of study period who had HAI 97, 28, 769, 68, 63, 26819, 01, 635 , 3, 27, 790. Average No of confirmed cases of each category of HAI / Year 359, 113, 37, 7. Average Extra cost paid by all the patient due to HAI / year 32, 25, 935, 61, 70, 153, 11, 19, 459, 2, 24, 376 *UTI, BSI, VAP, SSI* Respectively.

The cost spent by all the HAI patientsis higher when compared with any other patient who gets admitted to health care setting. The cost paid by all the HAI patients like UTI, BSI, VAP, SSI is calculated for all the HAI patients and the total cost for all the patients who got admitted calculated and the same has been explained in the below Table-1.

Table-1: Confirmed HAI cases, Total cost, Extra cost paid by HAI patients – (UTI, BSI, VAP, SSI)

Category	UTI	BSI	VAP	SSI
Average cost paid by all patients for 3 years of study period who had HAI (UTI, BSI, VAP, SSI)	97, 28, 769	68, 63, 268	19, 01, 635	327790
Average No of confirmed cases of each category of HAI / Year	359	113	37	7
Average Extra cost paid by all the patient due to HAI / year	32, 25, 935	61, 70, 153	11, 19, 459	2, 24, 376

Calculation of beds under Medicine and Surgery allied departments: For the study purposes the bed category is divided into Medical and allied department wards and Surgical and allied wards. The paediatric ward is taken into consideration separately because of varying factors contributing to HAI.

Extra cost for Medicine and allied departments/ per day / per patient: General Medicine department is categorized into various departments like Psychiatry, Endocrinology, Nephrology, Gastroenterology, Respiratory Medicine, Dermatology, Isolation ward, A block, Emergency Medicine, Medical Oncology taken into consideration , Total number of beds under each department taken as per the hospital categorization . Percentage of each HAI Calculated. Cost for medicine and allied department calculated as per 339 beds, cost /ward year is calculated and the cost / day in particular ward is calculated. Different HAIs like UTI, BSI, VAP, are considered.

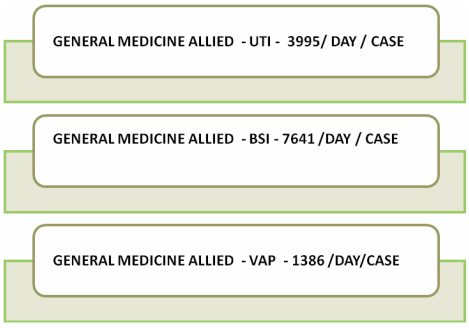
General medicine 1,202, 2,299, 417 Psychiatry 471, 902, 164 Endocrinology 259, 496, 90 Nephrology 259, 496, 90 Gastroenterology 318, 609, 110 Respiratory medicine 236, 451, 82 Dermatology 130, 248, 45 Isolation ward 47, 248, 86A block 283, 248, 98 Emergency medicine 118, 225, 41Medical oncology 471, 902, 164 UTI, BSI and VAP. Respectively */ Per day / Per patient* as shown in the Table-[2].

Table-2: No of beds , % Beds , Extra cost and Cost to Medicine and Allied departments - UTI

Medicine and Allied Departments	No of Beds	% Beds	Cost / ward / year/ Case	Cost / ward / day / Case
General medicine				
UTI	102	30.1	4,38,727	1,202
BSI			8,39,141	2,299
VAP			1,52,246	417
Psychiatry				
UTI	40	11.8	1,72,050	471
BSI			3,29,075	902
VAP			59,704	164
Endocrinology				
UTI	22	6.5	94,627	259
BSI			1,80,991	496
VAP			32,837	90
Nephrology				
UTI	22	6.5	94,627	259
BSI			1,80,991	496
VAP			32,837	90
Gastroenterology				
UTI	27	8	1,16,134	318
BSI			2,22,126	609
VAP			40,301	110

