Guest Editorial

Smart Health for Smart Cities

Most discussions on Indian health care invariably journey to the topic of dichotomy; the reality of two India's is not new – it is an undeniable truth that pervades most aspects of life in our nation. Illiteracy coexists with several brilliant academics in the world; abundance is contrasted by abject poverty. More ironically, for a nation, i.e., powering the technology revolution in the world, large percentages of our population remain untouched by the digital revolution.

The Digital India movement saw this gap, and is making a comprehensive effort to remedy the situation. Smart Cities is an ambitious and game-changing initiative under this umbrella. With a clear objective to bring about sustainable and inclusive development, these cities can be characterized as developed urban areas that create sustainable economic development and high quality of life by excelling in multiple key areas: Economy, mobility, environment, people, lifestyle, governance, and, most importantly, health.

Core to the Smart City initiative is the promise of Smart Health. The theme of "Smart Health" encapsulates intelligent, networked technologies for improved health provision, is recognized as one of the most promising remedies to the rising per capita health care expenditure, and as the solution to address the challenges of the Indian health care system. Smart Health innovations allow health care providers to cure more effectively, to care for patients more efficiently, and to prevent frequent occurrence and reoccurrence of illnesses. Smart Health involves the use of computational technologies, smart devices, computational analysis techniques, and communication media.

The sweeping change that Smart Health promises is an imperative in the Indian health care context. It is in health care that the dichotomy is the starkest. Private health care in India is comparable to the best in the world and addresses over 60% of the country's medical needs, and yet large segments of our population travel miles to access even the most basic health care. India has highly qualified and highly skilled doctors and also has one of the biggest gaps in health care manpower. This widespread and inherent variance in our health care system has a profound impact on the health of our nation.

India contributes to 16.5% of the total global population and 1/5th of the world's share of diseases.

The primary issue that ails Indian health care is the delivery gap – a burgeoning disease burden is placing a massive strain on our limited infrastructure. The Public Health System in India is overloaded with the coexistence of infectious/communicable diseases and noncommunicable immunological diseases. This is compounded by issues, such as environmental pollution, malnutrition, especially in children, unimproved sanitation, lack of adequate employment, and gender inequality, all of which are priority areas for public policy related to Social Determinants of Health.

The need of the day is to devise alternate techniques to improve the health care systems in India and make health care accessible to all.

Today, we see increasingly complex health care systems all over the world that are driven by the fact that modern medicine is turning into a data-intensive science. Traditional approaches for handling these large volumes of data can no longer keep pace with demand, and are increasingly plagued by unsatisfactory results. Consequently, to cope with this rising flood of data, smart approaches are vital.

Smart Health involves many stakeholders, including clinicians, researchers, and scientists with a wide range of expertise in health care, engineering, software, social sciences, public health, health economics, and management. Smart health care presupposes do it yourself, point of care diagnostics, promoting wellness proactively, Staying Smart the eWay, and is a combination of eHealth, mHealth, and Internet of things (IoT) to provide continuum of care. The system relies on the ability to collect, process, and transform health care data into information, knowledge, and action.

In order to implement Smart Health in Smart Cities, it is important to reach out to huge masses with limited investment and innovative technology. One of the ways in doing so is through mobile devices. This can be mainly

attributed to the fact that India has the second largest mobile phone user subscription base in the world, with over 1 billion mobile phone users.

With regard to eHealth, India has made reasonable progress with milestones like National Health portal. Many IT applications in the National Health portal are also available through mobile apps. Various dimensions of eHealth are health care portals, digitization of health care records (Electronic Health Records), and creation of a centralized IT infrastructure for health care information access.

Apollo Hospitals believes that in order to provide continuum of care, an integrated system of care is required, one which will guide and track patients over time through a comprehensive array of health services spanning all levels of intensity of care.

An effective and innovative use of medical technology, supported by IoT, as a connected device has the potential of increasing access, significantly reducing the burden of disease and the load on health care delivery services. This is achieved through early diagnosis, better clinical outcomes, less invasive procedures, and shorter recovery times. While point-of-care testing devices improve access to health care, integrating in vitro diagnostic machines and smartphones allows self-monitoring.

With the rapid increasing burden of noncommunicable diseases, mass screening for prevention and control will promote the concept of "wellness," not "illness." Low-cost tabs in an intelligent connected ecosystem with point-of-care devices will enable better population health control.

Apollo Hospitals was the first to create a digital patient health record in the country; the group pioneered preventive health checks and actively promotes the concept of wellness through its large network of clinics, hospitals, and tele-clinics. As the path-breaking innovator of technology-based health care delivery and tele-health in India and South Asia, Apollo is technologically and clinically equipped to be at the frontier of Smart Health solution design and delivery. By leveraging infrastructure and IT capability of smart cities, Apollo now aspires to provide continuum of care through smart health solutions.

An ever-growing disease burden and a populous nation demand fast-paced health reforms. We need to achieve what our peer nations achieved across three to four decades in a much lesser timeframe. In this day and age, it is critical that health care systems and health care providers adapt. A synergistic and multisectoral approach between State and Central governments, private health care provider, and medical technology companies can bring about a much required transformation – an era of Digital Health.

Digital is our best bet in the journey ahead. It is our conduit to be truly smart. And let us all be very clear – smart is not a bonus, it is what we need to be. It is our surest way to a happier, healthier, and brighter future.

Sangita Reddy
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Editorial

National Ambulance Code: Toward Safe Roads and Saving Lives

India records more number of deaths from road traffic accidents than most other countries in the world. In addition, with one of the highest motorization growth rate in the world accompanied by rapid expansion in road network and urbanization over the years, our country is faced with serious impacts on road safety levels. The total number of road accidents increased by 2.5% from 489,400 in 2014 to 501,423 in 2015. The total number of persons killed in road accidents increased by 4.6% from 139,671 in 2014 to 146,133 in 2015. Road accident injuries have also increased by 1.4% from 493,474 in 2014 to 500,279 in 2015. The severity of road accidents, measured in terms of number of persons killed per 100 accidents, has increased from 28.5 in 2014 to 29.1 in 2015.

To address the ever-growing concern of untimely deaths, casualty evacuation, and treatment en route, the government embarked on improving the state of ambulances in India. The Ministry of Road Transport and Highways, Government of India, had setup five Working Groups on the 4Es of road safety, i.e., Education, Engineering (Vehicles), Enforcement, and Emergency Care, on the recommendation of the National Road Safety Council. The Working Group on Emergency Care in its report had observed that the real concept of an ambulance is missing in India. Existing ambulances are more like transport vehicles, and any vehicle suitable to lay a patient is called an ambulance without consideration to the overall ambulance design. Research has shown that ambulances are more likely to be involved in motor vehicle collisions, resulting in injury or death than either fire trucks or police cars. Unrestrained occupants, particularly those riding in the patient-care compartment, are particularly vulnerable. It is, therefore, all the more necessary in an ambulance to take care of occupant safety, patient care ergonomics, medical equipment selection and placement, vehicle engineering and integration, etc.

The Working Group recommended that there is a need to formulate the "National Ambulance Code" with necessary amendments in the Central Motor Vehicle Rules (CMVR) that defines the constructional and functional requirements for road ambulances. In view of this, an Expert Committee under the Chairmanship of Dr Shakti K Gupta, Head, Hospital Administration and Medical Superintendent of the All India Institute of Medical Sciences (AIIMS), New Delhi, and comprising experts from AIIMS, Automotive Research Association of India, Ministry of Road Transport and Highways, Ministry of Health & Family Welfare, etc., was constituted by the Ministry of Road Transport and Highways to formulate the "National Ambulance Code." The following important points were highlighted during these discussions:

- There is no standardization of ambulance design across various procurements in the country and the industry is forced to reintegrate their vehicles every now and then.
- Most of the ambulance specifications are written by medical specialists who are unable to translate the user requirements in automobile terminology, thereby resulting in a huge gap between the user expectations and industry deliverability.
- There are certain inherent limitations in the existing laws, which allow goods vehicles to be converted as ambulances for passenger application without incorporating essential safety features in patient compartment like side door, forward backward seating, occupant restraints, certified electrical systems, etc.

During the preparation of the Ambulance Code guidelines, ambulance standards from across the globe were taken into consideration and a review of the existing legislation in India with regard to ambulances was done. There were few glaring observations that emerged from discussions and field research.

The National Ambulance Code classifies Road Ambulances into four types, viz:

1. *Type A Road Ambulance*: Medical First Responder
   Road ambulance designed to provide emergent out-of-hospital medical care to patients when stationary. This vehicle maybe any CMVR-approved Category M or L vehicle suitable for the terrain to be used in, but will not have the capability to transport patients in supine state or provide them medical care inside the vehicle.
2. *Type B Road Ambulance*: Patient Transport Vehicle
   Road ambulance designed and equipped for the transport of patients who are not expected to become emergency patients.

3. *Type C Road Ambulance*: Basic Life Support Ambulance
   A vehicle ergonomically designed, suitably equipped, and appropriately staffed for the transport and treatment of patients requiring noninvasive airway management/basic monitoring.
4. *Type D Road Ambulance*: Advanced Life Support Ambulance
   A vehicle ergonomically designed, suitably equipped, and appropriately staffed for the transport and treatment of emergency patients requiring invasive airway management/intensive monitoring.

The category of First Responder, which also includes two wheeled ambulances, has been specially introduced for the first time in India to cater to the need of providing prompt medical care in congested by-lanes and high traffic areas. Special care has been given to Care Ergonomics, Patient Safety, Oxygen System Design, Infection Control, Crash Rescue, etc., in the Code. The end objective of this code was to ensure uniformity and standardization in ambulance design and ensure the patients a minimum level of care as per the ambulance designation when appropriately staffed and equipped.

This committee submitted the draft document in April 2013 and this was subsequently approved by the Ministry as Automotive Industry Standard (AIS):125 in June 2014.

In 2016, the Ministry of Road Transport and Highways, in collaboration with the Health Ministry, launched a notification for the National Ambulance Code, i.e., applicable for all the ambulances across the country, and existing ambulances shall have to be standardized by April 1, 2018. Presently, various organizations are abiding by these guidelines and the actual impact will be seen in years to come. We are very sure that this ambulance code will pave way for safer roads and faster evacuation.

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ORIGINAL ARTICLE

A Study on the Utilization of Hospital Information System (Ward and Physician) Modules in a Tertiary Care Hospital

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ABSTRACT

Introduction: Hospital information system (HIS) is a key managerial tool for any hospital administrator. It gives him all requisite information online, wherever he is and whatever he is doing, so that he can apply timely interventions and set the things right and thereby take care of patient safety, quality improvement, and also minimize litigation problems in the hospitals.

After the initial introduction of HIS into the organization, the key findings were that the entire hospital operations are HIS driven. From the registration and admission of the patient, to the discharge summary generation of an inpatient, the entire process is guided by the HIS. It was found that the HIS is billing-centric, i.e., the HIS use pathway begins only when the registration fee is billed and the unique health identification number (UHID) of a patient is generated.

The main HIS modules under study are the Ward module and the Physician module. After conducting a utilization study using a structured questionnaire, it is found that the level of utilization of the Ward module is 36.4% and that of the Physician module is 6.66%. Using a Fishbone analysis, the causes of reduced HIS utilization have been identified and using a Pareto analysis the main causes have been found to be Work culture and Lack of mobile handheld devices. Various recommendations have been made to increase the HIS usage.

Keywords: Health care workers, Hospital information system, Physician module, Ward module.

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AIM

A study on the utilization of hospital information system (HIS) (Ward and Physician) modules in a tertiary care hospital.

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OBJECTIVES

- To study the utilization pattern of HIS modules (Ward and Physician modules) in a tertiary care hospital.
- To recommend the remedial measures, if there is gross underutilization of HIS modules.

REVIEW OF LITERATURE

An HIS is a computer system that is designed to manage the hospital's medical and administrative information in order to enable the health professionals to perform their jobs effectively and efficiently. Hospital information systems have a great potential to reduce time, health care costs, and improve outcomes. The information system is capable of capturing, storing, processing, and communicating timely information to the various end users that help to identify the risk of potential adverse events.[1] Generally, the main goals of the HIS are to improve the efficiency of the staff, to remove duplication and unnecessary procedures, to computers as work tools, aiding in performance analysis by making statistics and data mining techniques faster and more accurate, to improve the quality of health care, to create a modern working methods and systems and standardized hospital data communication systems and medical engineering, and to increase data communication between hospitals and medical centers. There is an urgent need to review how the HIS fits into the organizational structure of the hospital and the operational role played by the physicians in it.[2] It is observed that the HIS provides tremendous opportunities not only to reduce errors but also to support the health care professional's job by making available timely up-to-date information, to increase the efficiency of patient care by reducing patient waiting time and to improve the quality of care.[3] According to the BMC Health Services Research 2013 edition, the data stored in the HIS due to proper HIS use is also essential for health care performance indication (PI) studies, which need it for continuous improvement.[4] All in all, it is essential for improved patient care quality.[5]

MATERIALS AND METHODS

A structured questionnaire with one open-ended question was prepared for the Ward module and the Physician module respectively. The study variables were computed

as a comparison in terms of percentage between the available sections, the usable sections, and the actually used sections. A convenient sample size of 30 nurses from 5 wards and 5 outpatient department (OPD) doctors was taken under consideration in the study. Six respondent nurses were randomly chosen from each ward, 2 from each nursing station including 1 medical officer (MO) from each ward. Nurses were the target respondents because in wards they are the end users of the HIS.

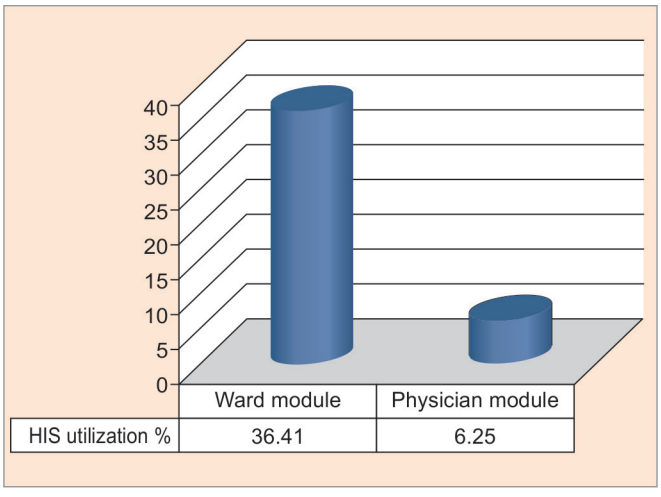
An introduction about the project and the main aim of the study was given to the respondents and it was told to them that their response is vital. The structured questionnaire was administered to the nurses at the end of their daily orientation program. For the OPD doctors, the questionnaire was taken to them personally.

OBSERVATIONS AND DISCUSSION

- Total number of sections in the ward module = 62
  Average number of sections used = 22.58
  Overall percentage utilization = 36.41%
- Total number of written documents maintained in the wards = 33
  Number of these documents that have provisions in the Ward module of the HIS = 19
  Percentage of documents that can be maintained in the HIS but are maintained in hard copy = 57.57%
- Total number of sections in the Physician module = 16
  Average number of sections used = 1
  Overall percentage utilization = 6.25%

The level of utilization of the major HIS modules in the hospital was found to be very low shown in (Graph 1). The causes for this low level of utilization were found.

The overall operational pathway of HIS usage was mapped and then the deviations from the pathway were found.



Graph 1: Utilization of the hospital information system

The overall process (Flow Chart 1) has been explained as follows:

- The patient enters the hospital and registers himself by paying 150 rupees at the registration desk. The REGISTRATION MODULE is used to enter patient name, age, sex, primary consultant's name, and the patients unique health identification numbe (UHID) is automatically generated by the Registration module. This is a unique one-time patient's number that can be rechecked to see if previously he had been admitted or not.
- An OPD patient then takes the receipt and goes to the OPD department for consultation.
- The patient details are reflected in the PHYSICIAN MODULE.
- The consultant physician sees the patient, prescribes him medicines, investigations.
- Taking this prescription, the patient goes to the OPD pharmacy and procures the medicines.
- Based on this prescription, the patient goes to the admission department to enquire about and pay for the investigations needed – Laboratory-based Radiology or Cardiology.
- On receiving receipt, the patient goes to the respective investigation department and test is done.
- The tests results are collected from the enquiry.
- Based on the test result/advise of the consultant, the patient leaves/gets admitted.

Inpatient Department Process

- The UHID and details of the new admitted patient gets updated in the WARD MODULE.
- The bed occupancy status gets updated in the WARD and HOUSEKEEPING MODULES.
- Sister incharge creates patient file hard copy – provision is there in HIS but not used.
- Nurse fills assessment sheet and nursing notes in hard copy.
- MO takes patient medical history.
- Consultant doctor visits and gives Investigation/ Medication advice in treatment sheet.
- Nurse copies these manually in the patient file and indents in the respective HIS modules.
- The results of investigations are printed and again values are manually copied in the patient file by nurse.
- Consultant doctor sees them while on rounds.
- Dietician on rounds sees patient details from the file and advices diet which the nurse copies in the file and accordingly diet is served.
- Operation theatre (OT) request and scheduling is done using OT MODULE.
- Drugs in excess are indented in DRUGS RETURN part of WARD MODULE by nurse.
- For discharge, the discharge summary letterhead is printed and given to Consultant.

- Consultant writes and gives to scribe for typing.
- This copy is corrected by physician and again given to scribe for typing.
- This version is handed to the patient party.
- After patient physically leaves the bed, bed status is changed and housekeeping takes over for preparing the bed for next patient using WARD and HOUSEKEEPING MODULES.

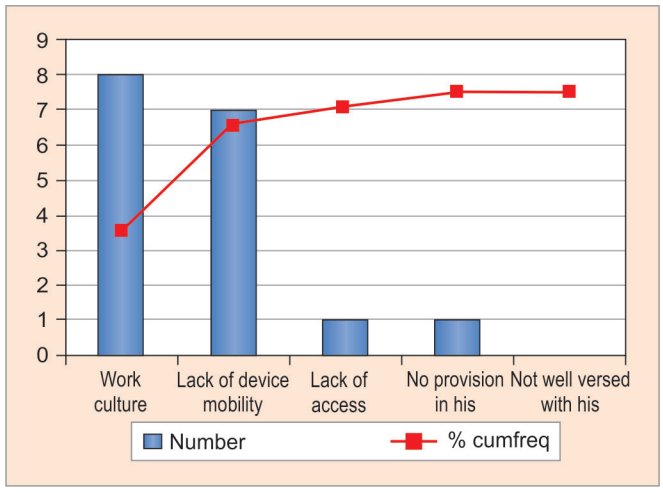
PARETO ANALYSIS ON ERRORS AND CAUSES OF ERRORS

Based on the above data collection, the following Pareto analysis (Table 1 and Graph 2) was done:

Table 1: Work Culture Device Mobility Access of HIS

Causes	*Number*	*Cum.Freq*	*%Cum.Freq*
Work culture	8	8	47.05
Lack of devise mobility	7	15	88.23
Lack of access	1	16	94.11
No provision in HIS	1	17	100
Not well versed with HIS	0	17	100

The Pareto analysis (Graph 2) is done to analyze from which cause, the maximum errors arise. The parameters under study are number of errors and the causes of errors.



Graph 2: Pareto analysis: Ward module usage

From the above Pareto chart, it is observed that the major contributors of error are Work culture in the hospital and Lack of devise mobility or Lack of handheld devices.

A gap analysis is done (Table 2) indicating the differences in how the HIS must be used and how it is being used. Also, the responsible personnel and respective HIS modules have been stated in the following Table 3:

Flow Chart 1: The flow of patients' activities from registration to the OPD consultant physician through the HIS and what the physician should use the physician module to do further.

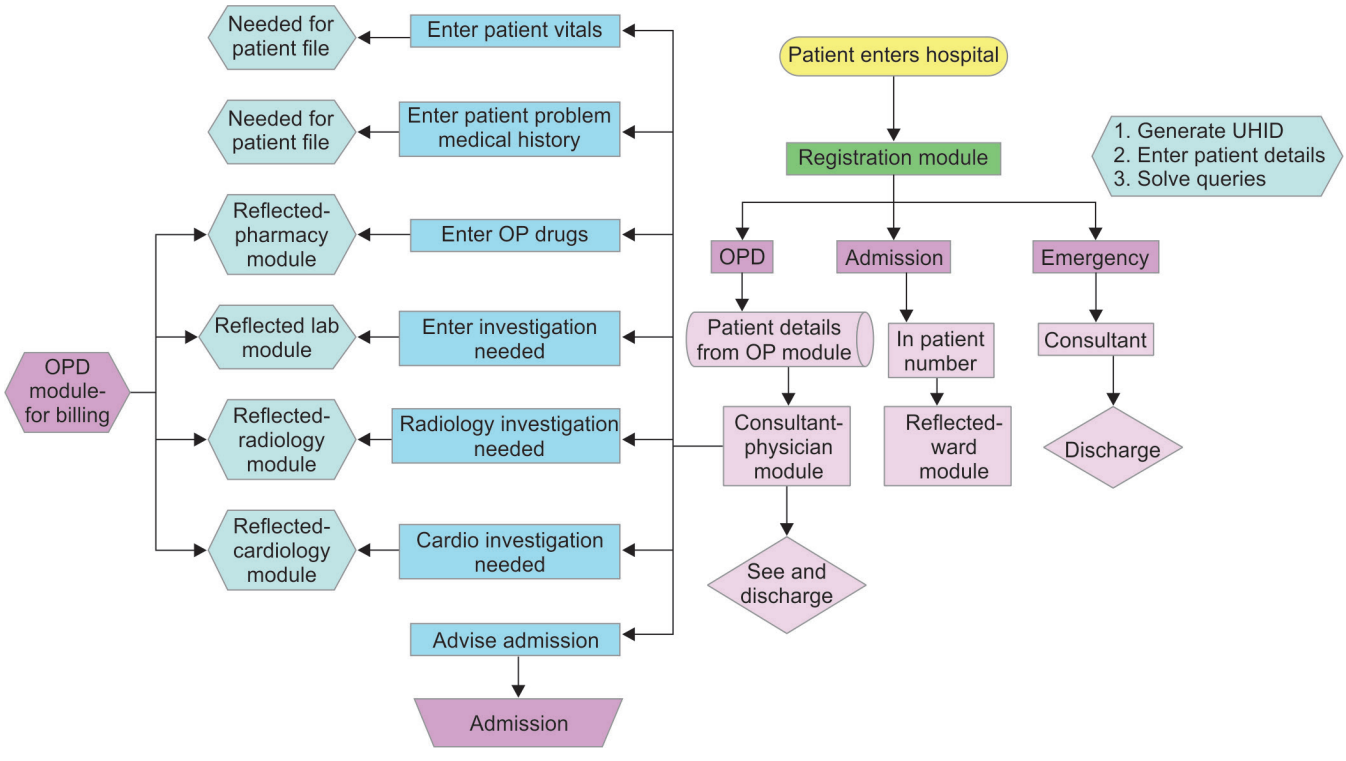


Table 2: Differences in how the HIS must be used and how it is being used

Sl No.	*Error pathway*	*What it should be*
1	Consultant doctor in OPD gives written orders to patient about admission, drugs, and investigation	Consultant doctor in OPD must input the UHID of the patient, give the consultation in a digital prescription using the Physician module.
2	Consultant does not enter history and other patient details in module	Consultant doctor enters patient details in the patient vitals, details, and patient file section of the physician module. This patient file gets reflected in the Ward module also and in turn reduces the clerical work of the nurses if the patient gets admitted.
3	Results of investigations not linked to physician module. Hard copies printed and viewed.	PACS is not linked to the HIS. But from the Laboratory and Cardiology modules, the UHID of the patient is entered and then the corresponding test results are entered. This gets reflected in the Ward and the Physician module. No printing of reports required.
4	Admission advise given in writing not through HIS	Admission advice given by the physician in the Physician module.
5	Inpatient department (IPD) – sister incharge creates patient file hard copy – provision is there in HIS but not used	If the patient is coming from the OPD – as stated earlier. Otherwise the sister incharge compiles the details directly in the patient file section of the Ward module.
6	IPD – nurse fills assessment sheet and nursing notes in hard copy	Nurse fills patient assessment sheet and nurses progress notes in the respective sections in the Ward module.
7	IPD-MO – takes medical history, checks other specifications in hard copy	MO refers to the medical history that is already entered by the physician. Or the MO enters it in the patient file section of the Ward module.
8	Consultant doctor visits and writes medications, investigations in doctors' notes. Nurse indents into HIS.	Doctor directly indents in the Ward module of the HIS.
9	Dietician visits and checks history and suggests diet to nurse, not directly through HIS Dietician module	Dietician uses the Dietician module of the HIS where on input of the UHID of the patient all details are visible and he/she can suggest diet which will be reflected in the diet chart/diet plan section of the Ward module.
10	Investigation reports from lab (SRL reports) downloaded and radiology reports printed to be viewed by consultants. No link with Physician module	This is a technical subject for the IT vendor. But direct results communication must be made available to the physician/doctor.
11	Values from hard copy report manually entered in patient file by nurse.	Test result report values are entered by the lab report compiling personnel directly in the HIS by entering the patient UHID from the Lab module of the HIS.
12	Investigation sheet, clinical chart, intake output record, diabetes management, nurses daily assessment, activity sheet, nurses progress notes, print of lab reports maintained in hard copy by writing even though provision is there in HIS	These are entered in the respective sections available in the Ward module of the HIS.
13	Discharge summary (DS) PDF printed sent to consultant who writes and then it is sent to scribe for typing, resent to consultant for checking, and final DS again typed and given.	Physician directly gives the discharge intimation and DS sections against the UHID of the patient from his Physician module from his desk or from the Ward module from the ward.

CAUSES INDEX

Cause Notation	*Cause Details*
A	No provision in HIS
B	No mobility of device – HIS only on desk top
C	Not ready to shift to new technology (work culture)
D	Not well versed with HIS
E	Lack of access

Table 3: Error details chart from observation

Sl No.	*Error*	*HIS Module*	*Cause*	*Responsibility*
1	Consultant doctor in OPD gives written orders to patient about admission, drugs, investigation	Physician	C	Consultant doctor
2	Consultant does not enter history and other patient details in module	Physician	C	Consultant doctor
3	Results of investigations not linked to physician module. Hard copies printed and viewed	Physician, Radiology, Cardiology, Lab	A,B	Lab personnel, doctor
4	Admission advise given in writing not through HIS	Physician	C	Consultant physician
5	IPD – Sister incharge creates patient file hard copy – provision is there in HIS but not used	Ward	B	Sister incharge
6	IPD – nurse fills assessment sheet and nursing notes in hard copy	Ward	B	Nurse

Sl No.	*Error*	*HIS Module*	*Cause*	*Responsibility*
7	IPD-MO – takes medical history, checks other specifications in hard copy	Ward	B	MO
8	Consultant doctor visits and writes medications, investigations in doctors' notes. Nurse indents into HIS	Ward, Physician	B	Consultant doctor, Lab/Radiology/ Cardiology personnel, Nurse
9	Dietician visits and checks history and suggests diet to nurse, not directly through HIS Dietician module	Ward, Dietician	C,B	Dietician
10	Investigation reports from lab (SRL reports) downloaded and Radiology reports printed to be viewed by consultants. No link with Physician module	Physician, Radiology, Cardiology, Lab, Ward	C,B	Lab/Radiology/ Cardiology personnel, Nurse
11	Values from hard copy report manually entered in patient file by nurse	Ward	C	Nurse
12	Investigation sheet, clinical chart, intake output record, diabetes management, nurses daily assessment, activity sheet, nurses progress notes, print of lab reports – maintained in hard copy by writing even though provision is there in HIS	Ward	C	Nurse, Sister incharge, MO
13	Discharge summary PDF printed, sent to consultant who writes, and then it is sent to scribe for typing – resent to consultant for checking and final DS again typed and given	Physician	E,C,B	Consultant doctor

FISHBONE DIAGRAM FOR CAUSE AND EFFECT ANALYSIS

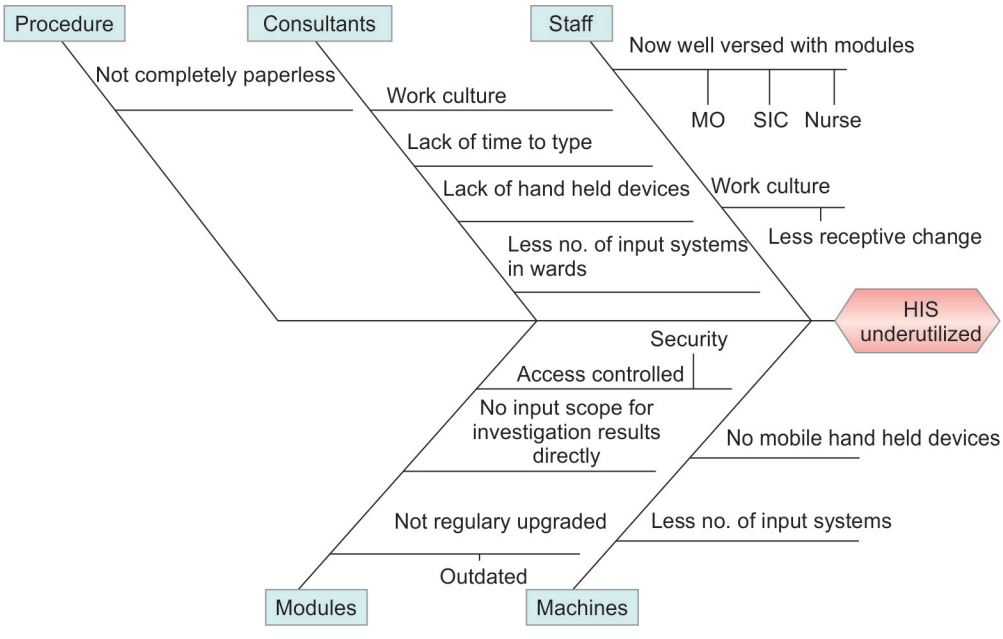


Fig. 1: Fishbone analysis

RECOMMENDATIONS

Based on the analysis and the discussion, the suggested solution to increase the HIS uses are:

- *Implementation of mobile handheld devices*: These can be in the form of electronic tabs given to the doctors in the OPD for digital prescriptions and to the MOs in the wards for input of patient data directly into the HIS. The HIS modules must be installed into the tab.
- *Implementation of a redefined policy or a new SOP* for operations in the wards that use the HIS more.
- *Expanding the current use of HIS*: As in using more sections of the modules so that the level of utilization increases.
- *Training* of the end users regarding the proper use of HIS.

The strength of the project lies in the fact that it has been based on opinions and evaluations of the real end users of the HIS and not of the policymakers in the hospital completely. All surveys are done in the natural working environment of the end users. Assumptions about data have not been made; all findings have been stated only after studying the related reports. (For example, only after

studying the FOS Report May 2015, the pilot study has been initiated.)

CONCLUSION

A well-connected and utilized HIS increases connectivity, maintains proper channels of communication and archives data about each and every step in the entire process flow from patient entry till the discharge of the patient. In this particular hospital, it was found that there was a HIS system but the main modules of the HIS were underutilized. The Ward and Physician modules of the HIS are said to be the main ones as they have the maximum number of interconnections and can be used to operate any other module. One of the major causes of underutilization is the work culture in the hospital. The workforce has been using paper and pen operations since the inception of the hospital and they are not open to the idea of a completely paperless hospital. With training and establishment of new SOPs that define a new paperless method of doing the same work, this hurdle of a stringent work culture can be overcome with the active participation of the higher management. However, greater mobility and connectivity can be achieved if the HIS is installed in handheld devices that can be carried by the end users. Many times paper forms have to be filled by the end users like staff nurses and MOs and then the same data has to be again entered into the HIS. Hence, this is a repetitive time-consuming stage in operations. If a handheld device like an electronic tab is provided with the HIS installed, then this issue can be addressed. Overall, the participation of the higher management and the dedication of the end users is what may bring about a positive change and increase the utilization of HIS modules ultimately aiming toward paperless operations in the hospital.

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Annexure "I"

Questionnaire on Physician Module of HIS Usage

DEMOGRAPHIC DATA:	DEPARTMENT:
NAME:	DESIGNATION:
AGE:	DURATION OF JOB:
SEX:	
ORGANIZATION:	

Respected doctor,

Kindly tick only those sections of the Physicians module of the HIS that are being used by you.

Manage appointments	
Patient details viewing	
Patient drug allergies	
Patient food allergies	
Patient other allergies	
Important patient-specific information entry	
The Rx-consultation outcome of the patient	
Drugs (Medicines) entry into Rx	
Investigation required	
Lab tests required	
Cardiology tests required	
Radiology tests required	
View investigation results in HIS	
Give discharge intimation	
Give discharge summary	
Patient medical history	

Thank you for your cooperation.

Your responses shall be kept confidential and used for educational purposes only.

Annexure "2"

Questionnarire on Ward HIS Module Utilization

DEMOGRAPHIC DETAILS OF RESPONDENT	
NAME:	DESIGNATION:
AGE:	DEPARTMENT:
SEX:	FLOOR:
WORK EXPERIENCE TILL DATE:	SIGNATURE:

Kindly TICK the parts of the WARD HIS MODULE that are being used in the ward. DO NOT TICK those parts which are being maintained in written and not in the HIS.

Drug allergies	
Food allergies	
Other allergies	
Investigations	
Drug orders	
Drug returns	
Medical equipment	
Case sheet	
Bedside procedures	
Intake output	
Vitals	
Other procedures	
Patient progress notes	
Nurses progress notes	
Test requisition	
Results view	
Graphical test result	
Blood request	
Transfusion feedback	
Reason for admission	
Vitals chart	
Diabetic chart	
I.V. fluid chart	
Drug administration	
Hand over/take over	
RMO progress notes	
Visiting doctors charges	
Referral doctors charges	
Transfer request	
Discharge intimation	
Discharge summary	

Patient folder	
Bed status	
Patient tracking	
Billable tariff	
Find patient	
Diet order	
Food order	
Diet chart request	
CSSD	
Physiotherapy request	
Operation notes	
Surgery activity timings	
OT schedule request	
Cath notes	
Cath patient timings	
Cath schedule request	
Biomedical	
HR	
Housekeeping	
Indent order	
Indent receipt	
Indent returns	
IP issues	
IP issues without stock	
Store consumption reports	
Admission reports	
Doctor wise/bed wise admissions	
Current inpatient reports	
Tentative discharge report	
VIP inpatients reports	
Bed status report	

Kindly TICK the most appropriate answer:

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The HIS helps me in making decisions					
The HIS has provisions to compile reports of investigations					
The HIS is easy to use					
The HIS makes my work easier					
The HIS aids in interdepartmental communication					
The HIS makes work faster, saves time					
The HIS needs some changes					

If the HIS NEEDS CHANGES to be made to it, what are the changes you think must be made?

Do you think that there should be an increased use of the HIS?

YES/NO (Please tick)

Thank you for your cooperation. Your responses shall be kept confidential and used for educational purpose only.

Annexure "3"

Questionnaire for Data Source

No.	*Date*	*Name*	*UHID*	*Case*	*Origin*	*Ease of billing rating*	*Respon-siveness of staff rating*	*Sitting arrangement rating*	*Toilets rating*	*Drinking water rating*	*Pre test Prep rating*	*Report generation time rating*	*Radiologist rating*		*Pre test delay in min*	*Post test delay in min*	*Average Delay in minutes*
1	23/6	Mir Mohd Firoze		MRI OP	OPD	5	4	5	4	5	2	1	5		120	190	Pretest av.: 41.9
2	23/6	Sarika Majeed		CTOP	OPD	4	4	4	4	4	3	1	5	Have been waiting for more than 2 hrs of the reports	37	<24 hrs	Posttest av.: 96.52
3	24/6	Ansura Bibi		CTOP	OUT	5	5	5	5	5	3	3	5	Not proper time estimation was given to them	10	<24 hrs	
4	24/6	Sonam Tobgay		CTOP	INT OP	5	5	5	5	5	5	1	5	Report not given on same day, an international patient from Myanmar could not collect his report on the same day of test. It had to be later dispatched.	37	60	
5	24/6	Mithu Ghosh		CTOP	OPD	4	4	4	4	5	2	2	4		130	<24 hrs	
6	24/6	Bandana Bannerjee		CTOP	OPD	3	3	3	4	5	2	1	5	Swiftness lacking	30	<2 4 hrs	
7	24/6	Amiyo Netai Das		CTOP	OPD	5	5	5	5	5	3	2	5		10	37	
8	25/6	Ajoy Misra		CTOP		4	4	4	5	5	2	1	5		51	<24 hrs	
9	25/6	Niloy Ghosh		CTOP		4	5	3	5	5	3	2	5		88	28	
10	25/6	Lopsang Lama		CTOP		5	5	5	5	5	1	1	4		139	10	

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ORIGINAL ARTICLE

Knowledge of Appropriate Prescription of Dental Radiographs among Interns of Two Dental Institutes of Belagavi City: A Questionnaire Study

[1]Parul Tyagi, [2]Zameera Naik, [3]Maria Ana Karina Erica De Piedade Sequeira

ABSTRACT

Aim: To assess the level of knowledge of appropriate prescription of dental radiographs amongst Interns of two dental institutes of Belagavi city.

Materials and methods: A cross-sectional study was conducted on 120 interns of 2 dental institutes of Belagavi city. The knowledge of appropriate prescription of dental radiographs was assessed using a structured, close ended and self-designed questionnaire.

Results: Knowledge of appropriate prescription of dental radiographs was significantly lower in Institute 1 than Institute 2 (p=0.001*).Only a small % of 33.76 and 38.66 of interns of institutes 1,2 respectively had an above average knowledge. Thus, it is inferred that the awareness level of interns of correct prescription of radiographs is lower than expected.

Conclusion: The lack of awareness could be due to various factors such as a lack of previous knowledge, inadequate quality and quantity of educational courses and so on. Thus, students should receive the necessary education on correct prescription of radiographs to ensure their correct prescription, circumventing unnecessary exposure and their consequent detrimental effects.

Clinical significance: Radiographic examination is an important diagnostic tool used by dentists leading to an increased exposure to radiation. However, unessential exposure may lead to detrimental effects such as mutations, genetic changes and so on. One efficient way of decreasing exposure is to avoid their application when not indicated. Thus, it is the professional duty of a dentist to have adequate and accurate knowledge of prescription of radiographs. The present study shows the necessity to optimize educational tools to increase the theoretical knowledge of students and consequently improve clinical application of the knowledge gained.

Keywords: Dental education, Preventive care, Radiograph prescription, Radiation risks.

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INTRODUCTION

Evidently, there is adequate proof of detrimental consequences of radiation in sufficient doses. At present, there is no evidence of such consequences from doses routinely used in dental practice; however, it has not been manageable to prove the absence of such effects. A study by Claus et al[1] found an association between the use of low-dose examinations and meningiomas. Presently, most specialists acknowledge that there may be a small, hard to determine danger of cancer or genetic mutation from diagnostic exposure in patients. Thus, of crucial concern is the growing utilization of radiation for diagnostic purposes in both medicine and dentistry.

Multiple studies prove that the dose of radiation exposure from dental radiography is so minimal that it is highly doubtful to result in a quantifiable risk. Various national surveys reveal the following mean values from exposure to various radiographs: 1 to 8 mGy in terms of entrance surface air kerma for intraoral radiography, about 100 mGy cm^2 in terms of kerma area product for panoramic radiography, 0.257 mGy in terms of entrance surface air kerma for cephalometric radiography.[2,3] These approximates are statistically quite minor, but the consequences are grave. Thus, these risks cannot be neglected. Hence, proper knowledge of prescription of a dental radiograph is of utmost importance and radiographs should be prescribed only when they are needed.

MATERIALS AND METHODS

This was a cross-sectional study wherein written informed consent was obtained from the participants. The study included 120 dental interns of batch 2014–2015 of two dental institutes of Belagavi city. A total of 105 interns participated in the main study and 5 in the pilot study.

A structured, close-ended, self-designed questionnaire containing 20 questions was developed, based on a previously validated and reliable questionnaire and on

the American Dental Association (ADA) guidelines for prescription of dental radiographs, which was updated by the FDA in 2015[4] and a similar questionnaire used for a study in Iran.[5]

The questionnaire was divided into two sections. The first section included informed consent and demographic details, such as name, age, sex, name of institute, and the second section contained a questionnaire. The questions were segregated based on indications of periapical, bite-wing, occlusal, orthopantomographs (OPGs), and lateral cephalometric radiographs.

Every question had four options with one correct option. The participants were required to select any one correct option. Each correct answer received one point and each incorrect answer received nil points. The sum of these points made up the score out of 20, which denoted the level of knowledge of each respondent. The nominal levels of knowledge were assigned as follows: Good, >50% of correct answers; average, exactly 50% of correct answers; poor, <50% of correct answers.

Statistical Analysis

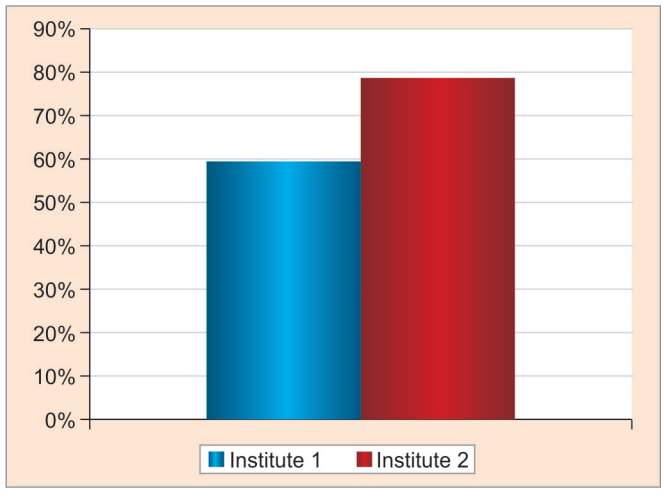
Data entry was done on an Excel sheet and analyzed using Statistical Package for the Social Sciences software, version 16. The knowledge of interns among two dental institutes was compared in each section and the study was analyzed by chi-square test and frequency test. Descriptive statistics was used to represent the data in frequencies and percentages.

RESULTS

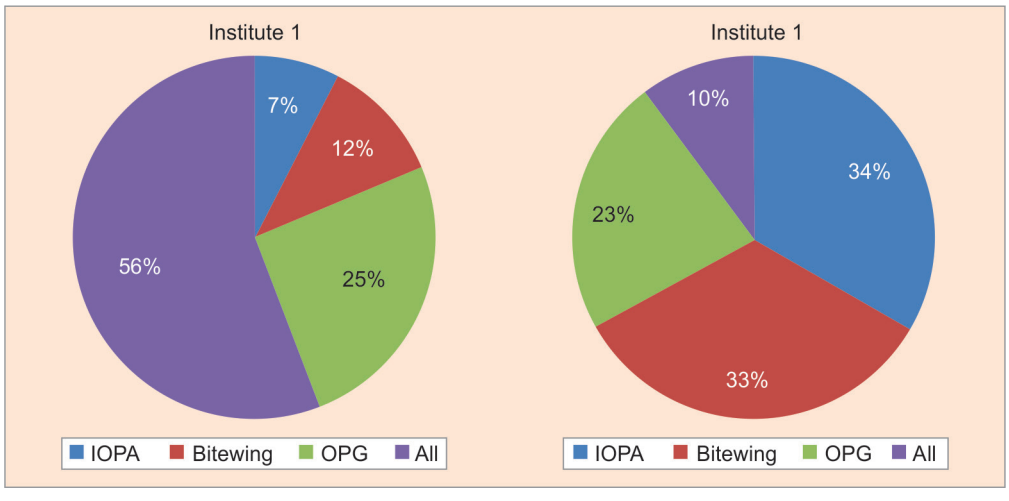
Knowledge of appropriate prescription of dental radiographs was significantly lower in Institute 1 than Institute 2 ($p = 0.001$). The mean knowledge score of dentists in Institute 1 was 59.73% and in Institute 2 was 78.66%. Only 33.76 and 38.66% of interns of Institutes 1 and 2 respectively, had above-average knowledge. Thus, it is inferred that the awareness level of interns of correct prescription of radiographs is lower than expected (Graphs 1 to 6, and Table 1).

DISCUSSION

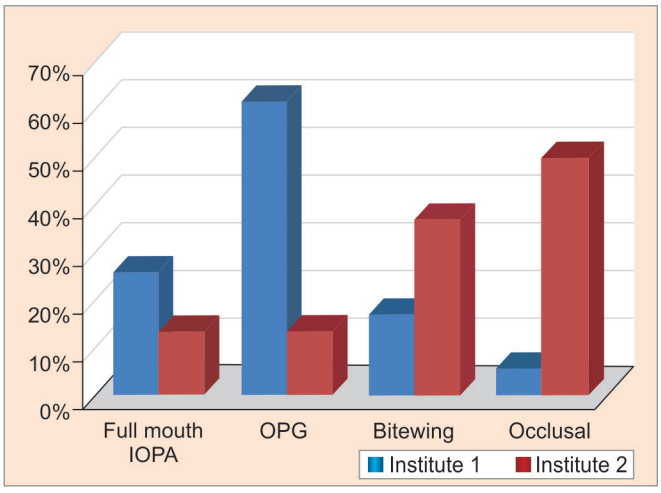
Radiation is potentially damaging. Sadly, the expression of this damage may not be manifested for up to 10 to 20 years, which is the so-called latent period of radiation injury. In humans, free radicals produced through interaction of radiation with water molecules can initiate a cascade of events throughout the cell, damaging cellular macromolecules including deoxyribonucleic acid, proteins, enzymes, lipid, and carbohydrate molecules.[6] Thus unnecessary exposure to radiation must be avoided as much as possible and it is mandatory for dentists and other health care professionals to have basic knowledge of X-ray radiation so that their patients, in particular children and adolescents, are not victims of unnecessary exposure to radiation.



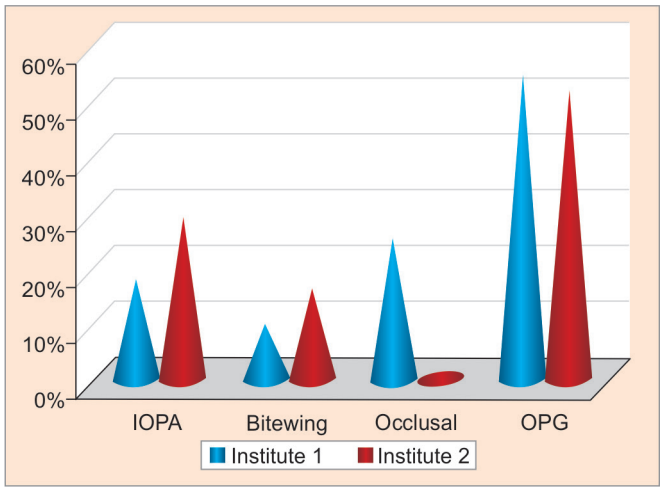
Graph 1: Comparison of knowledge score of interns in institutes 1 and 2



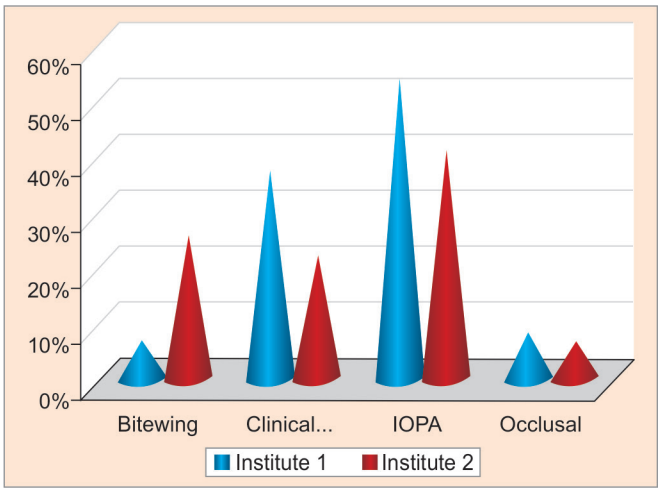
Graph 2: Assessment of knowledge of radiograph prescribed for dentoalveolar trauma



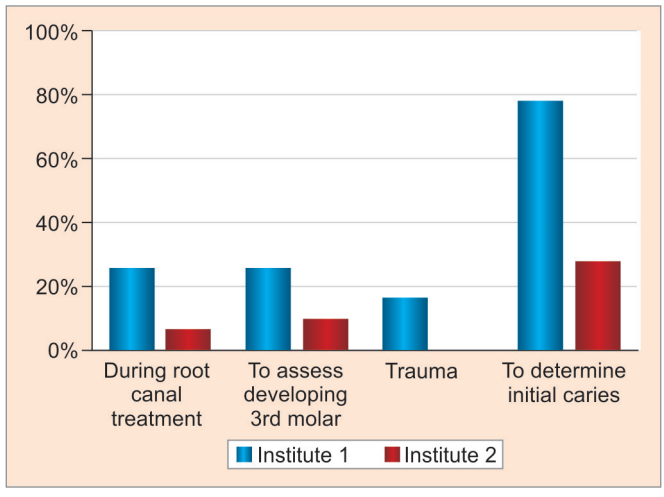
Graph 3: Assessment of knowledge of radiograph prescribed for an edentulous patient going for an implant



Graph 4: Assessment of knowledge of radiograph prescribed for generalized aggressive periodontitis



Graph 5: Assessment of knowledge of preferred method to check for root caries



Graph 6: Assessment of knowledge of prescribing multiple radiographs

Table 1: Overall analysis of the study conducted

Total no. of questions	20
Maximum score	18
Minimum score	3
Above average	66.3%
Below average	33.7%
Mean knowledge score of Institute 1	59.73%
Mean knowledge score of Institute 2	78.66%

In this study, the knowledge of prescription of various dental radiographs was studied among interns of two dental institutes. The mean knowledge score of dentists in Institute 1 was 59.73% and in Institute 2 was 78.66%. There was a statistically significant difference in the knowledge score of the two colleges.

Food and Drug Administration guidelines suggest bitewing examination is the best method for detecting proximal lesions.[4] A study by Akarslan et al[7] showed the highest diagnostic accuracy with bitewing, followed by the periapical and panoramic images. Another study by Kamburoğlu et al[8] on proximal caries detection accuracy using bitewing and panoramic radiography revealed bitewing radiography was superior to panoramic radiography. In the current study, 50.5% of interns of Institute 1 and 23.4% of interns of Institute 2 chose bitewing, indicating a poor knowledge in this area.

The ADA recommends using FDA guidelines for prescription of radiographs, and studies suggesting the benefits of these have been undertaken. In the current study, approximately 50% of interns of Institute 1 and 40% of interns of Institute 2 opted for intraoperative periapical (IOPA) radiographs as the best method for the diagnosis of root caries. A study by Banting[9] on the diagnosis of root caries reveals clinical examination although associated with a large number of uncertainties remains the best method for detection of root caries. Even the ADA guidelines state the same.[4] Interns of both institutes had an inadequate knowledge regarding this, probably due to reduced exposure to such cases.

Radiographic detection of caries is primarily based on the fact that as the caries process proceeds, the mineral content of enamel and dentin decreases.[10] Wenzel[11] claimed that lesions confined to enamel may not be evident radiographically until approximately 30 to 40% demineralization occurs. Yang and Dutra[12] stated that 40 to 60% of tooth decalcification is required for a lesion to be seen radiographically. Thus, radiographs should not be used for diagnosis of early carious lesions. The present study reveals 78 and 28% of interns of Institute 1 and 2 respectively, believed multiple radiographs should not be used for diagnosis of such cases, indicating good knowledge.

Serman[13] suggests, in cases of pain in a tooth with no clinical evidence of caries, a patient may benefit from a bitewing radiograph for detection of interproximal caries. Although no clinical signs exist, the dentist relies on clinical knowledge of the presence of caries to decide that a radiograph has a reasonable possibility to find caries. The present study reveals the interns had just an average knowledge here.

Corbet et al[14] claim that "therapeutic yield" in generalized aggressive periodontal disease can be achieved by panoramic radiographs supplemented by selective intraoral views; 50% of students in both institutes opted for OPG as a tool to assess generalized periodontal diseases, indicating a good knowledge. A study by Molander[15] suggests intraoral radiographs, such as bitewing and periapical are the best when a specific restricted area needs to be studied.

Rushton and Horner concluded that panoramic radiograph was not an appropriate approach for diagnosis of tooth caries and periodontal problems in large number of patients, while bitewing and periapical radiographs were more suitable. In their study, 94% of the dentists answered correctly to this question, the reason could be the increasing usage of this technique by dentists, especially specialists.[16]

A study by Taguchi et al on 64 postmenopausal women concluded that panoramic radiographic findings could serve as a tool for dentists to assess the possibility of latent osteoporosis.[17] Another study in Italy on 45 patients afflicted with chronic renal failure concluded that panoramic radiography is useful in monitoring renal osteodystrophy, especially to assess the response to therapy, such as parathyroidectomy or renal transplantation.[18] The current study reveals a small percent of 31.8 and 7.5 interns of Institute 1 and 2 respectively, opted for OPG. Most interns in both institutes opted for IOPA as a means of diagnosis, indicating poor knowledge in this area. Lack of exposure to such cases may be a contributing factor.

According to the ADA recommendations, before eruption of first permanent molar, radiographic examination to assess growth and development in the absence of any clinical signs and symptoms is unlikely to yield any productive results.[4] Results of the current study, however, were contrary to this. After eruption, the child may have radiographic examination, the reason being that the first molars are the most important teeth. Andrews argumentation for his postulation "First molars are the key to normal occlusion" supports the same.[19]

Cephalometric radiographs are useful for assessing growth and dental and skeletal relationships. This is in correlation to a statement by Salzmann.[20] Lack of exposure to specialist cases may be a contributing factor for a poor knowledge in this area. As per ADA recommendation, occlusal radiographs may be used separately or in combination with panoramic radiographs in case of unsatisfactory panoramic radiographs due to abnormal incisor relationship.[4] In the present study, only 18.7 and 10.3% of interns of Institute 1 and 2 respectively, opted for occlusal radiographs; most interns opted for lateral cephalograms, indicating incorrect views of students. A study conducted by Taylor and Jones[21] concludes the same.

According to an article on diagnosis and management of supernumerary teeth by Shah et al,[22] the most useful radiographic investigation is the rotational tomograph OPG, with additional views in the form of occlusal or periapical radiographs. In case of the possibility of root resorption of a permanent tooth caused by a supernumerary tooth, a long-cone periapical radiographs will be required. In the current study, 7.5 and 3.7% of interns of Institutes 1 and 2 respectively, opted for OPG, indicating poor application of radiographs for diagnosis of supernumery teeth.

A study by Ghosh[23] reveals periapical X-ray view is most suitable to assess the developing 3rd molar as it provides an accurate picture of that region for detail assessment needed. A report by Howe and Poyton shows intraoral periapical X-ray is the best radiograph to predict the relationship of the inferior dental canal and the root of the third molar. However, the disadvantage of this view is the inability to obtain the X-ray in cases of trismus. Lateral oblique X-ray is considered to be a suitable substitute for periapical X-ray in such conditions, though this X-ray does not give an accurate picture.[24] Panoramic radiographs can also be used, but they have limitations; 72% of interns in both institutes chose the option of occlusal radiograph in our study, indicating false perceived knowledge.