Medicine and Allied Departments	No of Beds	% Beds	Cost / ward / year/ Case	Cost / ward / day / Case
Respiratory medicine				
UTI	20	5.9	86,025	236
BSI			1,64,537	451
VAP			29,852	82
Dermatology				
UTI	11	3.2	47,314	130
BSI			90,496	248
VAP			16,419	45
Isolation ward				
UTI	21	6.2	90,326	247
BSI			90,496	248
VAP			31,345	86
A block				
UTI	24	7.1	1,03,230	283
BSI			90,496	248
VAP			35,823	98
Emergency medicine				
UTI	10	2.9	43,012	118
BSI			82,269	225
VAP			14,926	41
Medical oncology				
UTI	40	11.8	1,72,050	471
BSI			3,29,075	902
VAP			59,704	164
TOTAL	**339**	**100**	**45,63,809**	**12,505**

Fig-1: Overall HAI cost – Medicine and Allied departments



Extra cost for Surgery and allied departments / per day / per patient: surgery department is categorized in various departments like general surgery, Vascular surgery, Neuro surgery ,Surgical oncology, Urology, Ophthalmology, Orthopaedics, OBG, Plastic surgery, ENT, Paediatrics surgery, A block. Total beds of 410 are taken into consideration. The cost /ward / department wise /yr calculated. And the cost / day as per the particular ward is calculated. Different HAIs like UTI, BSI, VAP, SSI are considered.

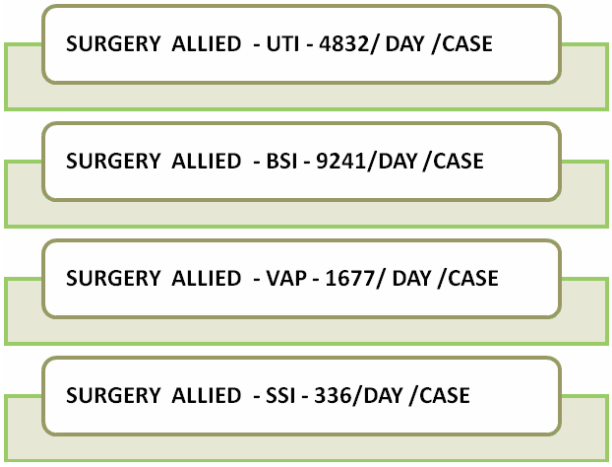
General Surgery 589, 1,127, 204, 41 Vascular surgery 117, 225, 41, 8 Neuro surgery 117, 225, 41, 8Surgical oncology 117, 225, 41, 8 Urology 424, 811, 147, 30 Ophthalmology 589, 127, 204, 41 Orthopaedics 954, 1,826, 331, 66 OBG 942, 1,803, 327, 66 Plastic surgery 259, 496, 90, 18 ENT 259, 496, 90, 18 Paediatrics surgery 129, 248 ,45, 9 A BLOCK 329, 631, 115, 23 UTI, BSI, VAP, SSI Respectively *Per day / Per Patient* has been explained in the below mentioned Table-3.

Table-3: No of beds, % Beds, Extra cost and Cost to Surgery and Allied departments

Surgery and Allied	No of Beds	% Beds	Cost / ward / year / Case	Cost / ward /day / Case
General surgery				
UTI	50	12.2	2,15,062	589
BSI			4,11,344	1,127
VAP			74,631	204
SSI			14,958	41
Vascular surgery				
UTI	10	2.4	43,012	117
BSI			82,269	225
VAP			14,926	41
SSI			2,992	8
Neuro surgery				
UTI	10	2.4	43,012	117
BSI			82,269	225
VAP			14,926	41
SSI			2,992	8
Surgical oncology				
UTI	10	2.4	43,012	117
BSI			82,269	225
VAP			14,926	41
SSI			2,992	8
Urology				
UTI	36	8.8	1,54,844	424
BSI			2,96,167	811
VAP			53,734	147
SSI			10,770	30
Ophthalmology				
UTI	50	12.2	2,15,062	589
BSI			4,11,344	1,127
VAP			74,631	204
SSI			14,958	41
Orthopaedics				
UTI	81	19.8	3,48,400	954
BSI			6,66,377	1,826
VAP			1,20,902	331
SSI			24,233	66

Surgery and Allied	No of Beds	% Beds	Cost / ward / year / Case	Cost / ward /day / Case
OBG				
UTI	80	19.5	3,44,099	942
BSI			6,58,150	1,803
VAP			1,19,409	327
SSI			23,933	66
Plastic surgery				
UTI	22	5.4	94,627	259
BSI			1,80,991	496
VAP			32,837	90
SSI			6,582	18
ENT				
UTI	22	22	94,627	259
BSI			1,80,991	496
VAP			32,837	90
SSI			6,582	18
Paediatrics surgery				
UTI	11	2.7	47,313	129
BSI			90,496	248
VAP			16,419	45
SSI			3,291	9
A BLOCK				
UTI	28	6.8	1,20,434	329
BSI			2,30,352	631
VAP			41,793	115
SSI			8,377	23
TOTAL	**410**	**116.6**	**58,71,161**	**16,084**

Fig-2: Overall extra HAI cost –Surgery and Allied departments



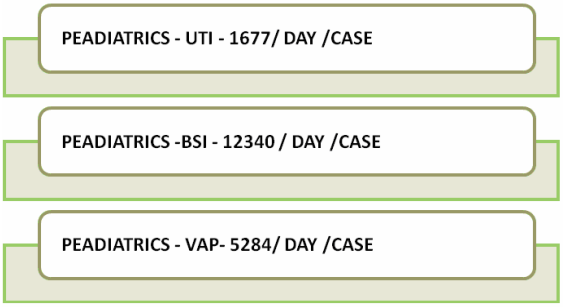
Extra cost for Intensive careunit [ICU] category per day / per patient: Various ICUs like Multi-disciplinary intensive care unit [MICU], surgical intensive care unit [SICU], STEP DOWN intensive care unit, Labour Room, Isolation intensive care unit, Neonatal intensive care unit [NICU], Paediatric intensive care unit [PICU], Emergency intensive care unit [EICU], Total beds of 96 in ICU category. MICU 8,782, 16,797, 3,047, 611 SICU 2,867 , 5,485, 995, 199 STEP DOWN 4,480, 8,570, 1,555, 312 LABOUR ROOM 11,470, 21,938, 3,980, 798 ISOLATION 1,120, 2,142, 389, 78 NICU 21,685, 41,477, 7,525, 1,508 PICU 7,572, 14,483, 2,628, 527 EICU 2,867, 5,485, 995, 199 UTI, BSI, VAP, SSI respectively *cost per day / per patient* as shown in the Table-4.

Table-4: No of beds , % Beds , Extra cost and Cost related to ICU Category				
ICU	**No of Beds**	**% Beds**	**Cost / ward / year/ Case**	**Cost / ward / day Case**
MICU				
UTI	14	14.6	60,217	8,782
BSI			1,15,176	16,797
VAP			20,897	3,047
SSI			4,188	611
SICU				
UTI	8	8.3	34,410	2,867
BSI			65,815	5,485
VAP			11,941	995
SSI			2,393	199
STEP DOWN				
UTI	10	10.4	43,012	4,480
BSI			82,269	8,570
VAP			14,926	1,555
SSI			2,992	312
LABOUR ROOM				
UTI	16	16.7	68,820	11,470
BSI			1,31,630	21,938
VAP			23,882	3,980
SSI			4,787	798
ISOLATION				
UTI	5	5.2	21,506	1,120
BSI			41,134	2,142
VAP			7,463	389
SSI			1,496	78
NICU				
UTI	22	22.9	94,627	21,685
BSI			1,80,991	41,477
VAP			32,837	7,525
SSI			6,582	1,508
PICU				
UTI	13	13.5	55,916	7,572
BSI			1,06,949	14,483
VAP			19,404	2,628
SSI			3,889	527
EICU				
UTI	8	8.3	34,410	2,867
BSI			65,815	5,485
VAP			11,941	995
SSI			2,393	199
TOTAL	**96**	**99.9**	**13,74,708**	**2,02,566**