One efficient way of decreasing exposure is to avoid their application when not indicated. Thus, it is the professional duty of a dentist to have adequate and accurate knowledge of prescription of radiographs. Thus, dental students should be trained in the right way.

LIMITATIONS

The current study has not considered advanced imaging methods like cone beam computed tomography. The lower dose of radiation exposure and better image quality make it necessary for dentists to be aware of various advanced and better imaging techniques available.

CONCLUSION

With respect to the obtained results, the knowledge of correct prescription of radiographs among the interns assessed was not at a desired level. It can be inferred that the awareness level of dentists for correct prescription of radiographs is lower than expected. This low level could be due to various factors, such as a lack of previous knowledge, inadequate quality and quantity of educational courses in the university or in continuing education courses, and so on. Sometimes, though the students are aware theoretically, clinical application of knowledge is seldom practiced. It is recommended that dentists receive the necessary education on use and implementation of guidelines for appropriate prescription of radiographs.

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ORIGINAL ARTICLE

Streamlining the Process of Communicating and Recording the Gender of the Newborn Child in the Labor Room

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ABSTRACT

Purpose: The article tries to streamline the process of communicating and recording the gender of newborn in the birth certificate in the labor room.

Design: Descriptive.

Materials and methods: Redesigning of the process of recording gender in hospital information system (HIS) module/e-birth module using process mapping and feedback from stakeholders.

Results: There were instances of discrepancy in verbally communicating the gender of newborn soon after the birth and the gender being recorded in the birth certificate issued in the labor room. Soon after these instances were reported, the process was examined and redesigned. After implementation of the redesigned process, follow-up was done and it was noted that there had been no further instances of discrepancies in communication of sex of the newborn child and recording of gender in the birth certificate. However, to institutionalize the change and to prevent any further mishaps in future and to eliminate chances of all possible human errors, it was decided that the whole process will be retested and all possible loopholes will be identified, with the aim to create a process which achieves the objective of elimination of all possible human errors (mistake-proofing). Initially, the process mapping was done. Later, the new process of recording birth-related information including gender was codified and implemented. The follow-up was again done post this intervention. It was found that systemic changes had streamlined the process. This had resulted not only in right gender recording and elimination of possibility of any errors, but also in reduction of number of visits by patients to labor room to get birth certificate.

Conclusion: Investigation of errors and redesigning of processes help in rooting out various defects in the system. Therefore, all the acts of omission/commission resulting in undesirable outcomes should be used as opportunities for overall improvement rather than to find fault of erring employees. As in this case, the overall approach was to improve the existing system leading to elimination of chances of any mistake and streamlining operations leading to desired outcomes.

Keywords: Electronic module, Quality improvement, Root cause.

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INTRODUCTION

Quality improvement (QI) consists of systematic and continuous actions that lead to measurable improvement in health care services and the health status of targeted patient groups. To make improvements, an organization needs to understand its own delivery system and key processes. The key concept behind the QI approach is that both resources (inputs) and activities carried out (processes) are addressed together to ensure or improve quality of care (outputs/outcomes).[1]

Process mapping is a tool commonly used by an organization to better understand the ongoing processes within the system. A process map provides a visual diagram of a sequence of events that may result in a particular outcome. This helps in identifying bottlenecks and potential opportunities for improvement. The process mapping tool can thus be used to evaluate and redesign a current process.[1]

BACKGROUND

Head of the Department of Pediatrics had written a letter to Head of the Department of Obstetrics and Gynecology informing about wrong recording of gender of newborn by junior resident (JR), Obstetrics and Gynecology, in the e-birth record in the month of August 2015. This lapse came into notice when the ward sister in private ward had refused to accept the female baby as on face sheet of case file where the newborn sex had been recorded as male instead of female. On inquiry, it was brought to notice that this baby sex was wrongly entered as male by JR, Obstetrics and Gynecology in the gender column in e-birth certificate module in HIS in labor room. Therefore, face sheet of case file of newborn had shown this baby as male, instead of female.

Medical Superintendent decided to inquire into the matter so that remedial measure could be initiated. Discussions were held with all stakeholders to review

the existing practices and identify immediate remedial measures to ensure that such instances do not happen in future. It was decided to follow QI approach in this case.

This group discussed the matter to find out the root cause of the problem. As it was a matter of grave legal importance and to prevent any such incidence in future, the whole process of e-birth record was examined and intervention was carried out in a phased manner.

A number of QI models are presently in use and five are highlighted here. Two of the models, Care Model and Lean Model, provide a framework to improve patient care, whereas the other three models, Model for Improvement, Focus Analyze Develop Execute and Evaluate (FADE), and Six Sigma, focus on processes that monitor the results of measures. There are four broad steps to the FADE QI model: Focus—define process to be improved, Analyze—collect and analyze data, Develop—develop action plans for improvement, Execute—implement the action plans, and Evaluate—measure and monitor the system to ensure success.[1]

In the present case using FADE model, the errors were identified and analyzed in a step-wise manner. A plan was then developed for removal of the errors that involved redesigning of the Information Technology (IT) processes and existing reporting practices. Progress was monitored for the next 6 months and it was noticed that no case was reported where there was any discrepancy in communicating the gender of newborn after redesigning the process of IT in e-birth module.

Previous Practices

Previously, only pediatric resident used to identify the sex of the newborn and inform the sex of the newborn to the mother/relative and then used to fill the admission slip of the newborn and neonatal case sheet. The obstetrics and gynecology resident used to fill all the details of the newborn in the e-birth form and then after putting their initials used to send the e-birth form to the admission counter for admission of the newborn.

Electronic Birth Module

The documentation of birth is a universal practice widely practiced throughout human civilization. The child shall have the right, from birth, to a name and the right to acquire a nationality. So, the importance of a birth certificate for a child is immense.

According to the Registration of Births and Deaths Act, 1969 (Act no. 18 of 1969), every birth and death has to be notified. Every birth or death is to be reported and registered within 21 days at the place of its occurrence in the prescribed reporting forms. The Birth and Death Certificates in Delhi are issued by the Local Bodies namely MCD, NDMC, Delhi Cantonment Board within 7 days from the date of receipt of application from the applicant, provided the birth/death has already been registered. This procedure is being followed as per the guidelines of Registration of Births & Deaths Act 1969 (RBD Act) and Delhi State Rules for Registration of Births & Deaths 1999. The MCD introduced computerization of births and deaths on 19 February, 2003. The MCD had introduced a scheme called On Line Institutional Registration where nearly 400 hospitals have been empanelled and issued user id and password for uploading registration data. This software has been appreciated at national and international level and is referred as MCD model.[2]

Background

In December 2014, as a part of digitalization, a web-based application "E-BIRTH MODULE" was introduced in All India Institute of Medical Sciences, New Delhi, India.

PROBLEM IDENTIFICATION AND QI TOOL IMPLEMENTATION

In the instant case regarding miscommunication of gender of the newborn child, the following problems were identified during the initial meeting held with the various stakeholders (as per FADE Model of Quality Initiative):

The ongoing practice was that only Pediatric resident used to identify the sex of the newborn and inform the sex of the newborn to the mother/relative. Pediatric resident used to fill the admission slip of the newborn and neonatal case sheet thereafter. The Obstetrics and Gynecology resident used to fill all the details of the newborn in the e-birth form, and send the e-birth form as part of procedure for admission of the newborn.

With this process, the following problems were being faced by the residents of Department of Obstetrics and Gynecology:

- While filling the e-birth form, there were various entries in the e-birth form which did not have any options in the scroll down menu and this sometimes led to mistakes.
- While filling the e-birth form, male sex and Hindu religion were being shown as default settings on the form and sometimes on scrolling down, the selection of female sex got changed automatically to male. Time of admission and date of delivery were being shown as zero in default settings and APGAR score was being shown as 1 in default settings.
- Address on the birth form was self-populated and was the same as on the face sheet of the admission paper. Some patients used to come back searching for the same resident who had signed earlier on the birth form with a request to make changes in the

address after the documentation had been completed. To accommodate such requirements, the birth form printout used to be taken out and the concerned resident (who had signed the certificate earlier) signed the form with correct address. This forced the newborn's family members to make one or more visit to hospital to get necessary changes made in address, which was a major cause of inconvenience to the patients.

- The computerized form had few spelling mistakes which needed correction.

Quality Improvement Remedial Measures and Action taken

Initially, the following remedial measures were undertaken immediately by obstetrics and gynecology residents to prevent the above-mentioned problems:

- On the directions of the head of department, obstetrics and gynecology, all the obstetrics and gynecology residents had started declaring the sex of the newborn child to the mother or the relatives in addition to the Pediatrics resident.
- In addition to this, the birth register and the live birth form were being filled and signed by the resident conducting the delivery in legible handwriting and a senior resident (SR) countersigned it. But still, some residents were not writing their names under the signature and the relative's signature was also being taken without any mention of his/her relationship with the mother or the name of the relative was not being mentioned on the form.

After the above-mentioned problems were identified by coordinating various meetings with the stakeholders, another meeting was arranged by the Department of Hospital Administration with the Computer Facility to rectify the problem and to incorporate necessary changes required in the e-birth module.

The initial changes incorporated in the e-birth form were as follows:

- The computer program was modified to add a counter signature block column in the existing form where the name of the SR assisting the procedure could be entered in the system and an additional separate column was added at the end of the form, where a note stating that "The above-mentioned particular are correct in my knowledge and no correction will be made in future" and below this statement the father/mother/relative name was written with signature block.
- The computer program was modified to show "select" as default option for all the below mentioned situations and then on scrolling/drop down relevant options can then be selected as depicted in Table 1:

Table 1: List of changes carried out in the computer program

Sl. no.	*Default settings before intervention*	*Default settings after intervention*
1	Sex—female	Sex—select
2	Religion—hindu	Religion—select
3	Methods of delivery—natural	Methods of delivery—select
4	Nature of labor—spontaneous	Nature of labor—select
5	Rupture of membranes—artificial rupture of membranes (ARM)	Rupture of membranes—select
6	Induced vaginal delivery—successful	Induced vaginal delivery—select
7	Trial of labor before lower segment cesarean section (LSCS)—yes	Trial of labor before LSCS—select
8	Gestational age—appropriate-for-dates (AFD)	Gestational age—select
9	Live birth—live born and fresh	Live birth—select
10	Time of admission—zero	Time of admission—select
11	Date of delivery—zero	Date of delivery—select
12	APGAR score—1	APGAR score—select

- In addition, a few medical terminology spellings were also corrected in the e-birth form and were incorporated in the computer software.
- At each step, whenever changes were incorporated in e-birth module by coordinating with the programmer, the changes were then shown to User Department and the Medical Record Department for their feedback. These proposed changes were then made after seeking concurrence of all the stakeholders. These changes made the software more user-friendly.
- All these changes that were incorporated in the e-birth form were again shown to the User Department and then implemented after their concurrence. The changes incorporated in the e-birth form made e-birth module more user-friendly and robust with minimum chances of recurrence of the incidence of wrong entry of sex. These measures helped in streamlining the process and preventing errors of communicating sex of newborn as well as recording of the correct address on the birth certificate.
- There was a need to integrate the e-hospital by the nurse informatics specialists (NIS) with the e-birth module and User Department had to put up the requirements to both the programmer and NIS for smooth functioning. During this exercise, it became evident that all the stakeholders have been working in silos and there is a need for someone to be a connecting links between them to facilitate and coordinate various activities of the user department and the computer facility. The integration of both hardware and software is required and a team approach is a

must to make the system work in a robust manner and to make it foolproof without any errors.

- This was achieved by facilitating and coordinating various meetings, with the programmer in Computer facility and the User Department. This led to streamlining of the process with modification in the e-birth module.
- On follow-up, it was noted that there had been no further instances of miscommunication of sex of the newborn child after incorporation of the changes in the e-birth module.

POST INTERVENTION IMPACT

One year after the implementation of changes incorporated in the e-birth module, a post intervention study was carried out, which showed that there was not even single instance of discrepancy in verbally communicating the gender of newborn soon after the birth and the gender being recorded in the birth certificate. This positive result was possible through a small quality initiative implemented through a team approach.

CONCLUSION

Quality improvement consists of a set of systematic processes and actions that can lead to a measurable improvement in health care services. An organization needs to understand its own delivery system and key processes to make effective changes and deliver quality care to its dependent clientele. Improvement requires change, but not every change is an improvement. The model for improvement is a strategy to systematically and effectively manage change, which stemmed from the work of William Edwards Deming, also known as the founder of continuous QI. A QI program is not intended for attributing blame, but rather for creating systems that prevent errors and improve health outcomes. The QI activities are designed to improve how things work. While the process of finding where the system can be refined or new ways to do things can be challenging, the process can also be rewarding. These QI activities provide an organization with opportunities to "think outside the box" and promote creativity and innovation.[1]

Similar to FADE, root cause analysis (RCA) is a promising approach with considerable face validity as a way of producing learning from things that have gone wrong. A practice which has been followed worldwide for investigation of serious incidents is RCA.[3]

Incident investigation clearly will continue to play an important role in making health care safer, but it must first get better at doing what it does.[3]

Quality improvement is basically a team process and under the right conditions and right composition, a team harnesses the knowledge, skills, experience, and perspectives of different individuals within the team to make lasting improvements. In an organization that seeks to improve patient care services, a team effort by the QI team helps the organization to achieve significant and lasting improvements. In a team, every member brings a unique perspective to the process, i.e., how things work, what happens when changes are made, and how to sustain improvements during daily work, and every member has a responsibility to be active and contributing member of the team. Positive interactions among departments that work together to create a dynamic mechanism for continuously improving processes and outcomes of health care services ensure that quality patient care services are achieved. Successful implementation of a QI program begins with an honest and objective assessment of an organization's current culture, and its commitment to improving the quality of its care and services.[1]

Investigation of such errors helps in rooting out various defects in the system and should be seen as an exercise in overall improvement rather than a fault-finding mission. As in this case, the overall approach was to improve the existing system so as to reduce the chances of a mistake recurring (mistake-proofing). All such exercises have to be collaborative efforts between the users and the hospital administration with the overall aim of improvement of patient care.

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Author would like to thank Dr K Aparna Sharma, Associate Professor, Department of Obstetrics and Gynecology, All India Institute of Medical Sciences, New Delhi, for her intellectual and critical input, and Mrs Atasi Behera, Software Programmer for technical inputs.

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ORIGINAL ARTICLE

An Evidence-based Study on Traffic Flow in Operation Theater

SV Saraswati

ABSTRACT

Introduction: An unusual amount of brisk and continuous traffic of people as well as goods crisscrossing every zone of the theater was noticed at an operation theater (OT) of a cardiothoracic center. Many storage areas were filled with cartons of various sizes which are good media for fungi and bacteria. Interactions with the theater staff and a study of the stores revealed that the traffic of people and goods was interconnected, and improper stores management was the root cause of the increased traffic. The focus of this study was to identify possible reasons for unusual traffic in the OT and to arrive at solutions in an objective manner for optimizing it.

Aim: The aim was to assess the traffic flow in an OT with the purpose to devise and implement measures for optimal and even flow of traffic during surgery and to create an additional operating room (OR) and instrument room and to improve the overall indoor air quality (IAQ).

Materials and methods: Scholarly articles regarding ventilation, traffic flow, and inventory management were reviewed along with information available onsite. The method of descriptive study was adopted. Data were collected after analyzing the traffic flow charts, prestudy questionnaire, nonstructured interview results, and nonparticipant observation study. Tools for the study included: (1) Anecdotal evidence, (2) checklists, and (3) rating scales of three different groups. Compliance levels of five different categories of people in the OT were assessed. Air efficiency microbial culture studies and wound swab cultures were carried out during and postimplementation.

Results: The process also resulted in generation of optimal traffic of staff and goods inside the ORs and decreased air turbulence, collateral benefits, such as (1) creating space for an additional OR, (2) creating a sterile area for storage of instrument packs, (3) optimal space management by segregation of bulk stores, (4) organized inventory control and indenting, and (5) good ventilation in ORs. Changes made in administration and training program increased awareness and compliance levels among staff. No surgical site infection was reported during poststudy observation period.

Conclusion: The study has resulted in improvisations originally conceived, planned, and implemented by the author at the work station. This study facilitated optimizing traffic of people and goods in OT and stores and in improving IAQ. Excellent cooperation among staff, clean and pleasant ambience, peaceful work situation, laid out standard operating procedures, segregated stores, and well-designed work hours boosted the morale of the entire staff.

Clinical significance: One of the main sources of airborne contamination in ORs is dead skin cells called "squames," each around 15 μm or less in diameter shed by staff and patients. A proportion of these may carry harmful bacteria. The rate of shedding increases with movement. This study focused on optimizing traffic of people and goods in the OT and thereby resulted in improving overall IAQ.

Keywords: 5S Methodology, Heating, ventilating, and air-conditioning, Indoor air quality, Operating room, Operation theater, Standard operating procedures, Storage, Surgical site infection, Traffic flow, Ventilation.

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INTRODUCTION

An unusual amount of brisk and continuous traffic of people as well as goods crisscrossing every zone of the theater was noticed at an operation theater (OT) of a cardiothoracic center. Many storage areas were filled with cartons of various sizes which are good media for fungi and bacteria. One of the sources of airborne contamination in OTs is the dead skin cells called "squames" shed by staff and patients.[1] The rate of shedding increases with movement (10^6 CFU/hour) as staff move briskly during surgery. A proportion of these will carry colonies of bacteria that grow on the skin (1 to 1,000 bacterial cells). Normal human skin is colonized with bacteria and different areas of the body have varied total aerobic bacterial counts.[2] Increased and avoidable traffic of people and goods can have harmful consequences to patients.[3,4] Figure 1 shows the layout of the OT where the increased traffic was noticed. The traffic flow of staff is shown in Figure 2. Though there are many other interlinked causes for airborne contamination in operating rooms (ORs), like aerosols, gases, dust, and lint,[3] it was observed that the main cause was increased and avoidable traffic of staff. It was felt that traffic could be regulated by proper planning and rearrangement of storage areas as shown in Figure 3. There were 12 storage areas filled with cartons of various sizes, which were good media for fungi and bacteria and these pollutants adversely affect indoor air quality (IAQ).[5] Interactions with the theater staff and

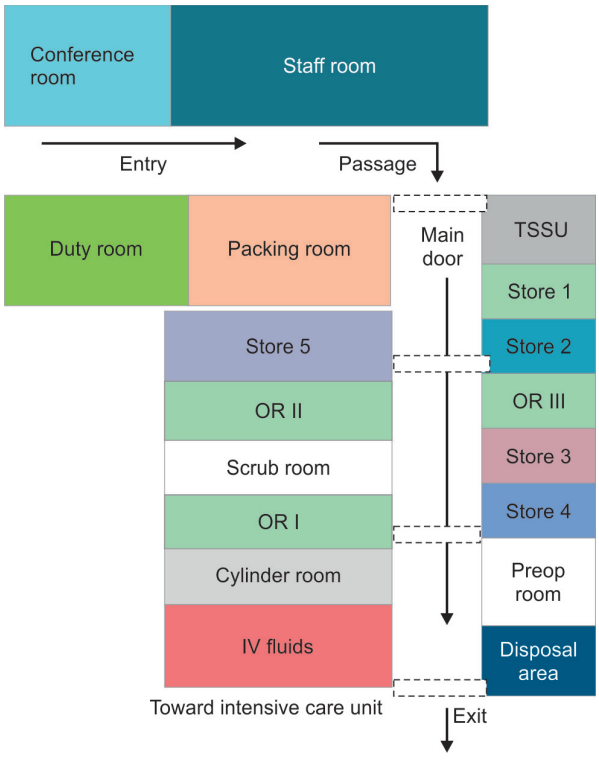


Fig. 1: Layout of OT

study of the stores and traffic flow chart of goods as shown in Figure 4 revealed that the traffic of people and goods was interconnected and improper stores management was at the root of the increased traffic of goods. Increased traffic inside ORs was due to poor material management, lack of awareness, and low compliance among staff. This resulted in the undermentioned issues that need to be addressed:

- Undue delay in procuring surgical and anesthesia items when needed
- Prolonged duration of surgery and increased working hours
- Deterioration of IAQ
- Unpreparedness for emergencies and lack of accountability
- Frequent postoperative wound infections especially in long drawn-out surgeries
- Low compliance among staff in theater management
- Compromised quality of patient care and safety
- Poor material management and decreased job satisfaction and morale among staff

OBJECTIVES

- To find out the root causes of increased traffic flow
- To collect data for analyzing the problem
- To interact with theater staff and obtain feedback
- To analyze data in light of the feedback
- To formulate solutions
- To implement measures to improve situation
- To review the end result after a reasonable time interval

MATERIALS AND METHODS

Material for the study required was all available at the site of study. Some material was sourced from the internet. Academic literature was reviewed to obtain an overview of ventilation systems. Observation of contents of stores in different storage areas, an assessment of space

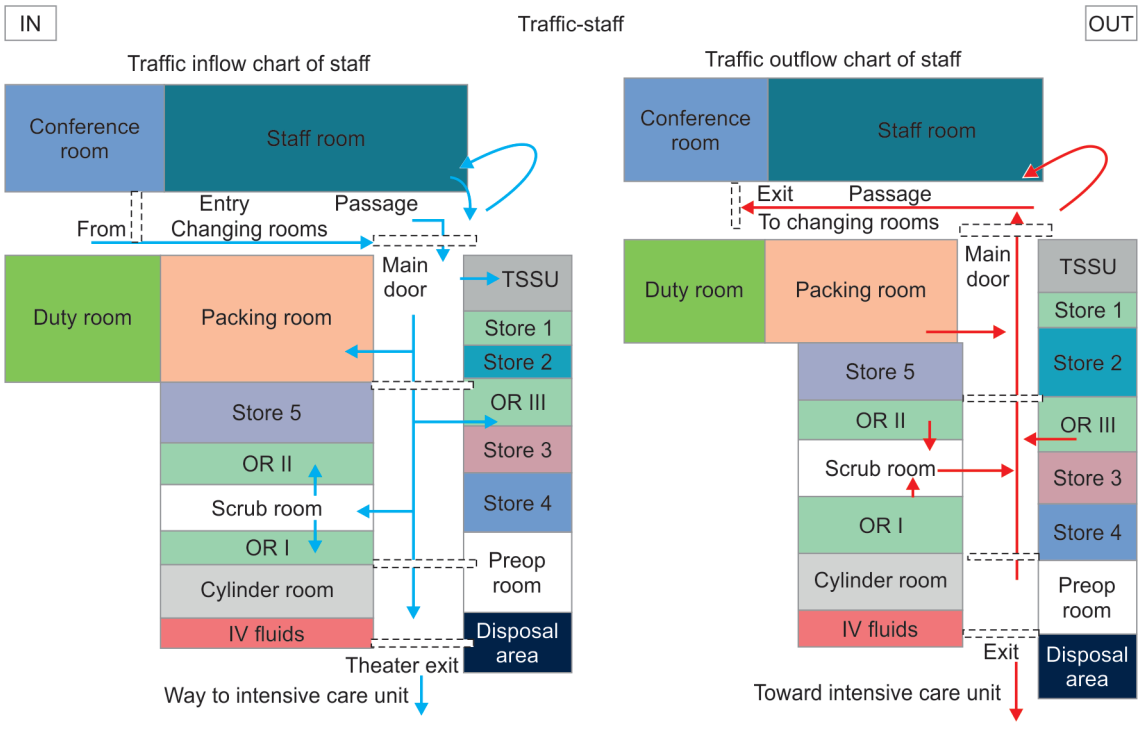


Fig. 2: Traffic inflow and outflow of staff

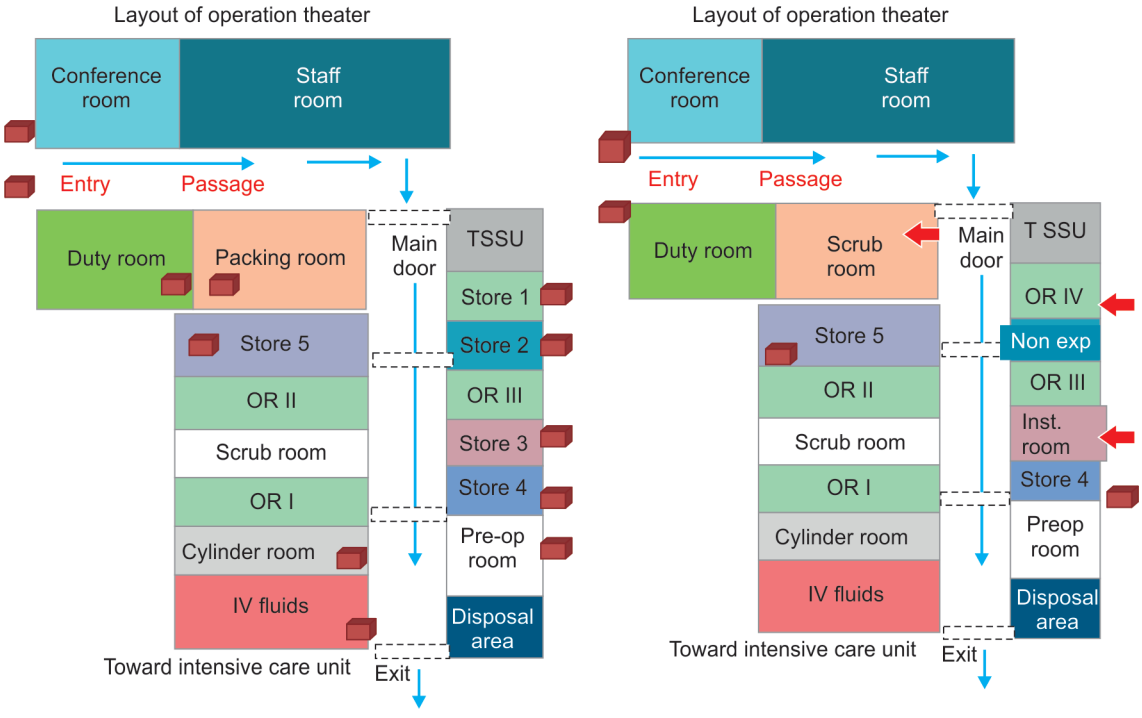


Fig. 3: Storage areas—before and after red arrows indicate

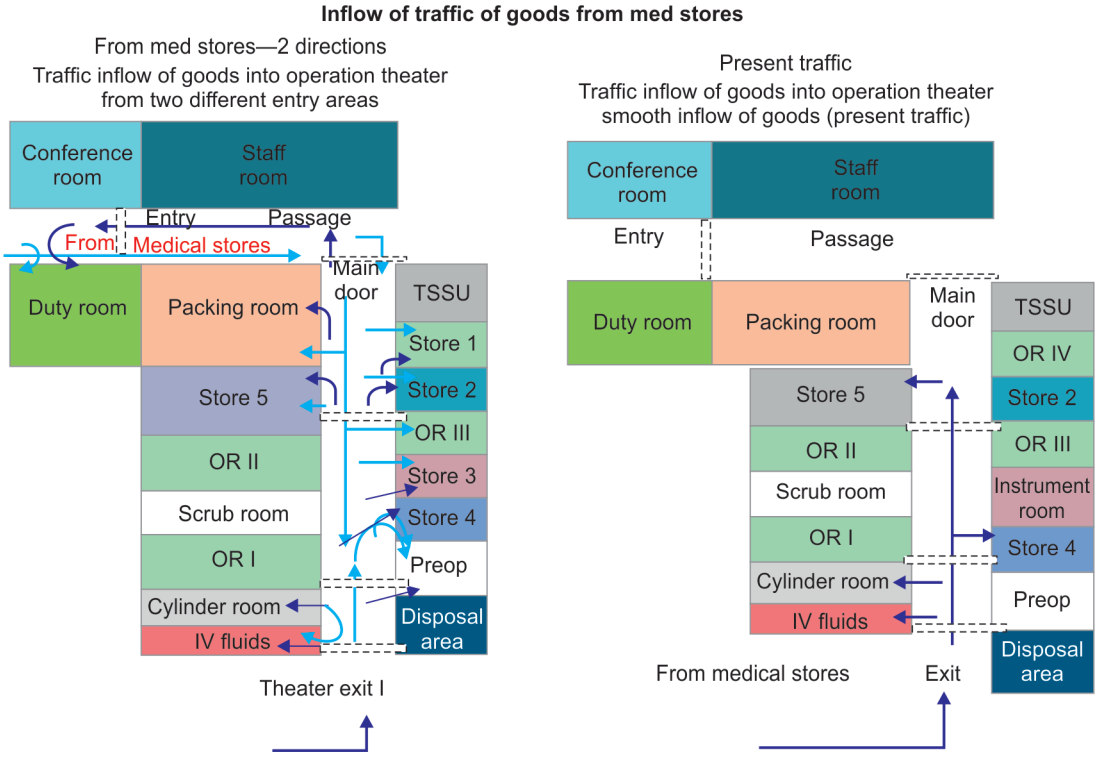
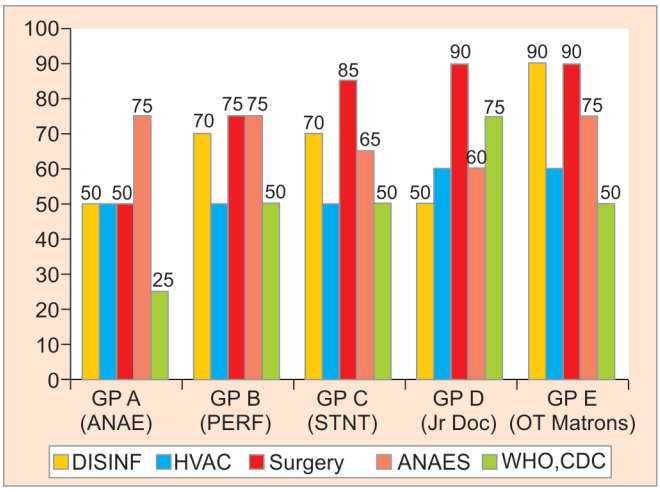
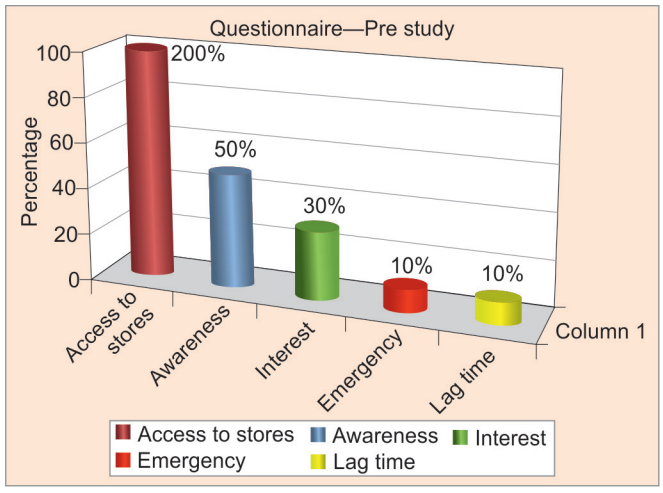


Fig. 4: Traffic inflow of goods into OT (before) and present traffic

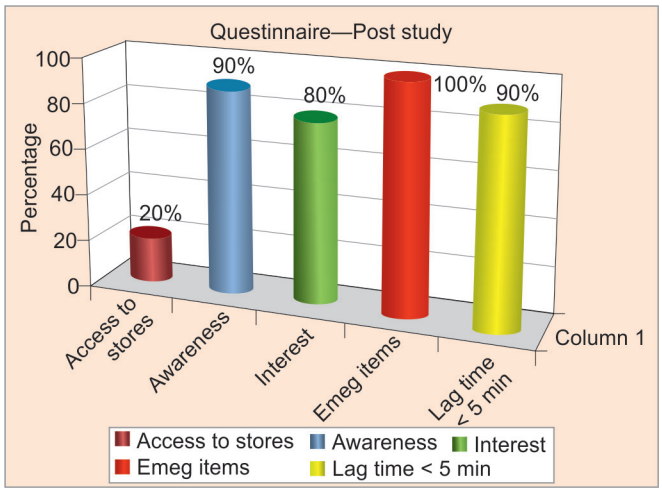
availability for shifting and segregation of storage areas, and ventilation checks to chalk out traffic flow charts were done. The method of descriptive study was adopted. Random unstructured interviews were conducted to assess compliance levels of five different categories of people in OT regarding disinfection; heating, ventilating, and air-conditioning; surgical techniques; and anesthesia techniques. Informal workshops were conducted to appraise staff of the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) guidelines. Tools for the study used were rating scales of compliance in five different groups of professionals



Graph 1: Rating compliance levels among five groups of professionals



Graph 2: Knowledge levels regarding storage—prestudy



Graph 3: Knowledge levels regarding storage—poststudy

Table 1: Checklist scores of three categories of OR staff

		Checklist			
Sl. no.	*What to check*	*Score*	*GP I (Anaes)*	*GP II (Perf)*	*GP III (OT Matrons)*
1	All items and drugs were available	20	15	17	18
2	Emergency articles included	20	15	15	18
3	Additional material kept handy	20	10	10	15
4	Expenditure was correctly charted	20	18	18	18
5	Good time management (lag time > 1 hour)	20	15	15	17
	Total	100	73	75	86

Table 2: Observation of work pattern among three groups of OT staff

Anecdotal evidence (among OT Matrons, AORAs, pefusionists)					
Sl. no.	*Behavioral observation*	*Score*	*GP I (Anaes)*	*GP II (Perf)*	*GP III (OT Matrons)*
1	Location, cost, usage, availability	20	15	10	18
2	Preparation for next day	20	15	15	18
3	Replacing the used articles used	20	10	10	15
4	Performance	20	18	15	18
5	Extra effort to improve	20	10	15	15
	Total	100	68	65	84

as shown in Graph 1. All possible efforts were made to involve the staff at various levels to improve compliance. Knowledge levels of staff regarding storage pre- and post-study are presented in Graphs 2 and 3. Checklist scores of three categories of OR staff are presented in Table 1. Anecdotal evidence is tabulated and presented in Table 2 among three main groups: Anesthesia staff (group I), perfusionists (group II), and OT matrons (group III). Microbial culture studies to assess air efficiency and wound swab cultures of infected cases were carried out during and postimplementation as shown in Table 3. A master plan was made and implemented in 40 days to optimize traffic and reduce air turbulence (Graph 4).

PLAN AND IMPLEMENTATION

After a detailed study of the traffic flow charts, a plan was prepared. Traffic was to be restricted, modified, or stopped altogether to facilitate smooth functioning. To be stopped, traffic was marked and emptying of unnecessary storage areas was done as shown in Figure 3. To be restricted, traffic was decided and implemented. There were four different types of contents in stores

Table 3: Results of air culture after emptying stores

		Air culture reports			
Sl. no.	*Culture source*	*Report*	*Freq*	*Days of study*	*Remarks*
1	OR I,OR II	No growth after 72 hrs	Thrice a week	60	Sterile culture
2	OR III	Pseudomonas grown	Weekly	30	Growth ++
3	OR III	No growth after 72 hrs	Thrice a week	30	Sterile culture
4	OR IV and scrub room	No growth after 72 hrs	Daily	7 days	Done daily after emptying the bulk store
5	OR IV and scrub room	No growth after 72 hrs	Daily	2 weeks	Done daily after emptying the bulk store
6	Instrument room	No growth after 72 hrs	Daily	7 days	Done after emptying storage
7	Instrument room	No growth after 72 hrs	Thrice a week	2 weeks	Done after emptying storage

that needed segregation, i.e., items used in (1) surgery, (2) anesthesia, (3) perfusion, and (4) bulk storage. Entry into storage areas was restricted and traffic to be modified was decided. Traffic routes to decrease turbulence were opened as explained in Figure 4. Days were designated to collect supplies from medical stores. Entry for bulk stores and cartons in sterile areas was disallowed. There were no large containers to store items except cardboard boxes. Administrative authorities were approached for sanctions to purchase containers. Existing cartons were replaced with washable plastic containers. Checklists and standard operating procedures (SOPs) were made mandatory in ORs to know the stock of items available. 5S (Sort, Set, Shine, Standardize, Sustain) work place methodology was used to arrange stores. Segregation of stores resulted in control of traffic flow of goods. Clean and organized pre-operative environments reduce potential sources of injury and infection to care givers and patients.[4,5] Maintaining IAQ and temperature inside ORs is necessary to prevent OR infections and reduce contaminants.[4,6] Clogged air curtains were cleaned and damaged air handling unit (AHU) filters were replaced to improve IAQ. Changes were brought in biomedical waste management and staff was trained appropriately.[5]

LIMITATIONS

Implementation was completed in 40 days. As a precaution to prevent turbulence as well as postoperative infection, shifting was avoided when the cases were on. Initially, there was resistance to the idea in certain quarters. PowerPoint presentations and videos on hospital-acquired infection were screened to educate staff on air turbulence, air-conditioning, infection control, and biomedical waste management. Implementation was interrupted often due to shortage of staff. Since it was a rare kind of study, difficulties were encountered in collecting data from laboratory and the postoperative record section. Secondary sourcing and accessing published topics from books as well as websites on the issue was difficult.

RESULTS

The diagrammatic representation in Figure 1 is the layout of OT before implementation of study. It shows that there are a total of three ORs. The fourth OR was being used as store 1 and instrument room as store 3. Traffic flow path of staff into and out of ORs is explained in Figure 2. The number of storage areas was reduced from 12 to 4 as shown in Figure 3. This also facilitated creation of an additional OR (OR IV) with scrub, and in creating a sterile area for instrument packs as indicated by red arrows. The most important result of the study is generation of optimal traffic of people and goods inside the theater (Fig. 4). Every OR now has a checklist of items to make it self-sufficient. Results of checklists and anecdotal observations presented in Tables 1 and 2 clearly show that among groups I, II, and III, group III (OT nurses) had better preparedness and knowledge about cost and availability of stores and equipment. In Graph 1, compliance levels assessed in five groups of professionals showed better compliance levels in group IV (doctors) and group V (OT nurses). Certain changes made in administration and training programs, and introduction of SOPs and checklists helped in optimizing the traffic of staff. Graphs 2 and 3 present a comparative picture on five parameters: (1) The need to access stores, (2) awareness about storage and availability of stores, (3) involvement of staff, (4) management of emergencies, and (5) lag time for collection of stores. Staff followed "segregation of biomedical waste at source" and correct disposal methods. Good materials management lessened goods traffic in the ORs. The study resulted in optimal space management on account of segregation of bulk stores and labeling/color coding of items in issue stores. By involving and motivating the supporting technical staff and by drafting and implementing clear-cut SOPs, efficient functioning of AHUs was ensured. This resulted in good ventilation, optimum temperature, and humidity in ORs. A review of literature on ventilation was done. It was noted that this theater has "turbulent-mixed" type of ventilation, where fresh air is fed into rooms through ceiling outlets with integrated high-efficiency particulate

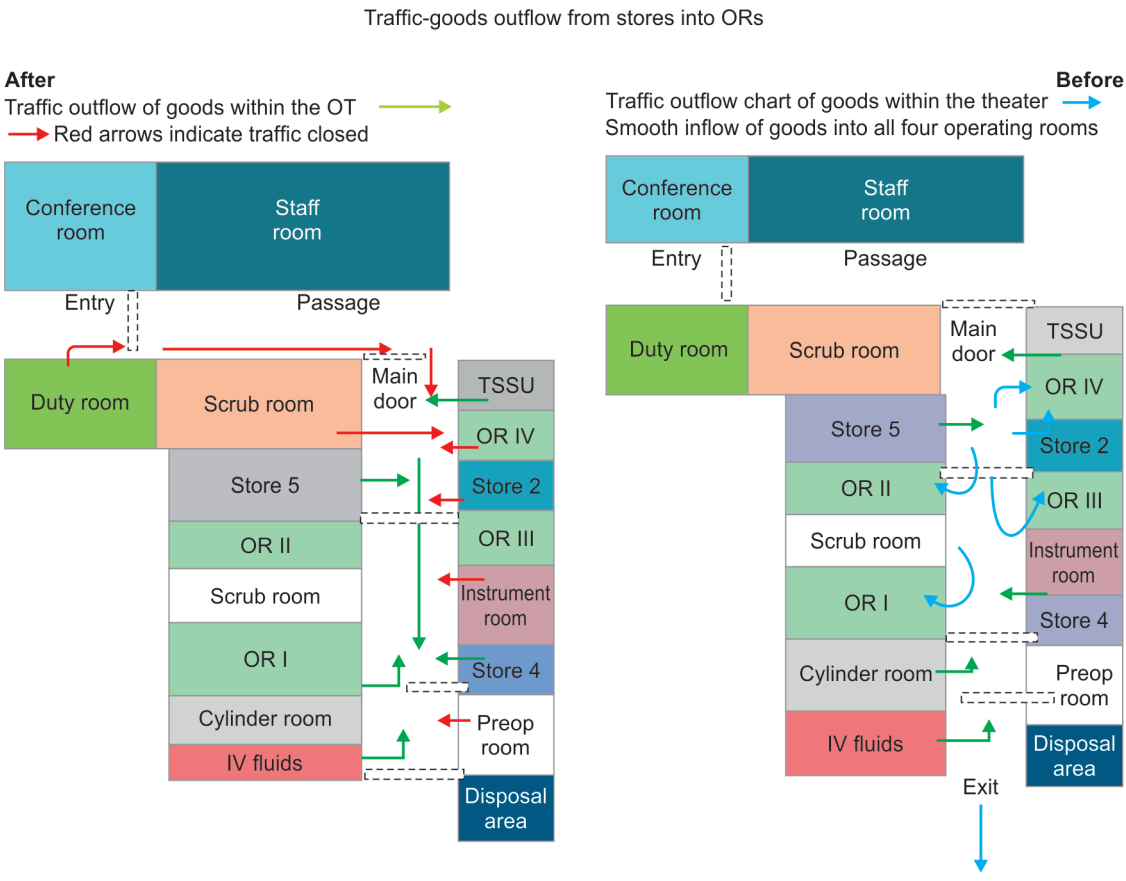


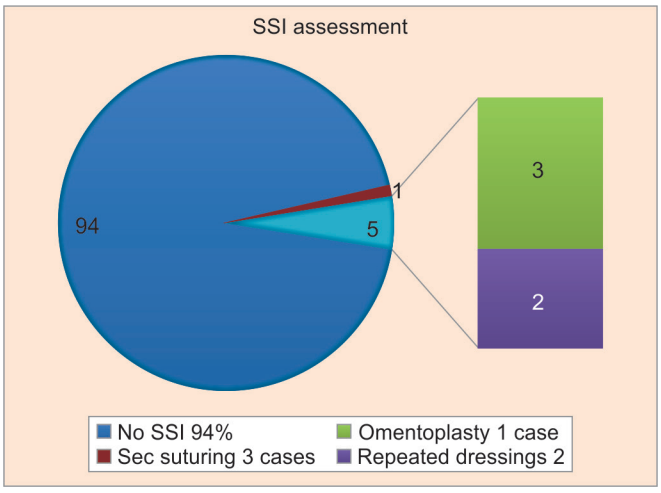
Fig. 5: Traffic flow of goods within the theater. Red arrows show closed traffic

air (HEPA) and mixed with room air. Settle plate method and blood agar cultures of air sampling were done during and after shifting and rearrangement of storage areas, and results were monitored as shown in Table 3. A total of 70 postoperative patients were observed during the 60 days of shifting and implementation of the project. Of these, six cases reported surgical site infection (SSI) as represented in Figure 5. No SSI was reported during poststudy observation period. The introduction of 5S methodology in inventory management resulted in better inventory control. Total computerization of indenting, procurement, and purchase procedures reduced the number of visits to hospital stores.

DISCUSSION

Major findings from this study and observations from literature review: Ventilation study was done by reviewing online research journals and articles available on manufacturing, engineering, and airflow studies apart from CDC and WHO guidelines.

- According to Thomas Schroth,[6] in his study he stated there are two types of ventilation. The ceiling area above the OT table is fitted with HEPA filters in air ducts where two different systems are employed. (1) Turbulent-mixed type of ventilation, where fresh air is fed into rooms through ceiling outlets with integrated HEPA and mixed with room air. (2) Low turbulence displacement flow where the OT table is continuously enveloped in veil of ultrapure air and shields it from surroundings (0.25–0.45 m/s). This theater had turbulent-mixed type of ventilation.
- Incidence of SSI is more in poorly ventilated areas. Incidence of SSI is also high when patient's surgical site is not properly prepared preoperatively.[7]
- In a study done by Leung and Chan,[8] nine hospitals revealed airborne contamination concerns. Effective dilution of air and removal of the contaminants by proper ventilation enhancement methods and ultraviolet germicidal irradiation was recommended.
- Melhado et al[3] in their study of "ventilatory systems in ORs" and Louise Belair and Leed,[9] in recommendations proposed for AIA Guidelines 2006 for design and construction of Hospital and Health care facilities in their publication dated 7/1/2006 "Reducing Operating Room Infections from Top Down," have both quoted a paper titled "Comparison of OR ventilation systems in the protection of surgical sites" (Memarzadeh and Manning, ASHRAE, 108, 2002), which suggests that the main factor of ventilation system design is control of the OR's central region, so the diffuser array should be large enough to cover main heat dissipating objects. The authors suggest ceiling-mounted equipment,



Graph 4: Results of wound swab culture done during study

monitors, lights, and unidirectional airflow along with diffusers with velocity of 25 to 35 fpm and return grills at 6″ above floor level. Measures were taken to keep the vent areas 6″ above ground level and clear of equipment. As this theater was under consideration for modernization, these aspects would be incorporated into future plans.

- Kabbin et al[10] in a review article on "Disinfection and Sterilization Techniques of OT" recommended removal of all foreign material from ORs and manual or mechanical cleaning of air-conditioning ducts on daily basis. Cleaning air curtains and air-conditioning ducts on a regular basis improves efficiency of filters.[10] Galvanized steel air curtains prevent warm air infiltration into cold areas and keep out flames and insects.
- Riley et al[11] in their article on "Indoor Air Quality and Infection Control" highlighted that pollutants in an OR include aerosols, fluids, and anesthesia gases. There are various types of ventilation systems with different airflow dynamics to address the issue of pollution, which need constant supervision. Poor discipline and not maintaining professional decorum can result in sloppy aseptic techniques.
- Nicholas[12] in his study of "Air Filtration Efficiencies in Hospitals" mentions three patient segregation categories where ventilation concerns apply. They are: (1) Airborne infection isolation room: Air may be recirculated if HEPA is used. Reversible air flow switching between protected environments and airborne infection isolation is not acceptable. (2) Protective environment room: Should have 99.9% HEPA efficiency. (3) Immune suppressed host in airborne infection isolation: Rooms with reversible airflow mechanisms or dual purpose are not acceptable. Some SSIs can be caused by particles which can be prevented with better airflow and proper filtration by following correct guidelines.
- Michalska and Szewieczak[13] in their study "The 5S Methodology as a TOOL" stated that implementation of 5S methodology of inventory management not only reduced the traffic of staff and goods but also resulted in organized inventory control and issue stores management. A study by Riley et al[11] explained that centralized receiving, storage, and trash removal, both temporary and permanent are issues that become more complex in hospital settings. With disruptions to ongoing activities during construction, renovation, shifting stores, etc., minimizing inconvenience to patients should be one of the important aspects to be kept in mind. Accordingly, material path ways, barriers, and training of workers need to be done. The 5S methodology improved efficiency and services. It also resulted in reduction of inventory and supply costs and recapturing of valuable spaces and in minimizing overhead costs. These benefits were sustained post-study. The 5S system reduces waste and optimizes productivity through maintaining an orderly workplace.
- Al-Saffar Ali,[14] Royal College of Surgeons of Ireland, in his review study, explained that the application simplifies the activities through reduction of unproductive/unnecessary activities.
- Manual for implementation of 5S in hospital setting[15] mentions that inventory systems of various items need proper tagging, labeling, and periodical review for improvement. It is important that all workers and staff involved should understand the benefits of the 5S methodology and follow rules. It should be reviewed once every month which helps its sustainability. Implementing 5S methodology in a group of disciplined workers leads to improvement of human relations.
- An additional OR with a scrub room was now available reducing the waiting period for surgery. All sterile packs now remained in sterile zone as a new instrument room in the sterile area was made available by rearrangement of stores. The new OR IV and the instrument room are connected to AHU and the air pressure in the OR IV is less in comparison to other ORs and instrument room. Hence, OR IV is more suitable for noncardiac surgeries and hence, utilized for the same.
- Changes in theatre sterile supply unit were made. Instruments were segregated into various packs. Disposable sterilization wraps and biological indicators and integrators for sterility efficiency tests were introduced.
- Maximum traffic was caused by junior staff. The number of airborne microorganisms in ORs is largely proportional to human activity. The more the number of people in ORs, the more contamination, as they

constantly close and open doors causing the air in ORs to mix with corridor air. Traffic in ORs when surgery is on should be minimal, which can be achieved by making every OR self-sufficient. Hence, staff rotation plans were implemented and staff detailed by rotation to ORs, TSSU, and other duties.

- In the area of waste management people needed stricter measures and repeated reminders. More BMW buckets were procured for this purpose. Staff were motivated and trained to follow the guidelines set up for waste management.

ISSUES ADDRESSED

- The lag time in procuring surgical and anesthesia items was effectively reduced as the ORs were made self-sufficient by introduction of tally cards and checklists.
- Involvement and awareness among OT staff has improved as shown in Graph 3.
- Indoor air quality was better postimplementation of study. Removal of excessive bulk storage, cleaning of air curtains, and periodical maintenance of AHUs helped in achieving better IAQ.
- There was accountability and readiness for all emergencies in all ORs. As reflected in Graph 3, compliance of staff in matters of inventory management has increased with continuing education.
- Seventy cases were observed during and post study for SSI. Six cases reported SSI, out of which one underwent omentoplasty. The rest five patients were subjected to repeated dressings followed by secondary suturing in three cases. There was no incidence of SSI in the poststudy observation period.
- Quality of patient care and safety improved as staff had more time to interact with patients. They were even spotted jotting down notes and clarifying queries and counter checking items using tally cards.
- There is organized inventory control and excellent material management.
- Certain items like microwave, water filter, footwear were procured. Better ambience and comfortable work atmosphere was created.

OBJECTIVES ACHIEVED

- The root cause of increased traffic flow was interlinked with goods and stores.
- Data for analyzing the problem were collected at the site.
- Interaction with theater staff yielded useful feedback.
- Data were analyzed and solutions were formulated to address the issues.
- A master plan was conceived and implemented with practical measures, keeping in view the ongoing cases of surgery.
- End results were reviewed continuously for 60 days and also after a reasonable time interval.

CONCLUSION

Not only was this study challenging due to its rare theme but also very interesting in terms of gaining knowledge. Interesting points that have come to notice:

- Cluttered and badly managed stores can cause traffic disturbances.
- Increased traffic in ORs interrupts the sterile air flow within the ORs.
- Indoor air quality reduces when there is more traffic.
- Badly arranged stores can have psychological impact on staff.
- Cluttered stores which harbor bacteria can predispose to postoperative infections.
- The nature of IAQ in the theater can alter the statistics of good postoperative results, and can increase morbidity and mortality.
- Traffic in the theater and within the ORs should have a definite purpose and a clear route to follow. The number of viable airborne microorganisms for a given amount of OR ventilation is largely proportional to human activity.
- A total of 50% of the staff working in theater have very little or no knowledge about air quality, various gadgets of air-conditioning, store management, turbulence, so they should be frequently updated regarding these aspects.
- Waste management is not one person's job but a teamwork.
- High cost of SSI can be easily brought down by improving IAQ.
- It is difficult to change an existing system but it is accepted when reasons are given and results shown.
- Clearly laid down standing operative procedures are not only useful in understanding a procedure but also needed to set in a routine.
- Cooperation between staff and the administrative authorities yields good results.
- No work is kept pending when equipment, ledgers, and stores are kept in order.
- Effective and significant achievement of this study is promotion of a harmonious working relationship among the staff and better patient care.
- The golden adage "a place for everything and everything in its place" is most applicable in theater and stores management.

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ORIGINAL ARTICLE

Why switch to Rental? Costing of Laundry Services at an Apex Tertiary Care Hospital from the View of Outsourcing based on Rental Linen Management Services

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ABSTRACT

Introduction: Modern hospitals are matrix organizations with a high investment in terms of capital, labor, and resources. It is imperative for the hospital administration to provide right material of right quality at the right time. Hospitals that set up in-house laundry operations generally make the decision without thoroughly identifying and accounting for total linen and laundry costs. Now evidence has emerged that hospitals that outsource were seeing improved linen utilization rates. If proper and clean linen is not provided, this can result in patient dissatisfaction. Further, innovations in laundry equipment have led to tremendous increases in efficacy. So, there is a need to ascertain the cost incurred in providing linen and laundry services so as to gauge the plausibility of transitioning to outsourcing-based models.

Aims and objectives: To study the cost incurred in providing linen and laundry services at an apex tertiary care hospital and to evaluate outsourcing model based on rental linen management.

Materials and methods: A descriptive, cross-sectional, retrospective, record-based study was conducted during a period of 1 month from March 1, 2016 to March 31, 2016.

Observations: The quantity of monthly linen washed in Dr Rajendra Prasad Centre was found to be 22,465 kg. The monthly laundry expenditure in Dr RP Centre was Rs. 1,415,295. The linen procurement expenditure per month at Dr RP Centre was Rs. 419,386. So total expenditure on linen and laundry per month at Dr RP Centre was Rs. 1,834,681. Thus, cost/kg (with inclusion of linen cost) was Rs. 82.

Discussion and conclusion: The rate quoted by a leading vendor to supply washed, sterilized linen to the hospital was Rs. 55 per kg. Since the expenditure incurred per kg at Dr RP Centre was Rs. 82, this amounted to a saving of around Rs. 27 per kg. It would mean saving of around Rs. 606,555 per month and Rs. 7,278,660 per annum. So, it was recommended that rental linen management services may be hired for Dr RP Centre after taking care of functional, operational, and strategic contingency.

Keywords: Apex, Linen, Rental.

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INTRODUCTION

Organizations that set up in-house laundry operations generally make the decision without thoroughly identifying and accounting for total linen and laundry costs. This was the conclusion of Textile Cost Manual for the Hospitality Industry #71578, a 1991 study completed for the Textile Rental Services Association of America by Pannel, Kerr, Forster, Certified Public Accountants.[1]

If proper and clean linen is not provided, this can result in patient dissatisfaction. Almost all soiled linen (96.1%) possess some detectable bacteria.[2]

A study by association for the advancement of medical instrumentation found that reusable garment if laundered properly is 70% more effective in providing barrier precaution. Staff handling used linen is predisposed to risk and can be potential agent for environmental contamination.

Moreover, the evidence is emerging that hospitals outsourcing linen and laundry services are seeing improved linen utilization rates. For example, when the University of Nebraska Medical Center outsourced its linen services, it saw its pounds per adjusted patient day decrease. The savings were nearly $100,000 in the first year and the anticipated savings in the future is $250,000 per year.[3]

Further, innovations in laundry equipment have led to tremendous increases in efficiencies. Large tunnel washing systems, with the capacity to wash more than 3,000 pounds of textiles at one time, have significantly decreased water usage from three gallons per pound to less than 0.75 a pound today.[3] These systems, along with chemical injection systems that precisely control the amount of chemicals injected into the washer, have allowed health care textile service companies to reduce the amount of chemicals they need to wash a pound of laundry. Water reuse and recycling systems are becoming more commonplace in professional laundries and are

also helping to reduce the amount of water necessary for the wash process. Heat reclamation systems are allowing energy to be captured throughout the laundry process and returned to heat wash water.[3]

Approach to Costing

Cost is the sacrifice incurred in an economic activity to achieve a specific objective, such as to consume, exchange, or produce. Cost is incurred when, in order to achieve its objectives, an organization acquires resources, transforms them in some manner, and delivers units of products or services to its customer.