Extra cost of Paediatrics department per day / per patient: For the paediatrics department total beds of 50 are taken into consideration. The cost /ward / HAI wise /yr calculated. And the cost / day as per the particular ward is calculated for different of HAIs like. 1,677 UTI, 12,340 BSI, 5,283 VAP respectively *per day / per patient*

Table-5: No of beds , % Beds , Extra cost and Cost to Paediatrics department				
Peadiatrics	**No of Beds**	**% Beds**	**Cost / ward / year / Case**	**Cost / ward/ day / Case**
UTI	50	14.6	83,874	1,677
BSI			6,17,015	12,340
VAP			2,64,192	5,283
TOTAL			**9,65,081**	**19,300**

Fig-3: Calculation of Cost / Day / Ward for – paediatric departments – overall HAI (UTI, BSI, VAP, SSI)



Discussion

Incremental cost is an important factor to find the extra cost paid by the patient.Health care associated infections causes increase in the incremental cost. This incremental cost is a burden for all category of health care workers. Incremental cost is always a burden for all category of people involved in the patient care. The incremental cost was calculated based on the ward category for most commonly occurring health care associated infections like UTI, BSI, VAP and SSI. The study was mainly focused on calculating the cost as per the speciality wise services available in the study hospital. Paediatrics and ICU category were taken separately.

Calculating the incremental cost among the different departments helps us to identify the approximate cost per department wise and the masseurs can be adopted to reduce the burden of HAI as per the speciality wise / department wise. The study was mainly focused on calculating the incremental cost The cost was calculated using the various parameters like No of available Beds in department wise percentage of Beds Cost / ward / year / case And Cost / day/ ward / case for all the HAI is calculated. The purpose of estimating an incremental cost helps any organization to guide the uncertainty / cost incurred due to HAI. Incremental cost is a representative of the various complex relationships like rate of different type of HAI, Hospital Costs, and the impact of rate of each different type of HAI. The incremental cost helps in eliminating a number of health care associated infections that can be preventable. Appropriate measures and standard operating protocols can be adopted to reduce the cost in any category of health care set up.

Estimates of the incremental use of resources associated with HAIs vary significantly in published reports. Such variations are partly a result of the different settings and patient populations from which data were collected and partly a result of the different economic models used for each study. Infections acquired in surgical settings, for example, may have, on average, a greater impact on resource utilization than do those acquired by medically managed patients. Moreover, estimates from single-centre studies will reflect the local case mix and practice of the centre. The choice of statistical methodology can also lead to significant variation in the estimates of HAI-attributable cost and length of stay [LOS]. In Spanish hospitals, the prevalence of nosocomial infections in 2014 was 5.6% of admitted patients, and a substantial proportion of these infections (15.3%) were bloodstream infections (BSI) [5].

The cost increase of hospital care due to the presence of bacteraemia oscillates between $5875 (€7814) and $86,500 (€115,045) [6]. Due to the wide variation in patient profiles, the type of infection, the causative organisms, and calculation methods. The few analyses including all patients in a hospital have reported excess costs of €11,916 [7] and €12,853 [8].

The development of Nosocomial Infection is the major consequent risk at any given point of time while a patient is receiving a care in the hospital. Risk of nosocomial infection is a problem of healthcare quality which may be due to improper hand hygiene, Personnel protective equipment's during patient care.

Many studies have shown that there is an increase in the cost due to health care associated infections, this in turn due to longer stay, more laboratory tests, and antibiotics. In addition, a hospital-acquired infection generates additional days of stay, turning length of hospital stay into a time-dependent bias. Other biases are related to uncompleted information on other confounding variables (default variable bias) or inclusion of an inadequate number of control cases in the sample (selection bias) [9- 11].

Conclusion

Incremental cost is a novel approach in estimating the economic burden of health care associated infections.The incremental costs are exclusive of administrative penalties or long-term outcomes for patients and caregivers such as lost productivity or indirect costs involved in treating the patients. Average cost / patient paid by SSI patients was highest 60256, BSI-60221, VAP – 5021, UTI-27077, UTI was the least paid cost. Incremental cost helps us to allocate the budget for individual departments and helps to monitor on regular basis to have tight control on reducing the infections by appropriate standard operating protocols and polices.

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