Elements of costing are[4]:

- Manpower
  - Direct manpower, also known as process labor, productive labor, etc., is one which actively or directly takes part in the production of a commodity.
  - Indirect manpower is the labor employed for carrying out of tasks incidental to the goods produced or services provided.
- Material/Resources
  - *Direct material*: The material which becomes an integral part of a finished product and which can be conveniently assigned to specific physical unit is termed as direct material.
  - *Indirect material*: This is the material which cannot be conveniently and wholly allocated to a specific cost center. The material, i.e., used for purposes ancillary to the business and which cannot be conveniently assigned to specific physical units is termed as indirect material. Consumable stores, printing and stationery material, etc., are some of the examples of indirect material.
- Expenses
  - *Direct expenses*: are those that can be wholly and directly allocated to the goods produced or to the service rendered, e.g., cost of buying the equipment.
  - *Indirect expenses*: For example, water or electricity charges which cannot be directly allocated to the expenses incurred are indirect expenses.

MATERIALS AND METHODS

Study Setting

The study was conducted at the Laundry of All India Institute of Medical Sciences (AIIMS), New Delhi, and Dr RP Centre for Ophthalmic Sciences at AIIMS, New Delhi.

Study Design

Descriptive, cross-sectional, retrospective, record-based study.

Study Period

The period of study was 1 month from March 1, 2016 to March 31, 2016.

Inclusion Criteria

The laundry services at AIIMS including the outsourced services have been included in this study. Both infected and noninfected linen have been considered together for calculation of cost per kg of linen.

Exclusion Criteria

- Cost of the land was excluded from the study.
- Minor costs on stationery, etc., were excluded.

Data Collection

The data collection was done in the following phases:

- The process of laundry services from receipt in wards to delivery to the wards was considered for the study. The operational aspects were studied and data collected for enabling calculation of the cost of the process.
- The data were collected during the month of March 2016.
- Key informants included laundry manager and the engineering representatives, medical store personnel from whom various details of cost heads and operational aspects were found.
- The engineering section was approached to acquire the Central Public Works Department (CPWD) rates in order to calculate the cost of laundry building and boiler room.
- Details of rate contract of outsourcing were also perused.

Cost Ascertainment Process

The cost centers (cost heads) were identified and data pertaining to each were collected under the following heads. The traditional method of costing was used for cost estimates as follows.

Building Cost

Depreciation cost of building: The land being that of the government, cost of land was not considered. Replacement cost method was used to arrive at the current construction cost, based on current CPWD construction rates (CPWD manual).[5] The area was physically calculated on ground. Life of the building being assumed as 100 years and the annual depreciation is estimated to be 1%.

Maintenance of building: The maintenance rate of the building as per engineering department as on 10.11.89 was Rs. 15/sqm. The cost index was Rs. 5,104/sqm (CPWD memorandum dated 23.02.15)[6] with base of

100 on 01.01.79. The annual maintenance cost was calculated on this basis.

Since the laundry was not air conditioned, no cost has been apportioned to the same.

Cost of Equipment, Fixtures, and Fittings

Depreciation of equipment, fixtures, and fittings: The inventory of the equipment purchased from the supplier firm was generated from the stores section along with cost incurred. Depreciation was computed based on the useful life of the product. An inventory list of electrical fixtures was generated with the help of the electrical engineering in-charge of the area and depreciation computed using straight line method, i.e., the cost of the asset was divided by the useful life, to arrive at the annual cost to the department.

Maintenance: The cost of maintenance of the equipment was already part of the contract drawn and was the responsibility of the vendor.

Cost of Electricity

The direct electricity consumption was calculated using the wattage system as the submeters were not installed. The total wattage and number of working hours have been taken to work out the electricity consumption cost.

Manpower cost

This was determined based on the pay commission as gross monthly salary. Other indirect manpower cost, e.g., that of the staff of the medical stores department, was not considered, being negligible.

Other Cost Heads

- Cost of outsourcing
- Cost of diesel
- Water Cost

Costing unit: Cost/kg of dirty linen

OBSERVATIONS AND DISCUSSION

Outsourcing Details

As a result of the decision taken by the hospital, the laundry services were outsourced, following a tendering process in November 2009. Six firms took part in the open tendering process and one of them was selected as per the rates quoted and specifications of tender document. Since January 2010, laundry services of AIIMS have been partially outsourced.

Costing

For the ease of analysis and costing, the various cost heads have been described along with the description of the infrastructure, equipment, manpower, and consumables. The equipment, however, was considered to depreciate at the rate of 10%.

Facility Cost

Facilities cost consists of the cost of the space utilized and the cost of electricity to operate the equipment.

Building Cost

Total area of laundry complex = 611.7 sqm

Total area of boiler room = 43.7 sqm.

The CPWD building cost index April 2015 with 01/10/12 (as base 100) issued by director general (DG) CPWD is 104. The building cost for 1 sqm area calculated after incorporating this cost index and after discussion with the engineering department[5] was Rs. 37,465.

Area of laundry + area of boiler in sqm	*CPWD rate per sqm*	*Total building cost*	*Annual building cost of laundry (1%)*
655.4	Rs. 37,465	Rs. 24,554,561	Rs. 245,545

There are three passenger lifts, the cost of which was apportioned as 32 lakh, each based on plinth area rates. So, the total cost of lifts was Rs. 96 lakh.

Chartered Institution of Building Service Engineers (CIBSE) has a lift cycle that indicates the life span of a lift as 15 years. Based on this, the annual cost of lift came to be Rs. 6.4 lakh.

So, the net monthly cost of lift was apportioned as Rs. 53,333.

Building Maintenance Cost

- The cost index was Rs. 5,104/sqm (CPWD memorandum dated 23.02.15),[6] with base of 100 on 01.01.12. The annual maintenance cost required to maintain the building was:

Area of manifold	*Maintenance per sqm*	*Annual maintenance cost*
655.4 sqm	Rs. 5,104	Rs. 3,345,162

The annual maintenance cost of lifts at laundry was Rs. 594,000.[5]

So, the monthly maintenance cost of lifts was apportioned as Rs. 49,500.

- *Electricity cost of equipment and fixtures*: The electricity cost has been worked out based on Rs. 10 per unit* (NDMC rates). The following formulae were used after consultation with the electrical engineering in-charge:
  - 1 kW = 1 unit
  - 1 Horsepower (HP) = 0.76 kW

*Average unit cost including DG sets

As there was no separate submeter to measure the consumption of electricity at the laundry, the total wattage and number of working hours was taken to work out electricity consumption cost.

Equipment

Machine Details

Washer extractor: There were 13 washer extractors in the laundry section. The washer extractors were used to wash and rinse the cloths. There were six washer extractors of capacity 100 kg; six washer extractors were of capacity 50 kg; and one washer extractor was of capacity 25 kg. Thus, the total capacity was 925 kg/cycle time.

Hydro extractor: There were nine hydro extractors in the laundry section. The hydro extractors were used for the removal of water from the linen mechanically. There were total nine hydro extractors of capacity 50 kg each. So, total capacity was 450 kg/cycle time.

Tumbler dryer: There were 12 tumbler dryers in the laundry section. The tumbler dryers were of capacity 50 kg each. The tumbler dryers were used for drying the washed and hydro extracted linen. Two energy sources were available for drying linen in tumbler dryer – steam and electricity. Therefore, the total capacity was 600 kg/cycle time.

Calendar dryer: There were two calendar dryers in the laundry section. The calendar dryers were used to press and final finishing of linen. The calendar dryer utilizes steam as energy source to press the linen which could then be finally used in the hospital.

Other equipments were:

- Boilers—electric as well as diesel
- Steam presses
- Water softening plant
- Director general set

Process Description

Laundry Steps with Time

Sl. no.	*Laundry steps*			*Quantity*	*Time taken*	*Temperature*
1	Rinsing		Water	400 L	5 minutes	43°C
2	Washing	Chemicals	Opal	500 gm	40 minutes	60–75°C
3			100S	100 mL		
4			OX-bleach	500 mL		
5			Legro	300 mL		
6			Whitener	400 mL		
7		Hypo wash	Hypo	500 mL	10 minutes	39°C
8		Shower	Johnson Diversey/Washing powder	As per required	10 minutes	36.2°C
9		Rinsing	Normal water	400 L	5 minutes	33°C
10		Neel wash	Neel	250 mL	5 minutes	32°C
11	Hydro				15 minutes	
12	Drying				40 minutes	
13	Total				125 minutes	

ANALYSIS OF AVERAGE WEIGHT OF LINEN AND LINEN WASHED PER DAY

To analyze average weight of the linen, different linen items processed in the laundry department and their respective weight have been taken. The historical data was obtained retrospectively to see the baseline.

Weight trials were undertaken to crosscheck the weights of different linen. The average weight per linen was evaluated based on number of pieces processed of different type of linen and their respective weight. The details are as follows:

Different Type of Linen Pieces received at Laundry per Month and Their Average Weight

Sl. no.	*Description*	*Qty. per month*	*Weight per piece*	*Total weight*
1	Bedsheet	76,163	0.65	49,506.0
2	Draw sheet	28,328	0.323	9,149.9
3	Patient coat	18,917	0.215	4,067.2
4	Patient pyjama	17,037	0.21	3,577.8
5	Women skirt	3,566	0.21	748.9
6	Women jacket	3,155	0.215	678.3

(Contd…)

(Contd…)

Sl. no.	*Description*	*Qty. per month*	*Weight per piece*	*Total weight*
7	Pillow cover	18,493	0.115	2,126.7
8	Turkish towel	782	0.475	371.5
9	Hand towel	1,034	0.15	155.1
10	OT towel	100,884	0.122	12,307.8
11	DL wrapper	33,337	0.267	8,901.0
12	Screen cover	6	0.72	4.3
13	OT gown	28,057	0.547	15,347.2
14	Curtain	189	0.72	136.1
15	Surgical shirt	20,938	0.1425	2,983.7
16	Surgical pyjama	20,158	0.17	3,426.9
17	Surgical frock	8,407	0.285	2,396.0
18	Patient sheets	2,632	0.203	534.3
19	Abdominal sheet	3,901	0.72	2,808.7
20	Trolley cover	13,202	0.187	2,468.8
21	Lagging	3,090	0.38	1,174.2
22	Syringe capper	8,277	0.086	711.8
23	Blanket	252	1.9	478.8
24	Baby frock	3,910	0.03	117.3
25	Children coat	1,070	0.114	122.0
26	Children pyjama	420	0.111	46.6
27	Door panel	99	0.02	2.0
28	Baby sheet	1,951	0.132	257.5
29	Couch cover	129	0.72	92.9
30	DL bags	2	0.1	0.2
31	Binder	9	0.12	1.1
	Total	418,395		124,700.4
	Average weight/piece			0.298 kg

Different Types of Linen Pieces received from Dr RP Centre and Their Average Weight

Sl. no.	*Items*	*Total monthly linen (no.)*	*Avg weight (kg)*	*Total weight (kg)*
1	Bedsheet	10,492	0.650	6,819.80
2	Draw sheet	373	0.323	120.48
3	Patient gown	3,095	0.215	665.43
4	Patient pyjama	2,904	0.210	609.84
7	Pillow cover	4,290	0.115	493.35
8	Bath towels	87	0.475	41.33
9	Hand towel	431	0.150	64.65
10	OT towel	17,931	0.122	2,187.58
11	DL wrapper	8,598	0.267	2,295.67
13	Surgeon gown	9,259	0.547	5,064.67
15	Curtains	31	0.720	22.32
16	Dr Kurta	5,956	0.142	845.75
17	Dr Pyjama	5,809	0.170	987.53
18	Surgeon's frock	5,326	0.285	1,517.91
24	Trolley cover	2,598	0.187	485.83
25	Child coat	561	0.114	63.95
26	Child pyjama	376	0.111	41.74
33	Blankets	72	1.900	136.80
	Total	78,189		22,464.62

Monthly Average Linen processed

Monthly linen processing for one year was evaluated using retrospective data based on monthly linen processed and average weight evaluated in an earlier table.

Month	Average monthly qty. in pieces	Average weight/ piece	Monthly total weight (kg)	Working days	Average weight/ day
Oct-15	402,099	0.298	119,825.5	26	4,608.7
Nov-15	381,653	0.298	113,732.6	26	4,374.3
Dec-15	397,719	0.298	118,520.3	26	4,558.5
Jan-16	398,152	0.298	118,649.3	26	4,563.4
Feb-16	408,340	0.298	121,685.3	26	4,680.2
Mar-16	419,266	0.298	124,941.3	26	4,805.4
Apr-16	392,345	0.298	116,918.8	26	4,496.9
May-16	409,644	0.298	122,073.9	26	4,695.2
Jun-16	383,928	0.298	114,410.5	26	4,400.4
Jul-16	398,387	0.298	118,719.3	26	4,566.1
Aug-16	432,524	0.298	128,892.2	26	4,957.4
Sep-16	425,042	0.298	126,662.5	26	4,871.6
Average	404,091.9		120,419.3		4,631.5

Average daily washing load: 4,632 kg

Average monthly washing load: 120,419 kg; i.e., 120.4 ton

Monthly Average Payment to the Outsourced Agency

Month	Monthly payment to outsourced agency
Oct-15	2,647,329
Nov-15	2,465,403
Dec-15	2,564,746
Jan-16	2,576,412
Feb-16	2,624,396
Mar-16	2,689,817
Apr-16	2,515,558
May-16	2,624,915
Jun-16	2,461,197
Jul-16	2,558,877
Aug-16	2,789,313
Sep-16	2,747,897
Average	2,605,488

Average payment to the outsourced agency/month: Rs. 2,605,488 per month

Rs. 31,265,860 per annum

The payment made to the outsourced agency covers the scope of work outsourced. The payment covers the following cost:

- Manpower
- Material
- Equipment maintenance expenses
- Water treatment expenses

In addition to the payment made to the outsourcing agency, AIIMS incurs cost of:

- Electricity
- Water
- Generator
- Boilers
- Manpower expenses (other than supplied by outsourced agency)
- Building maintenance

ANALYSIS OF UTILITY ENERGY CONSUMPTION

Boiler Fuel and Electricity Consumption

The boiler house has one oil fired boiler and two electricity operated boilers. This was operated as per requirement to meet the steam demand of the laundry unit. The general operational details of the boiler are as follows:

- *Operating pressure*: 4 kg/cm^2
- *Operating temperature*: 130 to 140°C
- *Boiler steam capacity*: 500 kg/hour
- *Boiler make*: INDCON
- *Electric boiler model*: ES20
- *Electric boiler make*: COLLIN WALKER
- *Electric boiler rating*: 215 kW

The pressure at steam header was around 3 kg/cm^2 and at the machine end it was approx.1 to 1.5 kg/cm^2.

All three boilers were operated to cater steam demand of laundry. To evaluate fuel consumption in steam boiler trials have been taken and based on that it has been found the average fuel consumption per day in boiler was approximately 80 to 85 liters/day (diesel).

To evaluate the energy input of electrical boilers three phase power analyzer was used to record power consumption of electric boiler. All relevant electrical parameters like voltage, current, harmonics, kW and kVA power and power factor were recorded. The details are as follows.

Load Profile of Other Utilities

The details of the electrical load profile of other equipment and utilities are as follows:

Type	Name	Voltage	Current	kW	PF
Utility	1. Compressor	388.3	9.98	5.778	0.857
	2. Submersible Pump-1	401.3	10.93	6.89	0.629
	3. Submersible Pump-2	401.1	8.517	5.198	0.876
	4. Filling pump-1	402.5	12.5	7.348	0.861
	5. Filling pump-2	398.1	11.06	6.857	0.897
	6. Filling pump-3	401.7	12.33	7.773	0.905
Lighting	1. Lighting			15	

Total Load of Other Utilities: 54.5 kW

Laundry Machines Power Consumption

The power consumption of all the machinery process like washer extractors, tumbler dryers, hydro extractor, and calendars was evaluated respectively. The details are as follows:

Type	*Equipment name*	*Nos*	*Load/equipment*	*Average load (kW)*	*Power factor (liters/day)*	*Load (kVA)*
Utility	1. Electric boiler	2	206	412	0.85	484.71
	2. Diesel boiler	1			88	
	3. Submersible pump-1	1	6.9	6.9	0.85	8.12
	4. Submersible pump-2	1	5.2	5.2	0.85	6.12
	5. Overhead tank pump	3	7.43	22.29	0.85	26.22
	6. Compressor	1	6.8	6.8	0.85	8
Rest utilities	1. Ceiling fans	31	0.07	2.17	0.85	2.55
	2. Exhaust fans	21	0.25	5.25	0.85	6.18
Equipment	1. Washer extractor	13	2.33	30	0.85	35.29
	2. Hydro extractor	9	1.66	15	0.85	17.65
	3. Tumbler dryer	12	28.3	340	0.85	400
Lighting	1. Lighting	250	0.06	15	0.85	17.65

Capital Cost of Equipment and Machinery Depreciation Cost

The cost of the equipment have been taken from an unpublished study done in the year 2011 to 2012.

- The cost of equipment with maintenance cost was Rs. 74 lakhs.
- The boilers have been installed at a capital cost of Rs. 3,000,000.
- The panels have been installed in new laundry at a cost of Rs. 3,600,000.
- Total approximate machinery cost = Rs. 14,000,000.

*The lifespan of equipment was taken as 10 years, thus depreciation of 10% was calculated on per annum basis.

Machinery Depreciation Cost

- Approximate machinery cost: Rs. 14,000,000
- Estimated life: 10 years
- Depreciation per year @10%: Rs. 1,400,000
- Monthly depreciation: Rs. 116,667

Manpower Cost

Overall manpower cost borne by AIIMS toward laundry is given below:

Sl. no.	*Category*	*No.*	*Pay/month/ in Rs.*	*Total*
1	Laundry manager	1	50,000	50,000
2	Laundry supervisor	1	46,000	46,000
3	Assistant laundry supervisor	3	35,000	105,000
4	Clerk	3	18,000	54,000
5	Tailor	2	25,000	50,000
6*	Laundry attendant	32	25,000	800,000
7*	Sanitary attendant	5	25,000	125,000
8*	Sulabh volunteers	28	10,000	280,000
Total				1,510,000

*Used for distributing washed linen to all the hospital areas as well as to collect dirty linen from these areas daily

Water Cost

Average monthly water bill of AIIMS for the months of Aug, Sep, and Oct 2016

Sl. no.	*Source of supply*	*Water consumption (in Kiloliters)*	*Cost/month (in Rs.)*
1	Delhi Jal Board	54,160	4,638,555
2	NDMC	1,492	104,470
	Total		4,743,025

The cost of water was apportioned to laundry @ 2%, i.e., Rs. 94,860 per month.

Overall Cost of Laundry per kg of Linen

Overall expenses of laundry/kg of linen have been evaluated based on the following details:

- Average weight/linen
- Average monthly production
- Electrical load profile of utilities
- Electrical load profile of machineries
- Fuel consumption in boiler
- Contractual expense
- Maintenance expense
- Softener expense
- Manpower expense (AIIMS)

The details of overall cost of laundry/kg of linen were as follows:

Total Monthly Cost

Sl. no.	Equipment name	Nos.	Load/ equipment	Average load (kW)	Power factor	Load (kVA)	Running hours	Avg. days/ month	Unit cost	Cost/ month
I.	*Electricity cost*									
1	Electric boiler	2	206	412	0.85	484.71	9	26	10	1,134,221
2	Washer extractor	13	2.33	30	0.85	35.29	9	26	10	82,579
3	Hydro extractor	9	1.66	15	0.85	17.65	9	26	10	41,301
4	Tumbler dryer	12	28.3	340	0.85	400	9	26	10	936,000
5	Lighting	250	0.06	15	0.85	17.65	12	26	10	55,068
6	Ceiling fans	31	0.07	2.17	0.85	2.55	12	20	10	6,120
7	Wall fans	21	0.25	5.25	0.85	6.18	12	20	10	14,832
8	Submersible pump-1	1	6.9	6.9	0.85	8.12	6	26	10	12,667
9	Submersible pump-2	1	5.2	5.2	0.85	6.12	12	26	10	19,094
10	Overhead tank pump	3	7.43	22.29	0.85	26.22	2	26	10	13,634
11	Compressor	1	6.8	6.8	0.85	8	6	26	10	12,480
II.	*Oil cost*									
12	Diesel boiler	1		88	liter/day			26	56/liter	128,128
III.	*Consumable cost*									
IV.	*Depreciation cost*									
13	Machinery depreciation cost									116,667
V.	*Maintenance cost*									
14	Boiler maintenance cost	3						26		370,000
VI.	*Building cost*									
15	Building cost (including lifts)									73,795
16	Building maintenance cost (including lifts)									328,264
VII.	*Manpower cost*									
17	Manpower cost (AIIMS)									1,510,000
VIII.	*Outsourcing cost*									
18	Outsourcing expenditure									2,605,488
IX.	*Water cost*									94,860
	Total expense per month									7,555,198

	Average annual linen purchase at Dr RP Centre					
Linen items	*Year 2013–14*	*Year 2014–15*	*Year 2015–16*	*Average annual quantity*	*Rate per piece (in Rs.)*	*Average annual cost (in Rs.)*
Bedsheet	2,000	2,500	3,500	2,667	416	1,109,333
Draw sheet	0	0	500	167	89	14,833
Patient kurta	2,000	1,000	2,000	1,667	198	330,000
Patient pyjama	2,000	1,000	2,000	1,667	180	300,000
Pillow cover	1,000	1,000	2,000	1,333	86.03	114,707
Eye towel	7,500	7,100	9,000	7,867	105.6	830,720
DL wrapper	2,100	1,000	2,000	1,700	189	321,300
Surgeon gown	2,000	4,100	4,500	3,533	252	890,400
Dr Kurta	2,000	1,100	1,500	1,533	97.08	148,856
Dr Pyjama	2,000	1,100	1,500	1,533	152	233,067
Surgeons frock	1,500	1,000	1,000	1,167	199	232,167
Trolley cover	1,500	1,000	2,000	1,500	185	277,500
Child kurta	500	500	500	500	98.01	49,005
Child pyjama	500	500	500	500	98.01	49,005
Blankets	400	200	200	267	494	131,733
Average annual cost						5,032,626

Cost of laundry per kg		
Laundry monthly expense	7,555,198	Rs.
Average monthly output of washed linen	120,419	kg
Cost of washing linen per kg	63	Rs.
Cost of linen processing for Dr RP Centre		
Monthly linen washed in RP Centre	22,465	kg
Monthly laundry expenditure in RP Centre	(a) 1,415,295	Rs.
Linen procurement expenditure per month	(b) 419,386	Rs.
Total (a + b)	1,834,681	Rs.
Cost/kg (with inclusion of linen cost)	82	Rs.

SUMMARY AND CONCLUSION

The laundry system at the AIIMS follows the outsourced system wherein the linen, machinery, electricity, water, and space was provided to the vendor by the Institute.

It was observed that the current system of laundry management entails a number of costs, such as cost of space, electricity, water, linen, and supervisory manpower designated for the laundry. In addition, other costs which are borne by the Institute in the current system are linen procurement-related costs, storage costs, both at the central and the ward level. Further, a lot of nursing manpower was being utilized only for linen management in the hospital which could have been used for other patient care services. Yet, the quality of wash and linen being supplied remains uncertain in terms of microbial load it may carry postwash and cross-contamination occurring during the various laundry process from collection of dirty linen to supply of clean linen to the user areas. The above statement can be corroborated from the fact that a large quantity of linen was getting condemned on a regular basis prior to its expected useful life.

Internationally, laundry services in health care are expected to conform to a few standards, such as RABC (EU), BS-EN, HLAC (USA), DHS, etc. These standards dictate not only the linen quality, but also the wash processes to be followed in order to ensure efficient and effective washing expected in a hospital. In the current scenario, where patients are becoming increasingly aware of their rights and responsibilities in a hospital and the law tightening its noose on health care institutions for every lapse in service, it is time to accept and develop systems which shall enable us to follow such international standards to provide the best quality of linen and a linen safe environment to our patients.

Financial Implications

Financial Implications in the Existing Model

In the existing model, the vendor was responsible for following services:

- Operating the laundry machines
- Collecting and distributing linen
- Ironing of linen
- Repairing of linen
- Repair and maintenance of laundry machines
- Provision of manpower
- Provision of materials

In this model, linen, space, machinery, electricity, steam, and water were provided by the Institute.

The Vendor was being paid Rs. 2,605,488 per month, which is equivalent to Rs. 31,265,856 Annually

Linen was procured and provided by the Institute.

Expenditure incurred in procuring linen per year at Dr RP Centre = Rs. 50,32,626

In addition to the direct expenditure being incurred on linen, cost was also being incurred on procurement, storage, as well as condemnation of linen, which if calculated would be significant.

In addition to the cost calculated earlier, a few indirect costs which had not been taken into considerations but if calculated would have been significant were as follows:

- Procurement
- Linen inventory management costs
- Water costs

Financial Implications of the Proposed Model

The rate quoted by a leading vendor to supply washed, sterilized linen to the hospital: Rs. 55 per kg. Since the expenditure incurred per kg at Dr RP Centre is Rs. 82, so, there can be a saving of around Rs. 27 per kg. It would mean saving of around Rs. 606,555 per month and Rs. 7,278,660 per annum. So, it was recommended that rental linen management services could be hired for Dr RP Centre after taking care of functional, operational, and strategic contingency.

In the proposed system, the vendor shall be responsible for purchasing, washing, sterilizing, collecting, distributing, and mending any linen required by the hospital. The vendor shall also be responsible for condemning and replacing linen as and when the need arises. Further, a feedback about the existing rental linen management services in the National Capital Region of Delhi was also collected to gauge the plausibility of transitioning to such a system.

Feedback about the available Rental Linen Management Services from various hospitals in national capital Region of Delhi:

Sl. no.	Hospital	Feedback (written verbatim)
1	A 1,000 bedded corporate hospital	Uninterrupted supply of high-quality disinfected linen, professional approach
2	A 600 bedded missionary hospital	Meets high standards for its services in all respects in a very professional manner; highly appreciated by all the stakeholders in the hospital, namely patients, staff, and management; have no reservation in recommending its services to other hospitals
3	A 300 bedded private hospital	Uninterrupted and smooth supply of consistently high-quality disinfected linen; professional approach and high-quality has played a key role in enhancing patient satisfaction and has added value to services provided by hospital
4	A 150 bedded trust hospital	Services provided by them are to our most satisfaction and the work done by them is commendable

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ORIGINAL ARTICLE

Prescriptions Written in Capital Letters in Compliance with National Accreditation Board of Hospital Standards

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ABSTRACT

Objectives: (1) To study compliance rate of prescriptions written in capital letters according to continual quality improvement (CQI) 3j indicator of National Accreditation Board of Hospital (NABH) (4th edition). (2) To study compliance to doctors and patient detail, legibility of prescriptions, strength and dose, frequency, route of administration, dosage form, abbreviation for drug, allergy detail, and leading zeros in the dose.

Materials and methods: Convenient randomly selected Medication Administration Record (MAR) sheets from wards and intensive care units (ICUs) were studied. One hundred thirty-two prescriptions were identified for errors pertaining to doctor's details, patient's details, and medication details. Errors were captured on a prepared checklist for a period of 11 days. Results were analyzed by Microsoft Excel.

Results: Results were expressed in percentages for wards and ICUs respectively. Six hundred twenty four and 652 drugs were observed in wards and ICUs respectively. Doctor's name was present in 79.6 and 83.3%. Out of 55 prescriptions in both wards and ICUs, patient's name compliance was 94.5 and 96.4% and patient's weight was 83.6 and 81.8% respectively. Compliance for drugs in capital was 98 and 100% for wards and ICUs respectively. Details pertaining to medication were also found out subsequently on various parameters.

Conclusion: The study revealed that the level of completeness of handwritten prescriptions was low in terms of doctor's details and patient's weight, which indicates unsatisfactory commitment of the prescribers to follow the hospital guidelines of prescribing. Majority of prescriptions showed compliance to medication written in capital but still the compliance to clear and legible prescriptions is three-fourths of the total prescriptions.

Keywords: Accreditation, Compliance, Medication administration record, NABH, Prescriptions, Quality.

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BACKGROUND

Prescription writing is one of the most important and basic skill that a doctor needs. It was seen in previous studies where a large number of medical errors include medication errors, which may be related to writing of an illegible prescription and dispensing of wrong, inappropriate medications that results in adverse events and death.[1] Prescription errors account for 70% of medication errors.[2] Studies show that the range of errors attributable to junior doctors, who are responsible for most prescriptions in hospitals, can vary from 2 to 514 per 1000 prescriptions and from 4.2 to 82% of patients or charts reviewed.[3] Further studies, in which legibility of doctors' handwriting was assessed, revealed that doctors' handwriting when compared to other health care professional and administrators was the worst of all.[4] A study by Rayan et al suggested that the errors of prescribing are the most common form of avoidable medication errors; these need to be targeted and improved.[5] As per the 'Right to Information Act 2005' (RTI Act 2005), it is the inherent right of every patient to have a correct and clear prescription.[1] After the introduction of Consumer Protection Act 1986 (CPA-1986) in India, prescription has become a valuable, consumable linkage between the patient and the registered medical practitioner and it is also the ethical and legal duty of medical practitioner to write the prescription clearly and legibly, which are the essential features of every prescription.[6] A public notice by the Ministry of Health and Family Welfare (MoHFW) proposes a change in the Indian Medical Council (IMC) regulation. Union Health Minister, JP Nadda agreed that illegible prescription by doctors may lead to serious implications and even death in certain cases. Later, he approved the amendment to the Indian Medical Council Regulations, 2002, providing therein that every physician should prescribe drugs with generic names in legible and capital letters and they should ensure that there is a rational prescription and use of drugs.[7]

Unfortunately, there is less awareness and recording of adverse drug reactions and medication errors in India and very few physicians are following prescription guidelines. To improve the quality of life, it is very important to standardize the prescription at all levels of the health care delivery system. Various prescription audit has to be conducted, to seek observation, evaluation, and further

recommendation on the prescribing practices of medical practitioners to make rational prescribing.[8]

INTRODUCTION

Prescription is a written directive, as for the compounding or dispensing and administration of drugs, or for other service to a particular patient. There are four parts to a drug prescription:

1. Superscription: Consisting of the word recipe, take, or its sign, Rx
2. Inscription: The main part of the prescription containing the names and dosage of the drugs
3. Subscription: Directions for mixing the ingredients and designation of the form (pill, powder, solution, etc.) in which the drug is to be made.
4. Signature: Directions to the patient regarding the dose and times, etc., of taking the remedy, preceded by the word signa, designate, or its abbreviation, S. or Sig.[9,10]

The Medication Use Process is commonly divided into four stages:

1. The prescribing stage (writing/ordering the prescription)
2. The medication supply stage
3. The administration stage (administering the prescription)
4. The monitoring stage (counseling the patient about the prescription and monitoring treatment outcome).[11]

Prescription writing error (prescription errors, including illegibility) and administering errors are the two most frequent types of medication errors. Prevention of errors at the prescribing stage is one of the most important step toward reducing medication errors and it has been recognized as a priority in health care systems worldwide.[12] The experts conclude that ambiguity or confusion in prescription order may be avoided in the beginning itself, by following some principles in prescribing stage. At the time of prescribing, always make sure that the prescription is legible and easy to read, complete doctor and patient details must be clearly mentioned, all text must be in clear handwriting and should be written in capital and all details pertaining to a drug must be mentioned clearly. Abbreviation of medicine name, archaic terminologies, such as Q.D. or O.D should be avoided.[1] We are identifying the number of prescriptions complying with the prescription guideline pattern, laid down by the hospital in which the study was conducted. In that hospital, certain policies and procedures have been established. As per those policies, certain criteria must be followed while writing a prescription in an inpatient department, to avoid medical errors.

- Patient information: It is used in a prescription to individualize treatment plan and to avoid confusion; hence, it is mandatory to write the patient demographics like name, age, sex, address, identification number, and weight. It is also compulsory to fill allergy box to know the allergic status before prescribing the drugs.
- Prescriber's information: Only a registered medical practitioner–medical officer, senior medical officer, and consultant shall prescribe medications. It is mandatory to prescribe all drugs with physician name and sign. So, when there is any doubt regarding the drugs and follow-up, contact physician directly.
- Drug information: Drugs are available in different dosage forms and strengths, so it is mandatory for every doctor to write the drug name in capital letters, clearly mentioning all the required details (frequency, dosage form, route, strength, time) without any unaccepted abbreviations and overwriting. Leading zero should always be used (e.g., 0.1 mg) and avoid using trailing zero (e.g., 1.0 mg). When medication is needed to be discontinued the word "discontinue" must be mentioned.
- Legibility: Make sure that your prescription is legible and easy to read. Due to illegible handwriting, nurses get confused and dispense look-alike drugs to patient. It has been found that this is the most common error identifying from practitioners.[8,13] Illegible prescriptions result in a lower quality of health care by loss of time and money, medication errors and patient harm, inefficient or faulty communications, and create legal issues.[14]

The National Accreditation Board for Hospital (NABH) and health care provider has certain accreditation standards for hospitals on particulars of continual quality improvement (CQI). The organization must identify key indicators to monitor the clinical structures, processes, and outcomes, which are used as tools for continual improvement. One of the objective elements is patient safety goals. Hence, the goal of this study is to capture the compliance of medication prescriptions written in capital and their legibility.

OBJECTIVES

- To study compliance rate of prescriptions written in capital letters according to CQI 3j indicator of NABH (4th edition).
- To study compliance to doctors and patient detail, legibility of prescriptions, strength and dose, frequency, route of administration, dosage form, abbreviation for drug, allergy detail, and leading zeros in the dose.

PURPOSE

The hospital is presently running in its 3rd cycle, and NABH mandates institutionalization of the revised standards (4th edition) by 1st July. One of the CQI 3j indicator

"Compliance to medication prescription in capitals" will be reviewed in the study as was asked by the medical superintendent of the hospital.

SCOPE OF THE STUDY

Study the Medication Administration Records (MARs) compliance to documentation standards as per NABH policy in wards and intensive care units (ICUs) and study the drug chart of pediatric and neonatal intensive care units (NICU).

MATERIALS AND METHODS

Study Area

Convenient randomly selected MAR sheets from wards and ICUs were studied.

Study Design

Retrospective descriptive observational study.

Sample Design

In this study, convenient random sampling technique will be used to select medical prescriptions (MAR) from the inpatient department (wards and ICU) during the functional hours.

Study Time

Various MAR sheets from existing one month of hospital data were observed and the required data was recorded over a period of 11 days from April 13, 2016 to April 25, 2016.

Study Tool

Prepared checklist (Annexure 1). Microsoft Excel for analysis of data.

METHOD OF MEASUREMENT

A sample of 132 prescriptions were selected during the month of April 2016 to identify prescription errors pertaining to doctor's details, patient's details, and medication details. Compliance rate of prescriptions written in capital and its legibility have been identified. Prescriptions were observed based on the presence or absence of the understated details. Various parameters were identified in each prescription, which are as follows:

- Doctors name and signature
- Patient name, age, sex, ID number, weight, date of admission.
- Drugs name written in capital
- Strength and dose of drug
- Frequency of drug
- Route of administration
- Dosage form of drug
- Abbreviation for drug name
- Leading zero
- Allergy details
- Data for stat/once only/premedication drugs (in capital, overwriting, not signed within 24 hours)
- Legibility of prescriptions was assessed based on the following points:
  - Point 1: Prescription details are clear and legible.
  - Point 2: Prescription details are clear but require efforts to read.
  - Point 3: Prescription details are not at all clear.
- Legibility of drugs was assessed base on the following points:
  - Point 4: One drug name is not clear.
  - Point 5: More than one drug name is not clear.
  - Point 6: All drugs names are clear.

During this study, over a period of 11 days, five prescriptions were randomly observed every day from both, ward and ICU, to calculate the compliance of prescription in six different wings of wards and in five different ICUs. (In the hospital two floors were occupied as wards, and each floor was named as "A" and "B" with three wings on each floor namely A1, A2, A3, B1, B2, B3.) Every day, two prescriptions were also observed separately from pediatric ICU (PICU) and NICU, to capture leading zeros.

Inclusion Criteria

- Inpatient department prescriptions (wards and ICUs)
- MAR sheet (Annexure 2 and 3)
- Medication chart for PICU and NICU (Annexure 4)

Exclusion Criteria

- Outpatient department prescriptions
- Some data of prescription like (generic name of drug, use of archaic terminologies, spellings of drugs, time and date of dosage, word "discontinued "mentioned or not) were excluded from study.
- Accuracy of prescriptions
- Doctor progress report

RESULTS

A total of 132 prescriptions of wards and ICUs were taken for observation for compliance rate of drugs written in capital and its legibility (Annexure 1, Tables 1 and 2; Graphs 1 to 8).

Results were expressed in percentages for wards and ICUs respectively. Lacking with the physician's information is one of the drawbacks that may create a chance for medical errors. In this study, when 624 and 652 drugs was

Table 1: Compliance related to patient and doctor's details in wards and ICU

Details pertaining to patient			
Criteria	*Total*	*Compliance of ward (%)*	*Compliance of ICU (%)*
Patient name	n = 55	94.5	96.4
Patient age and sex	n = 55	100.0	100.0
Patient ID number	n = 55	100.0	100.0
Patient weight	n = 55	83.6	81.8
Date of admission	n = 55	100.0	100.0
Details pertaining to doctor			
Doctor's name present	N_w = 624 N_i = 652	79.6	83.3
Doctor's signature present	N_w = 624 N_i = 652	92.3	96.3

n: Number of prescriptions observe, each in ward and ICU; N_w: Number of drugs observed in wards; N_i: Number of drugs observed in ICU

observed in wards and ICUs respectively, doctor's name was present in 79.6 and 83.3%, whereas signatures were present in 92.3 and 96.3% (Annexure 1, Table 1 and Graph 1). Patient information is used to individualize treatment plan and to avoid confusion among patients. When 110 prescriptions were observed, it was found that there was 100% compliance for patient's age, sex, ID number, date of admission, however, compliance for patient's name was 94.5 and 96.4% and patient's weight was 83.6 and 81.8% (Annexure 1, Table 1 and Graph 2).

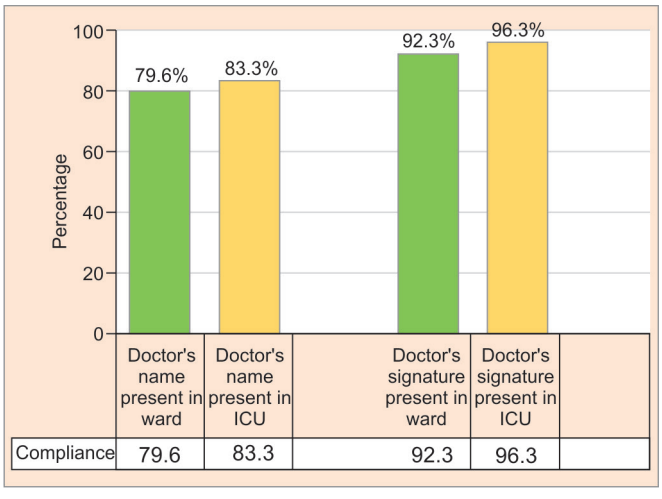
In order to get information about the , prescriptions were observed and it was found that compliance for strength of drug mention is 89.7 and 93.7%, whereas dose was mentioned in 93.4 and 97.1%. Allergy details were mentioned in 98.4 and 97.2%. In 98.4 and 99.7%, frequency of drug was mentioned, whereas for route of administration and dosage form it was (93.3 and 97.1%) and (96.2 and 98.9%) respectively (Annexure 1, Table 2 and Graph 3).

In the same number of prescriptions, it was also observed that out of 164 drugs in wards and 212 drugs

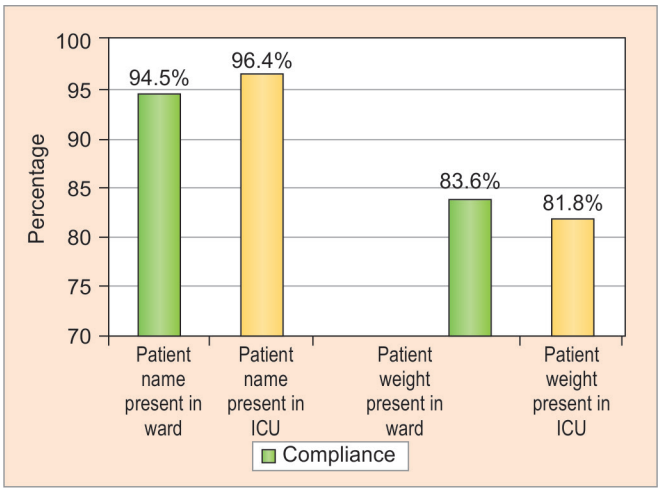
Table 2: Compliance related to medication details

Details pertaining to medication			
Criteria	*Total*	*Compliance of ward (%)*	*Compliance of ICU (%)*
Drugs written in capital	N_w = 624 N_i = 652	98	100
Strength of drug mentioned	N_w = 624 N_i = 652	89.7	93.7
Dose of drug mentioned	N_w = 624 N_i = 652	93.4	97.1
Frequency of drug mentioned	N_w = 624 N_i = 652	98.4	99.7
Route of administration mentioned	N_w = 624 N_i = 652	93.3	97.1
Dosage form of medication mentioned	N_w = 624 N_i = 652	96.2	98.90
Abbreviation for drug name not mentioned	N_w = 624 N_i = 652	97.3	97.0
Allergy details mentioned	N_w = 624 N_i = 652	98.4	97.2
Stat drugs in capital (by nurses)	N_w = 164 N_i = 212	49.3	95.8
No overwriting in stat drug	N_w = 164 N_i = 212	100.0	100.0
Signed within 24 hours	N_w = 164 N_i = 212	83.5	92.9
Legibility of prescriptions scoring			
Point 1	n = 55	61.8	70.9
Point 2	n = 55	38.2	29.1
Point 3	n = 55	0.0	0.0
Legibility of drugs name scoring			
Point 4	n = 55	23.6	18.2
Point 5	n = 55	16.4	7.3
Point 6	n = 55	60.0	74.5
Pediatric ICU and Neonatal ICU			
Leading zeros present in PICU and NICU	N = 74	–	99.0

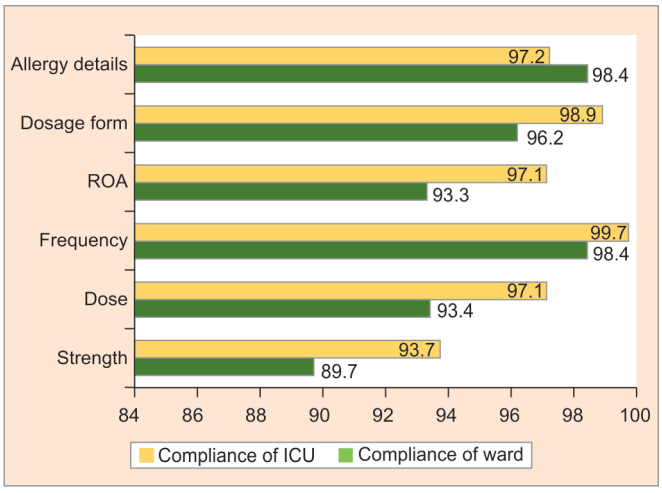
n: Number of prescriptions observe, each in ward and ICU; N_w: Number of drugs observed in wards; N_i: Number of drugs observed in ICU; N: Number of drugs in PICU and NICU



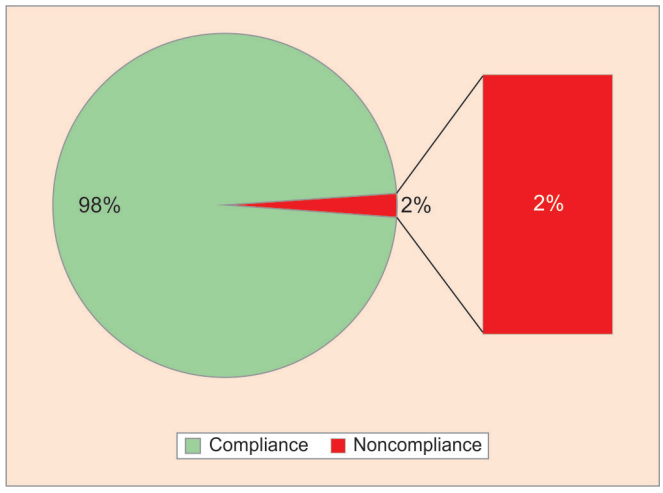
Graph 1: Compliance of doctor's details



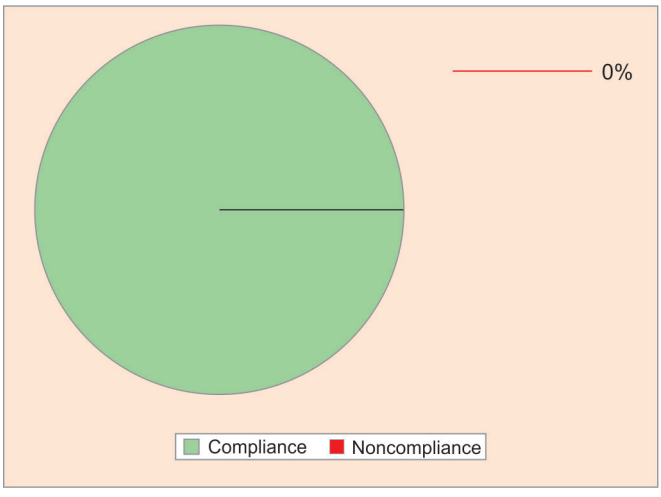
Graph 2: Compliance of patient's details



Graph 3: Compliance of medication details

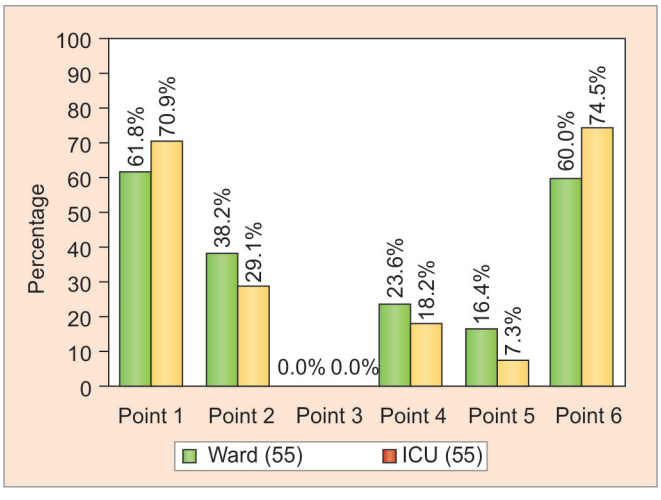


Graph 4: Compliance of drus in capital in ward

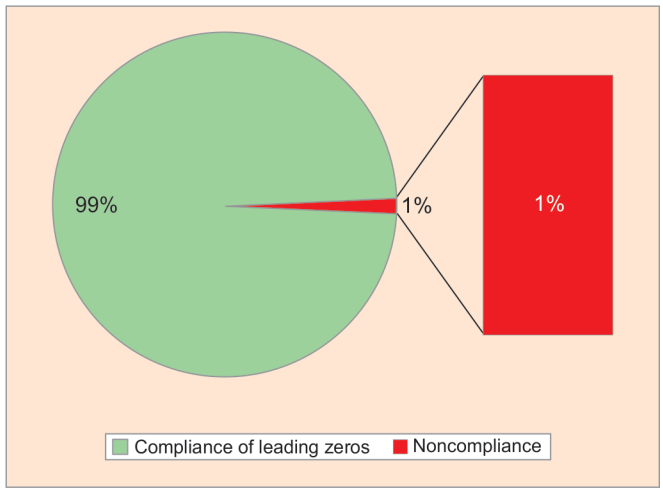


Graph 5: Compliance of drug in capital in icu

Graph 6: Stat/once only/premedication chart



Graph 7: Legibility of prescription and drug name



Graph 8: Compliance for leading zeros

in ICU for stat/once only/premedication, compliance for drugs in capital and stat not signed within 24 hours were (49.3 and 95.8%) and (83.5 and 92.9%) respectively. (Annexure 1, Table 2 and Graph 6).

In the prescriptions 98 and 100% of the drugs were written in capital letters (Annexure 1, Table 2 and Graphs 4, and 5). Out of 74 drugs of PICU and NICU, 99% have correctly placed leading zeros (Annexure 1, Table 2 and Graph 8).

When legibility of prescriptions was observed, none of the prescription was not at all clear (point 3). About 61.8 and 70.9% of prescriptions were legible (point 1) and rests 38.2 and 29.1% were clear but requires effort to read

(point 2). When legibility for drug names was observed, in 23.6 and 18.2% of prescription one drug name is not clear (point 4), in 16.4 and 7.3% prescription more than one drug is not clear, rest of prescription, i.e., 60 and 74.5% all drug names are clear (Annexure 1, Table 2 and Graph 7).

LIMITATIONS

- Due to time constraint, our sample size was not adequate as per the required standard sample size set by NABH and health care providers. This study can also be conducted with a large sample size and for a longer duration and perhaps the result can then be generalized. (For 1000 screening population, NABH recommends 278 sample size.) (Annexure 5)
- Other limitations also include study exclusion criteria.
  - Outpatient department prescriptions
  - Some data of prescription like (generic name of drug, use of archaic terminologies, spellings of drugs, time and date of dosage, word "discontinued "mentioned or not) were excluded from study.
  - Accuracy of prescriptions
  - Doctor progress report

CONCLUSION

The study revealed that the level of completeness of handwritten prescriptions was low in terms of doctor's details and patient's weight, which indicates unsatisfactory commitment of the prescribers to follow the hospital guidelines of prescribing. Remaining compliances showed less discrepancy. Majority of prescriptions showed compliance to medication written in capitals but still the compliance to clear and legible prescriptions is only three-fourths of the total prescriptions.

RECOMMENDATIONS

- Various studies have shown that electronic prescribing can reduce the incidence of medication error by more than 50% and improve the quality of life and patient safety.[15] So there is a need to move toward electronic prescribing to allow the hospital immediate benefit of improving legibility, completeness, and elimination of transcription errors.
- Additional research studies must be conducted in the hospital as per the NABH sample size, to assess the prescribing practices of practitioners on their prescription.
- The study highlights the need of more training programs and regular assessments to train and sensitize the prescriber about prescribing skills and the importance of neglected criteria. Also encourage them to follow the hospital prescription guidelines to make 100% compliance for the upcoming CQI 3j indicator of NABH.
- After implementation of e-prescriptions, studies can be conducted to compare them to handwritten prescriptions.

ANNEXURE 1

Table 1: Checklist

Details pertaining to doctors			
Sl. no.	*Identification criteria*	*Response*	
(a)	Doctor's name written on the prescription	Total	☐
		No name	☐
(b)	Doctor's signature	Present	☐
		Absent	☐
Details pertaining to patients			
Sl. no.	*Identification criteria*	*Response*	
(a)	Patient's full name	Present	☐
		Absent	☐
(b)	Patient's age and sex	Present	☐
		Absent	☐
(c)	Patient's ID number	Present	☐
		Absent	☐
(d)	Patient's weight	Present	☐
		Absent	☐
(e)	Date of admission	Present	☐
		Absent	☐

Table 2: Details pertaining to medications

Sl. no.	*Identification criteria*	*Response*	
(a)	Name of drug written legibly		
	Legibility of prescriptions was assessed on the basis of the following points:		
	• Point 1: Prescription details are clear and legible	Point 1	☐
	• Point 2: Clear but requires effort to read	Point 2	☐
	• Point 3: Prescription details not at all clear	Point 3	☐
	Legibility of drug name was assessed on the basis of the following points:		
	• Point 4: One drug name is not clear	Point 4	☐
	• Point 5: More than one drug name is not clear	Point 5	☐
	• Point 6: All drug names are clear	Point 6	☐
(b)	Name of drug written in CAPITAL	No. of drugs prescribed	☐
		No. of drugs not written in capital	☐
(c)	Strength and dose of the prescribed drugs not mentioned	Not mentioned strength	☐
		Dose	☐
(d)	Is the frequency of drugs prescribed mentioned?	Not present	☐
(e)	Is the route of administration of the prescribed drugs mentioned	Not present	☐
(f)	Is the dosage form of the medications mentioned	Not present	☐
(g)	Abbreviation for drug name used in the prescription	Present	☐
(h)	Use of leading zeros in dose of the drug used	Present	☐
(i)	Stat/once only/premedication drugs consultations signed by the consulting doctor within 24 hours or not	No. of drugs	☐
		Drugs not in capital	☐
		Overwriting present	☐
		Not signed in 24 hours	☐
(j)	Allergy details mentioned	Present	☐
		Absent	☐

ANNEXURE 2

Patient's Name : _____

UHID : _____ IPID : _____

Age : _____ Sex : _____

D.O.A. : _____ Unit : _____

MEDICATION ADMINISTRATION RECORD

Previous Hospitalization Yes ☐ No ☐	Weight in kg	Special Diet
Blood Group :	Diagnosis:	
Drug Hypersensitivities/Allergies:	Surgery/ Procedure : Date of Surgery:	
Previous Medications:		

Standard Timings :Once a day : 10am, Twice a day :10am - 10pm,

:Four times a day : 12 - 6 - 12 - 6, Q8 Hrly :6am - 2pm - 10pm Key: WH = Withheld

Note : Actual timings may vary as per ward routine. Administration of drugs half- an-hour before and after is acceptable

DRUG	Generic Name	Date										
		Time	Time	Inital	Time	Initial	Time	Initial	Time	Inital	Time	Initial
Special Instructions	Route											
Dose	Freq											
Doctor's Name	Signature											

DRUG	Generic Name	Date										
		Time	Time	Inital	Time	Initial	Time	Initial	Time	Inital	Time	Initial
Special Instructions	Route											
Dose	Freq											
Doctor's Name	Signature											

DRUG	Generic Name	Date										
		Time	Time	Inital	Time	Initial	Time	Initial	Time	Inital	Time	Initial
Special Instructions	Route											
Dose	Freq											
Doctor's Name	Signature											

All Drug Names Will Be Written In Capital Letters By Doctor

ANNEXURE 3

As Required Prescriptions

Drug				Date																
Dose	Max. Freq.	Route	Start Date	Time																
Doctor,s Name		Signature		Dose / Route																
Additional Instructions				Given By																

Drug				Date																
Dose	Max. Freq.	Route	Start Date	Time																
Doctor,s Name		Signature		Dose / Route																
Additional Instructions				Given By																

Record of Drugs Not administered or Withheld

Date	Time	Name of Drug	Reason Not Administered	Ordered By Doctor	Nurse Initial

Stat / Once Only / Premedication Drugs

Date	Drug (Approved Name)	Dose	Time	Route	Doctor's Signature	Given By	Checked by I / C

Date	Shift	Name of Nurse (in capitals)	Emp. Id.	Initials	Date	Shift	Name of Nurse (in capitals	Emp. Id.	Initials

All Drug Names Will Be Written In capital Letters By Doctor

ANNEXURE 4

TREATMENT CHART

S.No.	Drug & Dose	Time					VOL. IN 24 hrs
	ANTIBIOTICS	08:00	12:00	16:00	20:00	24:00	
1							
2							
3							
4							
5							
6							
	IONOTROPES						
1							
2							
3							
4							
5							
	SEDATION ANALGESIA / PARALYSIS						
1							
2							
3							
4							
	OTHERS INCLUDING I.V. FLUIDS						
1							
2							
3							
4							
5							
6							
7							

ANNEXURE 5

C. Sample size annexure	
Screening population	Sample size*
50	44
100	79
150	108
200	132
500	217
1000	278
2000	322
5000	357
10000	370
20000	377

*For the recommended sample size, all the samples should be taken on continuous basis; Sample size recommended by NABH (4th edition) for capturing CQI 3j indicator

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ORIGINAL ARTICLE

Incidence of Patient Identification Errors observed before Medication and Procedure/Intervention

[1]Ritwik Chawla, [2]Saakshi Kaushik

ABSTRACT

Objectives: To identify the number of individuals for whom double identification check was done before administering medication and before procedure/intervention, as per Continual Quality Improvement 3j indicator of National Accreditation Board of Hospitals (4th edition) and hospital policy.

Materials and methods: The study was a concurrent, observational recording of the study population which included doctors/surgeons, nurses, and/or technicians before administration of any medication and before beginning of any procedure/intervention. The observations were recorded on a prepared checklist to find the compliance of incidence of patients' double identification.

Results: A total of 34 observations were recorded before administering medication to a patient. In 18 cases, wristbands were not being used, and identification details were incorrect in 4 cases. Of 34 cases, identifiers were illegible in 6 cases. The major area where the error was high was noncompliance to verbal confirmation of identity (ID) and checking it from the patient's file. Out of 34 observations before a procedure/intervention, 9 errors were identified in cases where the ID band was not used for verification, and identification details on the band were illegible in 5 cases. In six cases, the patient's name was not verbally confirmed with the patient or carer. Furthermore, in 10 cases, verbally confirmed name was not checked with the patient's file. Out of 34 cases, double identification was not done in 13 cases.

Conclusion: Many nurses, doctors, and technicians in clinical settings do not verify patient ID before performing a task, resulting in more than one-third of staff not conforming themselves with the double identification procedure. The study also showed that over three-fourths of the total invasive procedures are compliant to double identification. On the contrary, noninvasive procedures showed less than one-fourth compliance to double identification.

Keywords: Band, Compliance, Double identification, Identification, National accreditation board for hospitals and health care providers, Wristband.

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INTRODUCTION

Worldwide, health care facilities face a wide range of safety problems. The failure to correctly identify patients continues to result in medication errors, transfusion errors, testing errors, wrong person procedures, and the discharge of infants to the wrong families.[1] During medication administration, failure to identify patients correctly can lead to patients receiving incorrect medications, perhaps resulting in adverse drug events and even death Schulmeister.[2] The major areas where patient misidentification can occur include drug administration, blood transfusions, and surgical interventions and procedures.[9] The trend toward limiting working hours for clinical team members leads to an increased number of team members caring for each patient. This increases the likelihood of hand-over and other communication problems, which increases the chances of avoiding identification check of patients.[1]

A patient wristband may seem a relatively simple feature of health care, compared with the management of high-risk procedures, medicines, and a work environment of constant vigilance and emergency situations. All patients admitted to acute health care settings are issued with a patient identity (ID) wristband. The aim of a patient wristband is to uniquely identify the patient in a hospital.

Identifying a Patient with ID Band

- The hospital staff must ensure that all inpatients must wear an ID band at all times during the stay in the hospital.
- The patient's ID must be confirmed by the staff before administering any medication or carrying out any intervention or procedure.
- At least two identifiers (e.g., patient's full name and ID number) must be used to verify patient's ID.
- If the patient is found to have no ID band, neither medication should be administered, nor should any procedure or intervention be performed.
- In cases in which patient's ID band is torn or rubbed or has been removed, for any reason, it is the responsibility of the staff to ensure that it should be replaced without any delay.

Several organizations have suggested guidelines to increase the accuracy of patient identification, including the National Patient Safety Agency, the Joint Commission on Accreditation of Health care, and the World Health Organization. The Joint Commission, in the United States of America, listed "Improve the accuracy of patient identification" as the first of its National Patient Safety Goals

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(NPSGs) introduced in 2003, and has since then updated it annually.[3] The Joint Commission guidelines for fulfilling this goal are as follows:[10]

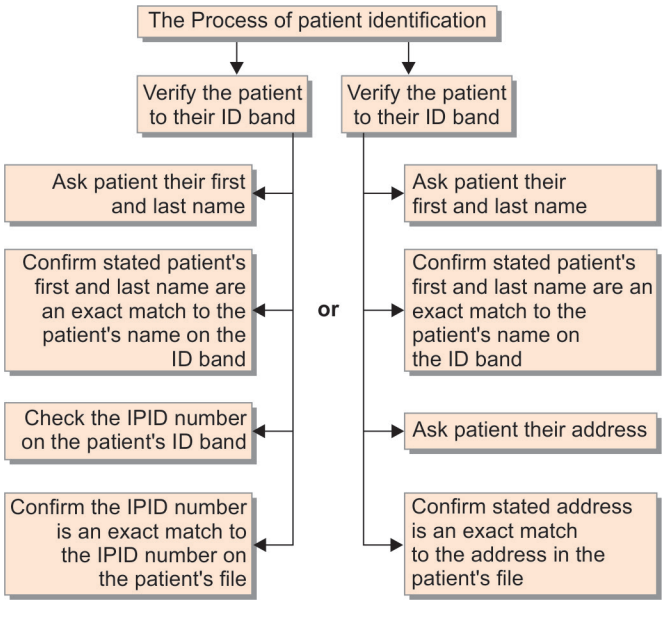
- *NPSG.01.01.01*: Use at least two patient identifiers when providing care, treatment, and services. Identifiers may be the individual's name, an assigned identification number, date of birth, or other person-specific identifier. The patient's room number or physical location is not used as an identifier.
- *NPSG.01.03.01*: Eliminate transfusion errors related to patient misidentification.

The process of patient identification has been explained in Flow Chart 1. The National Accreditation Board for Hospital and Health care provider (NABH) has certain accreditation standards for hospitals on particulars of Continual Quality Improvement (CQI). The organization must identify key indicators to monitor the clinical structures, processes, and outcomes, which are used as tools for continuous improvement. One of the objective element in the new 4th edition of guidelines include patient safety goals.

Health care facilities may train their workers by using policies and/or procedures based on their interpretation of the above-mentioned guidelines.[4] For example, in the studied healthcare facility, the facility specific guidelines were:

The two patient specific identifiers are: 1) First and last name of patient spelt in full (initials are not permitted) and 2) the inpatient identity (IPID) number of the hospital on his/her ID band – the two specific identifiers are matched with the individual before beginning with medication, blood collection, procedure, and/or intervention. Other identifiers which can be used are address, date of birth, and photo ID.

Flow Chart: 1 Flow chart explaining the process of patient identification using two identifiers



Types of Identification Bands

There are different colors of bands as per the category under which the patient falls. The different colors of bands are:

- White Band – Universal band, mandatory to be worn by all individuals admitted to the hospital. (ref. Annexure 1)
- Yellow Band/Red Band – For patients who have allergies or any history of allergy (ref. Annexure 2).
- Orange Band – For patients who need extra attention or care and/or patients who are above 65 or below 12 years of age and have potential to fall (ref. Annexure 1).
- Pink and Blue band – Identification for newborn children, pink is for girls and blue is for boys.

BACKGROUND

While in many countries wristbands are traditionally used for identifying hospitalized patients, missing bands or incorrect information limit the efficacy of this system. Color coding of wristbands facilitates rapid visual recognition of specific issues, but the lack of a standardized coding system has led to errors by staff who provide care at multiple facilities.[11] Between November 2003 and July 2005, the United Kingdom National Patient Safety Agency reported 236 incidents and near misses related to missing wristbands with incorrect information.[3] The National Patient Safety Agency's National Reporting and Learning System reported incidents, such as mismatches between patients and the documentation on their samples, records, blood transfusion samples, and products and medication (65%); missing ID bands with incorrect data on them (16%); mismatches between patients and their medical records (10%); and failures in the manual checking processes (9%) Berveley Norris.[5]

The amount of information on a wristband has steadily increased, usually with the aim of assisting delivery of care, e.g., consultant name, ward name, allergies, and address. The lack of standardization, prioritization, and space means that potential errors associated with patient identifiers include date of birth being mixed up due to differing formats and patients mixed up due to name formats. Long and multiple names may be truncated or omitted; first and second names may be presented in the wrong order; nicknames and shortened names mixed up with given full names; official names and known names mixed up; names from different cultures being wrongly translated or represented.

Several research studies have discussed patient identification errors in various health care processes in health

care facilities, few of those studies have also proposed specific strategies or guidelines to decrease such errors. Lane et al. propose a hierarchical protocol for the ideal medication administration process. Their research suggests to compare the patient's ID band to the patient's chart during medication administration.[6] Spruill et al. suggest matching two patient identifiers, the patient's name and medical record number (MRN), between two specific artifacts, namely the patient's ID band and the chemotherapy product label, to decrease incidents of patient misidentification before chemotherapy administration.[7] Paparella (2012) recommends matching any two patient identifiers suggested by the Joint Commission across three specific artifacts: The patient's statements about their ID, the patient's ID band, and the medication order with respect to the medication administration process.[8] These studies focuses on specific processes (e.g., medication administration, chemotherapy), specific artifacts (e.g., patient's ID band, patient's medication chart, chemotherapy product label, medication order), or specific identifiers (e.g., patient's name, MRN).

Purpose of Study

The hospital was running in its 3rd cycle of NABH. It mandates institutionalization of the revised standards (4th edition) by July 31, 2016. One of the CQI3j indicator, "Incidence of patient identification errors," before medication and procedure/intervention was reviewed in the study, as was asked by the medical superintendent of the hospital. This indicator provides guidance to the staff to ensure the correct ID of all patients, at all times, to restrict the risk of misidentification and adverse outcomes of care.

OBJECTIVES

- To identify the number of individuals for whom double identification check was done before administering medication, as per CQI3j indicator of National Accreditation Board of Hospitals (4th edition) and hospital policy.
- To identify the number of individuals for whom double identification check was done before procedure/intervention as per CQI3j indicator of National Accreditation Board of Hospitals (4th edition) and hospital policy.

SCOPE OF THE STUDY

This CQI indicator is applicable to the following staff of the hospital:

- Doctors/surgeons
- Nurses
- Technician

METHODOLOGY

Study Area

Inpatient wards, preoperation theater (OT) room, ultrasound room, computed tomography (CT) scan room.

Study Population

Total number of patients receiving medication and/or undergoing any procedure or intervention by doctors, nurses, and technicians of wards, pre-OT room, imaging department were studied.

Study Design

Concurrent, descriptive, observational study.

Sample Design

In this study, convenient random sampling technique was used to observe doctors, nurses, technicians of inpatient wards, pre-OT room, imaging department before administration of medicines and before beginning of any procedure or intervention, during the functional hours in the daytime.

Study Time

The study population was observed over a period of 11 days from April 13 to April 25, 2016.

Tool for the Study

Prepared observational checklist (ref. Annexures 3 and 4). Microsoft Excel for analysis of data.

Methods of Measurement

An observer followed the doctors, nurses, and technicians with each patient and filled an observational checklist. Identifying the patient identification error was defined as not completing the assigned task on that patient, which conforms to the policies and guidelines laid down by the hospital.

Convenience random sample of 68 observations respectively, were captured before administering medication and procedure or intervention during the month of April 2016. The study was conducted over a period of 11 days to identify the number of individuals for whom double identification check was not done. Verifying patient ID is defined as matching the patient to the ID band. Confirmation of patient ID required the use of at least two available patient identifiers (i.e., name, IPID number). Matching the patient to the ID band could only be done by asking the patient his or her name and matching the IPID number from the file to the ID band

Table 1: Comparison of incidences characterizing the inadequate patient identification before administering medication

Criteria	N_m	E_m	*Incidence of noncompliance %*
ID band not used for verification	34	18	52.9
Right color band used for allergic or vulnerable patients	34	0	0
Patient identification details incorrect	34	4	11.7
Core identifiers not present/ incorrect/rubbed	34	5	14.7
Identifiers illegible	34	6	17.6
Patient's name not confirmed	34	25	73.5
Verbally confirmed named not matched with file	34	29	85.2

N_m, number of observations before administering medication; E_m, number of errors

Table 2: Comparison of incidences characterizing the inadequate patient identification before procedure/intervention

Criteria	N_p	E_p	*Incidence of noncompliance %*
ID band not used	34	9	26.4
Patient identification details incorrect	34	1	2.9
Core identifiers not present/ incorrect/rubbed	34	3	8.8
Identifiers illegible	34	5	14.7
Patient's name not confirmed	34	6	17.6
Verbally confirmed named not matched with file	34	10	29.4
Identification check not done before transfer	34	9	26.4
Double identification not done before procedure	34	13	38.2

N_p, number of observations before procedure/intervention; E_p, number of errors

attached to the patient's wrist. Various other parameters were identified, such as

- Method of patient verification
- Color of ID band used
- Identification details on the band
- Legibility of identification details
- Presence of core identifiers on the band
- Verbal confirmation of patient's name
- Identification check before transfer to procedure room
- Type of procedure
- Double identification before medication
- Double identification before procedure

Inclusion Criteria

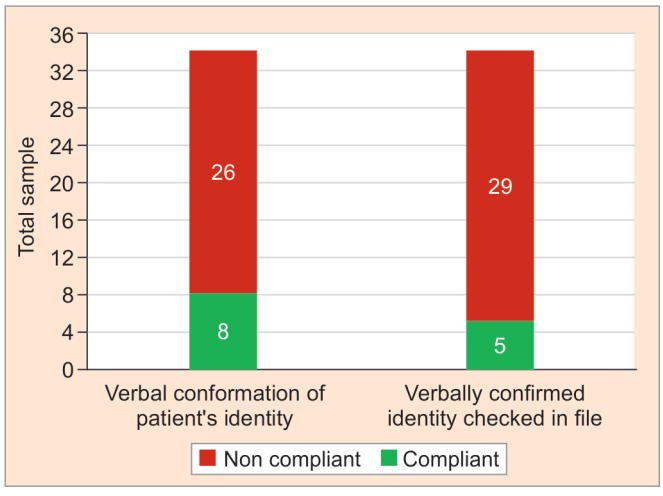
- Doctors/surgeons
- Nurses
- Technician
- Patients of wards
- Imaging department
- Pre-OT room
- Dialysis ward

Exclusion Criteria

- Intensive care unit
- Blood sample laboratory

RESULTS

Total observation before administration of medication has been taken as N_m and before procedure/intervention as N_p. Errors observed for both are E_m and E_p respectively. When results were calculated, it was found that before administering medication to a patient, identification wristbands were used for 16 patients, and in remaining 18 number of cases, ID band was not used, which accounts for 52.9% incidence. There were few errors observed in cases of identification details on the band (Table 1).

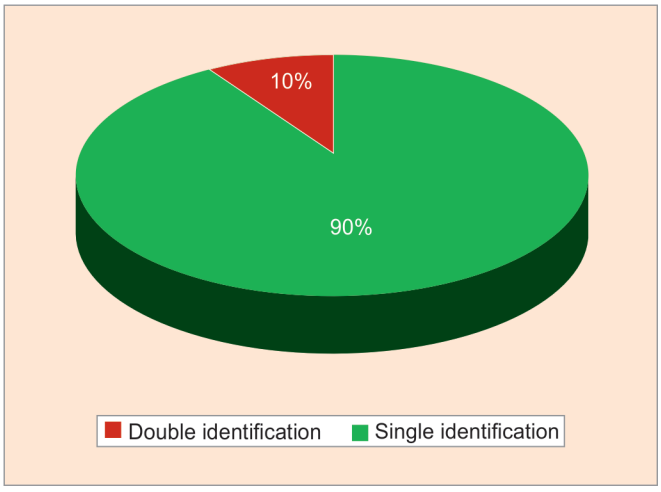


Graph 1: Identity confirmation before medication

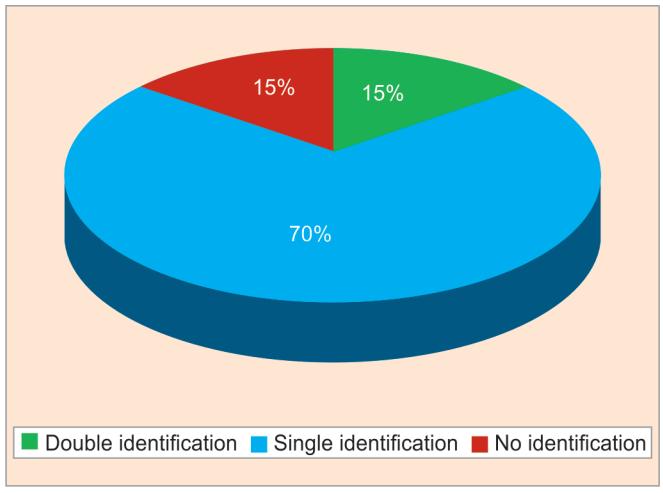
However, major areas where the scope of error was high were verbal confirmation of identity and checking it from the patient's file. The incidence here is as high as above 70% (Table 1 and Graph 1).

Results for patient identification before a procedure/ intervention were also observed in which nine errors were identified in cases where ID band was not used for verification. Identification details on the band were illegible in 5 cases out of 34 observations (Graph 5). In six number of cases, it was observed that the patient name was not verbally confirmed with the patient or carer. Furthermore, 10 cases were such where verbally confirmed name was not checked with the patient's file (Graph 6). Out of 34 number of invasive and noninvasive procedures, double identification was not done in 13 cases (Table 2).

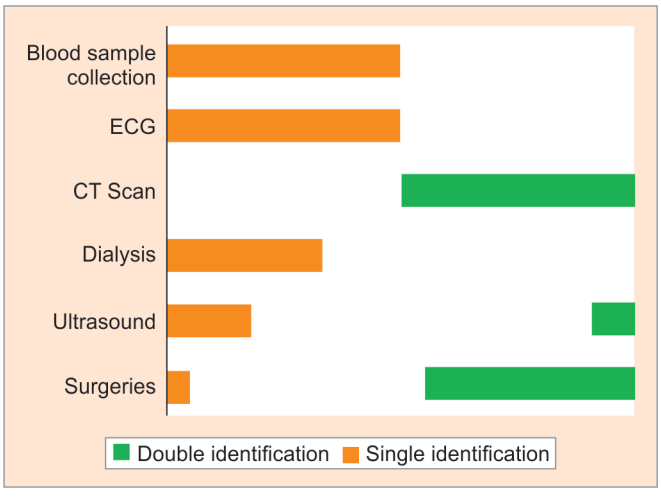
When bifurcation of invasive and noninvasive procedures is done, it was seen that in 90% of invasive procedures which includes surgeries and biopsies, a double identification check was done (Graph 2). Here, the identification procedure was carried out in the pre-OT room,



Graph 2: Invasive procedure



Graph 3: Noninvasive procedures



Graph 4: Compliance to identification check of different procedures

where patient's identity is confirmed using two identifiers (i.e., patient's name and IPID number of the patient). Whereas in noninvasive procedures the incidence of double identification was 15%, single identification check was done 70% of the time (Graph 3).

Incidence for identification check of different procedures has also been identified (Graph 4).

Here, incidence for double identification was 0% in procedures like blood sample collection, electrocardiography, and dialysis. On the contrary, incidence of double identification was 90.5% for surgeries and 100% for CT scan.

LIMITATIONS

Our sample size was fairly small (n = 68). This was due to the limited time we had for this study and limited financial support. This study can also be conducted with a large sample size and for a longer duration, and perhaps the result can then be generalized (for 1000 screening population, NABH recommends 278 sample size) (Annexure 5).

Other limitations also include the study exclusion criteria which are as follows:

- Intensive care unit
- Blood sample laboratory

CONCLUSION

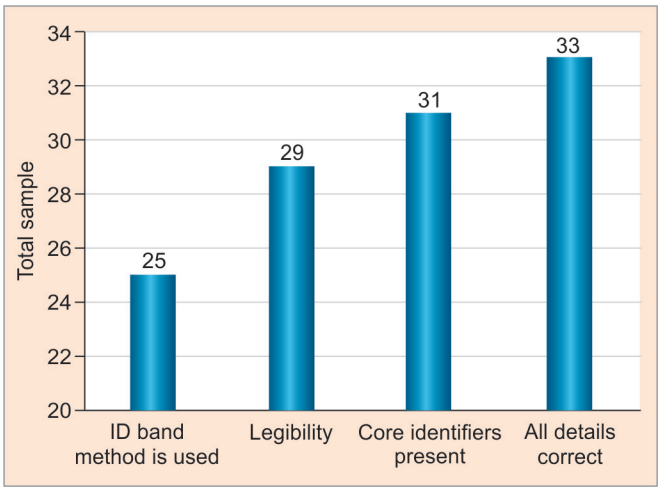
The process of patient identification is a prerequisite for providing successful and safe health care. In summary, it was concluded that many nurses, doctors, and technicians in clinical settings do not verify patient identity before performing a task, which resulted in more than one-third of staff not conforming themselves with the double identification procedure prior to medication administration. Our study also shows over three-fourths of the total invasive procedures are compliant to double identification. On the contrary, noninvasive procedure shows less than one-fourth compliance to double identification.

Although patient identification errors are infrequent, they may result in serious adverse events and are preventable. Improved training and better use of technology may improve the way health care workers verify patient identity, and additional research on these methods is warranted.

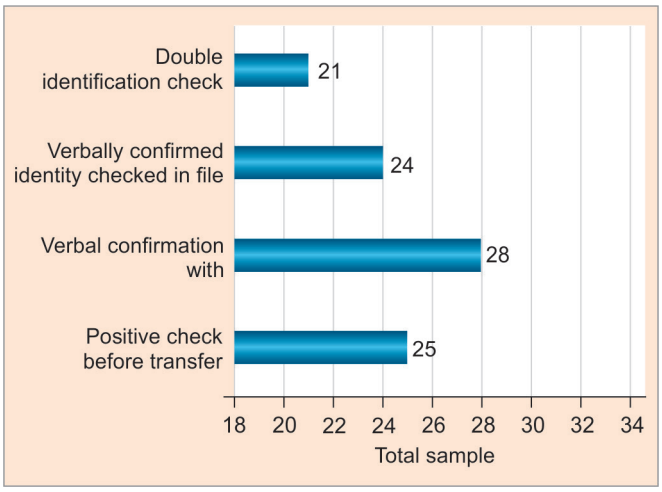
RECOMMENDATIONS

Additional training is one approach to improve the frequency and accuracy of health care workers verifying patient identity. Additionally, a bar-coded wristband can provide two forms of identification in one easy-to-access place by encoding the patient name and identification number. The bar-code frequently serves as a key to a database. When it is read, the scanner decodes the symbol and instructs a computer to look up or update the specific record that corresponds to that patient.

Combination of technology and training might overcome the limitations of the human mind during the time



Graph 5: Identification details of the ID band before procedure/intervention



Graph 6: Identification check before procedure

of verification procedures. In light of the critical requirement that a patient's identity band details be accurate and legible, it may be sensible to develop specific procedures for verifying all identity bands. This needs to be done immediately after they are applied by an individual other than the one who applied the band, to improve the results for the upcoming CQI3j indicator of NABH.

ANNEXURES

Annexure 1

Picture 1: White band, all the necessary details printed on the band

Picture 2: Orange band, for patients who are vulnerable, all the necessary details printed on the band

Annexure 2

Picture 3: Yellow band, for patients who are allergic, all the necessary details printed on the band

Annexure 3

Observation Checklist-1

Identification before medication

1.	What is the method used to identify the patient?	ID Band Photo ID Address None
2.	If ID band: Is it a single band (one only)	Yes No
3.	If No: What is/are the color of the other band/bands?	Orange Yellow
4.	If orange: Is the patient vulnerable?	Yes No
5.	If Yellow: Is the patient allergic?	Yes No
6.	What core identifiers are present on the identification band?	Patient's name Age Sex UHID number IPID number Date of admission
7.	Are the patient identification details on the band correct?	Yes No Unable to verify
8.	Are the identifiers in black text on a white background?	Yes No
9.	If yes, are all the identifiers on the band legible?	Yes – hand written Yes – typed No
10.	Is the patient conscious or unconscious?	Conscious Unconscious
11.	Is the patient's identity confirmed verbally with the patient or carer?	Yes with patient Yes with carer No
12.	Is the verbally confirmed name of the patient checked with the patient's file?	Yes No

Annexure 4

Observation Checklist-2

Identification before procedure/intervention

1.	What is the method used to identify the patient?	ID Band Photo ID Address None
2.	If ID band: Is it a single band (one only)	Yes No
3.	If No: What is/are the color of the other band/bands?	Orange Yellow

4.	If Orange: Is the patient vulnerable?	Yes No
5.	If Yellow: Is the patient allergic?	Yes No
6.	What core identifiers are present on the identification band?	Patient's name Age Sex UHID number IPID number Date of Admission
7.	Are the patient identification details on the band correct?	Yes No Unable to verify
8.	Are the identifiers in black text on a white background?	Yes No
9.	If yes, are all the identifiers on the band legible?	Yes – hand written Yes – typed No
10.	Is the patient's identity confirmed verbally with the patient or carer?	Yes with patient Yes with carer No
11.	Is the verbally confirmed name of the patient checked with the patient's file?	Yes No
12.	What is/are the type of procedure/(s) that the patient is required to undergo?	Invasive procedure Non-Invasive procedure
13.	Is patient identification check done before transferring the patient to the procedure room?	Yes No
14.	Is patient identification check done with two identifiers before initiating the procedure?	Double Identification Single Identification None

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Annexure 5

c. Sample size annexure

Screening population	Sample size*
50	44
100	79
150	108
200	132
500	217
1000	278
2000	322
5000	357
10000	370
20000	377

*For the recommended sample size, all the samples should be take n on continuous basis.

Picture 4: Sample size recommended by NABH (4th edition) for capturing CQI3j indicator

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JRFHHA

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ORIGINAL ARTICLE

Mergers by a Private Hospital: One Script Two Different Endings!

[1]Deepti Jain, [2]Kanika Jain, [3]Gurvinder Kaur, [4]Viney Kapur

ABSTRACT

Introduction: A comparative study of a failed and a successful merger in health care was conducted in an attempt to explore the reasons for success or failure of mergers.

Materials and methods: This was a retrospective exploratory study of two mergers with the primary hospital being common. A detailed study of the existing policies and procedures, hospital records, financial data, and hospital statistics was conducted. Trends were analyzed and compared with the observed value.

Results: Reasons for the successful mergers can be attributed to managerial commitment and coordination, communication, as well as proximity of consultants of the two merging entities. Adequate strategic planning, a professional approach, and incremental implementation of necessary changes are also essential. No redressal of staff and stakeholder apprehension and poor communication are reasons for failure of mergers.

Conclusion: A merger in the Indian hospital scenario is a fairly recent phenomenon. Factors, and their interplay that result in successful or failed mergers in Indian context, are an unexplored field of research. Mergers are capital and resource-intensive, and the consequences of a failed alliance are huge. Thus, a careful, holistic feasibility study is essential before embarking on a merger.

Keywords: Alliances, Health care, Mergers, Success.

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INTRODUCTION

Modern hospitals are expensive to build and operate. Their initial capital cost is high and their operational cost enormous. There are modern hospitals that are today standing almost empty for lack of funds to maintain them.[1] These high costs have led health care administrators to shift their focus from in-patient treatment to ambulatory care, bringing a paradigm shift in the health care milieu.

Hospital mergers are one such strategy adopted to decrease health care costs. Horizontal health care mergers are where two or more hospitals merge into a single entity, bringing all the hospital activities, including support services, management, patient care activities, and professional services, under the full control of the merged entity.[2] The main potential benefits from mergers are cost savings from economies of scale, elimination of duplicate services, reduction in unused capacity through pooling of staffs, improved management and production processes, better access to capital, quality improvements from higher volume of specialized procedures, and broader geographic/network coverage.[3,4] Consumers are also benefited from cost saving when prices are reduced. The main potential hazards of mergers are decreased competition, higher prices, and reduced geographical access because of consolidation.[5] The net impact of mergers depends on whether the benefits exceed the hazards.

The health services and organizational literature ascribes the following reasons for mergers.[6,7] First, mergers may occur in order to attain the requisite investment and management base (i.e., critical mass) necessary to acquire costly health technology, increase market share, support desired clinical services, or attract specialized technical staff. On the contrary, some have argued that mergers are precipitated by the desire to consolidate services, achieve efficiency, and reduce over bedding and staffing in highly restricted markets.[8]

Survival and viability are the prime objectives of hospitals in the present competitive environment.[9] There are two types of private hospitals: Corporate hospitals and Trust-run hospitals. Trust-run hospitals are charitable hospitals, run on a no-profit no-loss concept. Such hospitals also need a surplus to maintain sustainability by keeping pace with recent trends in terms of infrastructure and technology.[10] In the era of cost containment and self-sufficiency, hospitals have to generate surplus from the costs borne by the patient.

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Abroad, hospital mergers are reviewed for several reasons. First, the 1990s witnessed a sporadic wave of consolidation across hospital markets in the United States. Pursuant to which there was a nine-fold increase in hospital mergers. By 2003, highly concentrated markets were witnessed in the nation's larger metropolitan statistical area by virtue of 90% occupancy. Stakeholders and policymakers have raised concerns about this trend, pointing toward the potential impacts on health care costs and quality.[11]

Second, understanding competition in the hospital industry is important in its own right. Inpatient hospital care comprises 31% of total US health care expenditures.[12] Thus, mergers in the health care industry not only provide an opportunity to test theory, but may also create a substantial impact on its aggregate economic activity. Corporatization in the Indian health care sector has resulted in mergers primarily in pharmaceutical and biotechnology industry and secondarily in the hospitals. Few studies have reviewed the mergers among Indian hospitals.[13]

Indian public sector is mainly dependent on government funding or entering into public/private partnership and has been less keen in mergers or acquisitions. On the contrary, the growing competition in the health care industry has created an environment of uncertainty among the smaller hospitals in India. In such an environment such hospitals find mergers and acquisitions viable.[14] Examples of some acquisitions witnessed by the Indian health care industry include Fortis Health care acquiring 10 hospitals from the Wockhardt for Rs 909 crore and Fortis having invested its stakes into SRL labs.[14]

One such example is the subject of the study, the charitable trust Hospital A providing accessible and affordable health care to all sections of society, which entered into an alliance with other hospitals. The study was undertaken with the aim to explore and understand the various factors that play a pertinent role in mergers and acquisitions in order to help broaden the spectrum of knowledge on this topic.

MATERIALS AND METHODS

Two hospital mergers were studied. First merger was between Hospital A and Hospital B, both located at close proximity in West Delhi and the second merger was between Hospital C, located at Gurgaon and the primary Hospital A.

Data for a period of 15 years were collected after going through the existing policies and procedures, financial data, and hospital utilization statistics during the period of merger (secondary data) and Memorandum of Understanding (MoU) between the hospitals. For an objective assessment of the alliance, the hospital statistics were obtained from the Medical Records Departments of both the hospitals. These were then tabulated to facilitate intrahospital (over a period of time) and interhospital comparisons and analyze the benefits of the alliance for the two hospitals. For Hospital A, to understand the benefits garnered from the alliance, the income generated from management consultancy fee, increased investigations, procedure and surgeries, and the value of collection charges for consultants were studied (Table 1).

The Balance Sheets and the Profit and Loss Accounts of Hospitals B and C were studied and were compared over the timeline to analyze the alliance. Besides this, charges being paid to the treating doctors and the suppliers (outsourced diagnostic services) along with the increase in these charges over the years were studied.

Data were analyzed using Microsoft Office 2010 (including Word, Excel and Access), Adobe Acrobat 8 Professional, Statistical Package for the Social Sciences version 22.0. Conclusion was drawn following the trend analysis. Trends were compared with the observed values. By the method of least squares, the trend for the various data heads, like the number of inpatients, number of patient's days, etc., was calculated for the period from 1997 to 2005. Annual forecasts for the next 5 years (2006 to 2010) were calculated and compared with the actual figures for the corresponding period.

Table 1: Gains for hospital A (amount in Rs)

Years	*Management consultancy*	*License fee (pharmacy)*	*Collection charges*	*Revenue transferred inpatients*	*Outsourced diagnostics*
2005–2006	9,206,444.00	0.00	3,950,213	4,051,467	11,816,607
2006–2007	18,339,7712	1,723,562	10,298,508	16,431,462	21,822,5016
2007–2008	21,844,091	6,879,121	16,071,246	20,433,777	25,707,075
2008–2009	26,952158	8,243,836	21,184,178	41,447,766	54,803,812
2009–2010	33,196,252	8,498,877	22,805,776	36,279,631	57,778,688
2010–2011	26,879,724	14,552,610	52,783,962	28,910,893	75,586,392

Source: Monthly finance report by city hospital

RESULTS

Analysis

Merger between Hospital A and Hospital B: A Successful Alliance

Hospital A, a leading, 559-bedded not-for-profit, tertiary care referral hospital maintaining consistent bed occupancy of over 96% at all times situated in center of Delhi. Hospital B, a private 100-bedded, well-built, fully furnished, multispecialty hospital which is in health care operations for the past 7 years, but was not able to establish an independent identity prior to its merger with Hospital A.

Need for the Partnership between Hospital A and Hospital B

Hospital B after facing a debacle of losing a contractual agreement with a reputed hospital in Delhi was facing many challenges to establish an identity as the hospital did not have an independent outpatient department (OPD) base as doctors were not willing to associate themselves to the hospital which led poor occupancy. Lack of comprehensive services led to dissatisfaction among both patients and staff leading to high attrition.

Hospital A, on the contrary, was facing a problem of constrained resources due to 100% occupancy, so the hospital had to either ask its patients to wait for bed or refer them to other hospitals when emergent interventions were required, thus losing not only its patient base to other hospitals in the vicinity but was also foregoing revenue and losing business. The doctors were dissatisfied as they could not admit their patients. The hospital intended to tap the opportunity of increased demand for advanced treatment modalities for which high investments had been made, but these resources were not being utilized optimally. In addition, there was an impending threat created after the entry of corporate hospital groups who were vying for a larger market share.

Prior to entering into an understanding, the financial summary of the Hospital B was examined. Hospital A believed that its management team could turn around Hospital B in 2 years and restore its profitability. The points in favor were its assets worth 25 crores and absence of any long-term debt besides the proximity the location advantage the hospital offered to Hospital A.

After comprehensive evaluation, both the hospitals entered in a contractual agreement on the 3rd of March 2005 for a period of 15 years which was extendible further by mutual agreement.

Analysis of Financial Status of Alliance

There has been a consistent increase in the management consultancy fee of Hospital A, which was calculated on the gross turnover after deduction of preagreed expenses.

Considering Year I as the base year, the growth has been to the tune of 99% in the II year and 19 to 23% over the preceding years till 2009 to 2010. The pace of growth slowed down thereafter. Increased bed strength at Hospital A could be responsible for the same. The growth has been up to 190% with a peak at 260% in the year 2008 to 2009.

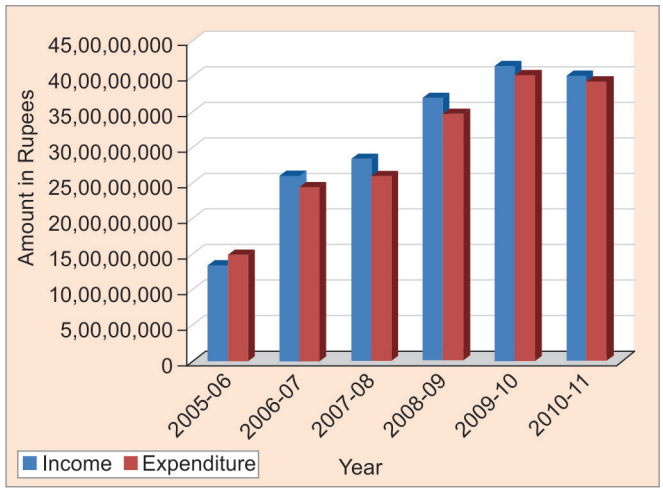
Over the years, reasons for major profits centers shifted from management consultancy and the increased volume of investigations outsourced to Hospital A (approx. 50% mgmt. fee and 40% from investigations) to the collection charges of the consultants (@ 20% of the professional charges) and revenue earned from patients transferred for various procedures, indicating increased utilization of the facilities at Hospital B.

Pharmacy

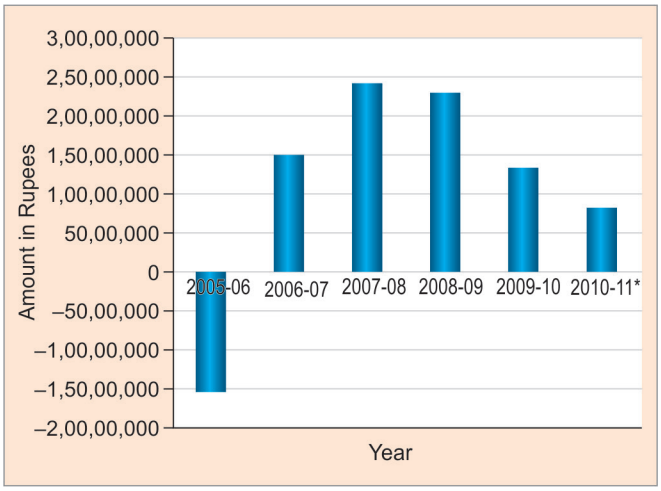
Following outsourcing of the pharmacy in the year 2006 to 2007, Hospital A's share of income from the pharmacy decreased by 25%. In the year 2010 to 2011, by mutual agreement, there was downward revision in the management consultancy fee paid to Hospital A, although when total earnings are considered, the amount in 2010 to 2011 is more than that in 2009 to 2010.

Income and the Expenditure

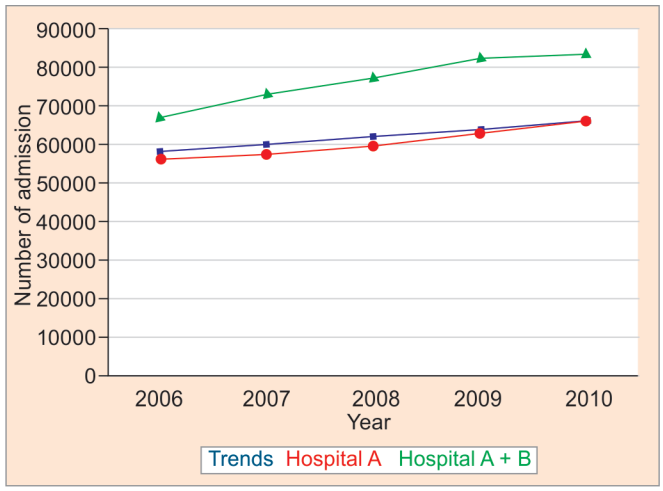
The income and the expenditure at Hospital B have consistently grown over the past 5 years, which was 0.89 in the 1st year of combined operations and has remained above 1.0 thereafter (Graph 1).



Graph 1: Income *vs* expenditure of Hospital B



Graph 2: Net profit (before tax) for Hospital B



Graph 3: Trends of admission at Hospital A and B

Table 2: Bed strength and admissions at Hospital A and Hospital B

	Hospital A			*Hospital B*		
Years	*Bed strength*	*Admissions*	*Admissions/bed*	*Bed strength*	*Admissions*	*Admissions/bed*
2005	559	56,709	101.4	100	3,074	30.7
2006	558	56,134	100.6	117	11,080	94.7
2007	567	57,298	101.1	124	15,596	125.8
2008	558	59,491	106.6	134	17,698	132.1
2009	675	62,980	93.3	140	19,168	136.9
2010	675	66,169	98.0	138	17,007	123.2

Source: Medical records department, hospital A

The income of Hospital B has grown by more than 300% with steady increase in profits (four times). The figures of 2010 to 2011 are as per the 1st three quarters of the financial year (Graph 2).

Consultants

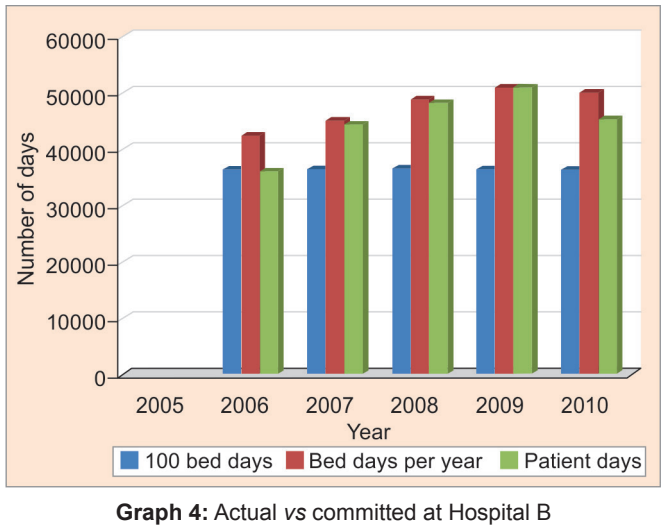
Consultants from Hospital A and outsourced agencies working in these organizations have benefitted from this alliance. The income of consultants has grown remarkably over the last 5 years. When the professional charges of both the hospitals were compared, the Hospital A consultants have contributed to approximately 70% of these charges, indicating that almost 70% of the occupancy and revenue generation is by Hospital A consultants.

Hospital Utilization Statistics

Both the hospitals have consistently maintained a bed occupancy rate of above 95% where Hospital A treated 39% more patients, exceeding the trend projection by as much as 25% (Graph 3). The admissions per bed at Hospital B have increased from 30.7 to 123.2 (Table 2). The decrease in the total admissions at Hospital B can be attributed to additional 117 beds commissioned at Hospital A in 2009.

As compared to the trend projection of 14% more patient days, Hospital A registered an increase of 18% in its own facility and 19.24% more patient days for the alliance taken together.

Hospital B maintained a healthy patient days to bed days ratio in the range of 0.85 to 0.9, touching 1.0 during the peak. Patient days to bed days ratio has always been in the range of 0.98 to 1.24, touching 1.9 at the peak times as per the MoU, and Hospital A had agreed to admit patients on 100 beds. Hence, a comparison of the total patient days at Hospital B per year for 100 bed days was plotted to assess the commitment (Graph 4).



Graph 4: Actual *vs* committed at Hospital B

Casualty Attendance

Hospital A has witnessed a sizable increase in the casualty attendance and in the admissions through casualty but bed availability was a limiting factor.

An increase in the number of inpatients has also given a boost to the diagnostics at Hospital B. The number of computed tomography scans done annually has increased by 125%. The number of X-rays done has increased by 110%, lab investigations have doubled, and echocardiography has quadrupled over the last 5 years. There has been a two and a half time's increase in ultrasound. However, investigations at Hospital A have not matched the trend projections. This is because the hospital was already running at full capacity.

Patients from Hospital B were admitted as day care cases at Hospital A and are transported back to Hospital B after surgery, which has enabled Hospital A to achieve economies of scale. Comparisons with trends show that Hospital A has kept pace with the trend of minor surgeries, which include day care surgeries that the hospital had promoted both at its own facility and at Hospital B, showing a corresponding increase in the number of surgeries.

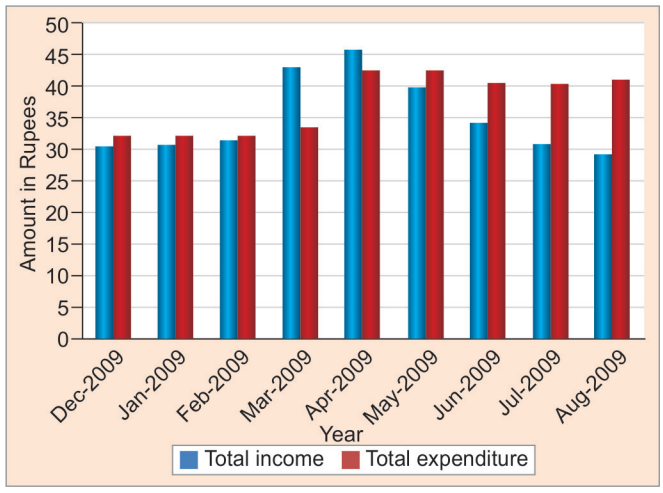
PARTNERSHIP BETWEEN HOSPITAL A AND HOSPITAL C: A FAILED ALLIANCE

Second group of merger that was studied was between Hospital A and Hospital C.

Need of Partnership

Hospital C, a private hospital, situated at Gurgaon, despite of its approachable location, was unable to attract patients because of lack of marketing, weak brand image, shortage of doctors, and other paramedical staff. Patients were not satisfied due to lack of comprehensive services, high waiting time, absence of super specialty, and continuum of care. To strengthen its position in market it approached Hospital A, which was also contemplating to increase its market share in national capital region (NCR) and become a hub for medical tourism. The alliance with Hospital C gave Hospital A an opportunity to create a niche for itself in NCR.

The observed values for both income as well as expenditure were declining (Graph 5), creating an enormous budget deficit in its first few months of operation and failing the main goal of alliance to economize the organization activity. As per MoU, Hospital A was entitled to monthly management consultancy fee @ 15% + applicable taxes of gross receipts of the Hospital C (including gross income of pharmacy (net of taxes) and income from all outsourced agencies) after subtracting deductions (national share of revenue amounting to Rs 40.00 lakhs per



Graph 5: Income *vs* expenditure – Hospital C

month adjustable on behalf of second party, professional fees of all Hospital A empaneled consultants, amount paid to the outsourced diagnostics, and pathology services or its outsourced services). Hospital C was unable to pay the management consultancy fees to Hospital A. In turn, it required increased investment by Hospital A to keep the hospital operational, proving to be a liability rather than an asset for Hospital A.

The statistical analysis clearly indicates a consistent downward trend in many of the hospital statistics like bed occupancy rate, average length of stay, etc. As expected, the merger also failed to attract patients in the casualty, OPD, for admissions, investigations, procedures, etc., further adding to the financial deficit (Table 3).

TERMINATION OF ALLIANCE BETWEEN HOSPITAL A AND HOSPITAL C

The alliance between Hospital A and Hospital C did not go as envisaged. The operation costs were much higher than expected; the hospital had continuous financial problems and personnel as well as patients were unsatisfied. After probing further it was found that despite acquiring a brand image Hospital C was not able to position itself well in the market. Distance and time constraints, in commuting from one hospital to another were a major hindrance for consultants of Hospital A to go to Hospital C, which contradicted the promises made in the marketing campaigns leading to dissatisfaction among patients. Management's resistance to change was responsible for the dissatisfaction among consultants and other staff, creating a vicious circle between services being provided and patient satisfaction. Dual control and ambiguous orders from Hospital C management and Hospital A administration created confusion among personnel in carrying out their job responsibilities, further fueling dissatisfaction among the staff at all levels.

Table 3: Trend analysis for total, casualty, and private OPD admission and investigations

Trend	Total admissions		Casualty admissions		Private OPD admissions		CT scan		Ultrasound		Lab investigations	
Years	Observed value	Trend value	Observed value	Trend value	Observed value	Trend value	Observed value	Trend value	Observed value	Trend value	Observed value	Trend value
Dec, 2008	124	101.62	456	536.24	1,193	1346.80	0	15.07	41	70.60	3265	3224.91
Jan, 2009	120	114.44	454	537.88	1,324	1395.93	15	15.55	87	73.62	4042	3428.54
Feb, 2009	111	127.26	540	539.51	1,618	1445.07	22	16.03	63	76.63	3116	3632.18
Mar, 2009	140	140.07	637	541.14	1,674	1494.20	25	16.52	101	79.65	3685	3835.81
Apr, 2009	169	152.89	650	542.78	1,652	1543.33	31	17.00	111	82.67	4100	4039.44
May, 2009	131	165.71	640	544.41	1,514	1592.47	22	17.48	82	85.68	4315	4243.08
Jun, 2009	126	178.52	562	546.04	1,439	1641.60	9	17.97	101	88.70	4256	4446.71
Jul, 2009	216	191.34	547	547.68	1,694	1690.73	13	18.45	83	91.72	3810	4650.34
Aug, 2009	239	204.16	399	549.31	1,782	1739.87	16	18.93	75	94.73	5766	4853.98

Source: Medical records department, hospital A

Increasing expenditure on the part of Hospital A and failure to recover cost on the part of Hospital C became another point of deliberation for the Hospital A management to terminate its understanding with Hospital C. As a result, MoU was terminated with mutual consent of both the hospitals on 5th September 2009.

DISCUSSION

Gains of the Alliance: Hospital A and B

The alliance was a mutually beneficial arrangement for both the organizations. The two hospitals have generated significant savings by sharing resources. Efficient provisions of services have helped achieve economies of scale. Greater leverage in negotiating prices combined with lower costs has been achieved and has helped achieve financial synergy by both cost-reducing factors as well as revenue-enhancing factors.

Hospital A

Bed availability has fueled patient referrals to Hospital A, in addition to increase in OPD and walk-in patients. It has provided greater leverage in getting more service provider agreements. Due to the infrastructure support provided by Hospital B, increased productivity and shorter waiting lists have been observed at Hospital A. It has improved resource and equipment utilization of the advanced modalities of diagnosis and treatment. Growth rate at Hospital A surged accordingly. The alliance has performed better than the trend projection, which has helped the hospital venture into new service domains.

Hospital B

After earning an affiliation with a trusted name, the hospital has seen a turnaround in a record period of one and a half year of combined operations, which has helped to broaden its service line and fill the earlier gaps. The alliance has helped Hospital B to provide services like blood bank, microbiology lab, magnetic resonance imaging services, eye bank etc., and maintain its occupancy rates over 95% at all times.

Mergers between two health care organizations happen due to interplay of a number of factors. Numbers of studies have been conducted to determine which factors should be taken onto consideration by the top management while coming to a decision to enter into an understanding.

Mergers are an area seldom researched in the Asian subcontinent. However, a number of studies have been conducted in the west to study mergers. The current study still agrees with the findings of the erstwhile studies conducted by Lee and Alexander[7] and Sidorov.[15] Besides, a number of studies have been conducted with a focus on various aspects of mergers be it acceptability, benefits, etc. A comparison between the studies conducted till date and the current study has been shown in Table 4.

CONCLUSION

Mergers are seen as a mean to help struggling hospitals at tough times. However, cost of failed mergers is enormous. In conclusion, a well-balanced MoU addressing the concerns of both hospitals, organizations of equal standing having similar mission, vision, and ideologies, and a clear, command structure as essential.

Importantly, the study also revealed that proximity, both between the merging hospitals and staffs, is a key factor. Stakeholder involvement and assuaging apprehension among staff at both organizations are areas that hospital administrators need to focus on.

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Table 4: Comparison between the findings in earlier studies and current study

Parameter	*Earlier studies*	*Current study*
Financial impact of merger	Mullner and Anderson[2] conducted a study on 32 hospital mergers and found no significant financial effects of mergers	Merger of Hospital A and Hospital B showed positive financial effects, while merger between Hospital A and Hospital C did not show any significant financial effects. The study concluded that the financial effect occurs selectively and depends on the conditions of the merger
Benefits	Lee and Alexander[7] concluded that the expected benefits of mergers include increasing market share, economies of scale, patient volume, and profitability	True in case of alliance between Hospital A and Hospital B
Impact on quality of services	Ho and Hamilton[6] study showed the slight reductions in quality of services as a result of merging of hospitals	The study also finds evidence of change in delivery of quality of services. Hospital A and Hospital B were able to maintain the quality of services, whereas a decline in quality was observed in Hospital A and Hospital C, which was attributed to the lack of management attention
Acceptability of merger by various stakeholders	Sidorov concluded that a health system merger does not automatically result in economies of scale; and not all stakeholders in the surrounding community necessarily would welcome a merger	The same observations are found
Stress among employees due to merger	Lees and Taylor[12] observed in their study that nurses in emergency experienced stress due to the alliance	The current study observed that all level of employees experienced stress due to job security
Motivational factors for organizations to merge	Patrick and Gaughan[16] concluded in their study that the two major motivations that dominate the activity of merger are the growth through taking advantage of the acquired company's resources and the synergy respecting the financial math equation "2 + 2 = 5"	Economies of scale were found to be one of the most dominating factors for merger
Importance of leadership in managing hospital mergers	Weil[19] studied the effect of hospital mergers in Europe and North America and suggested that they neither generated cost savings nor improved the quality of care. Almost all consolidations fall short, since those in leadership positions lack the necessary understanding and appreciation of the differences in culture, values, and goals of the existing facilities	The weak leadership of Hospital A and Hospital C was found responsible along with lack of consensus on the recruitment of staff

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EXPERT VIEW

In Pursuit of Holistic Green Health Care Facilities

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INTRODUCION

"It is health that is real wealth and not pieces of gold and silver." (Mahatma Gandhi)

Of late, rapid advancements in the health care industry have made recovery and recuperation of patients faster and precise, thanks to the prowess and skills of the medical fraternity. However, there is a growing need to design buildings and projects in the health care sector, which holistically address the health, comfort, and well-being of all the persons involved in the health care setup.

Understanding this imperative, the Indian Green Building Council (IGBC), part of the Confederation of Indian Industry (CII), has launched an exclusive rating system designed to holistically take care of the doctors, nursing staff, caregivers, paramedics, and all occupants involved in the health care facilities.

GREEN BUILDING MOVEMENT IN INDIA

Spearheading the green building movement in India is IGBC, a part of CII. The IGBC has the unique distinction of ushering and pioneering the 21st-century modern Green Building Movement in the country.

As on January 2017, the IGBC had already facilitated an overwhelming 4.48 billion sq. ft of green spaces in the country, thereby enabling India to become the second largest registered green footprint country in the world. Over 3,900 projects are adopting IGBC green building rating systems. The reason for this significant growth is the fact that "green buildings make good business sense" and IGBC within a short time could demonstrate that constructing a green building is technically feasible and economically viable.

Chairman IGBC Green Healthcare Rating

Consultant, World Bank

Vice President, RFHHA

Visiting Professor, London South Bank University, UK

Former Chief Architect, Ministry of Health and Family Welfare Government of India

Advisor (Architecture), HLL Lifecare Ltd. (A Govt. of India Enterprise)

To suit different building types, IGBC has the unique distinction of launching 18 indigenized green building rating systems. All the ratings are designed to address national priorities and are a blend of ancient architectural practices and modern technological innovations.

INDIAN GREEN BUILDING COUNCIL GREEN HEALTH CARE RATING SYSTEM

Introducing green concepts in the health care facilities can help address national issues like infection, epidemics, handling of biomedical waste, water efficiency, energy efficiency, reduction in fossil, fuel use for commuting, consumer waste, and, in general, conservation of natural resources. Most importantly, these concepts can enhance patients' health, recovery, and well-being.

Against this background, the IGBC has launched "IGBC Green Health care Rating System" on October 6, 2016, in the Green Building Congress at Mumbai. This rating program is a tool that enables the designer to apply green concepts and reduce environmental impacts that are measurable.

Photo 1: A green building is one that uses less water, optimizes energy efficiency, conserves natural resources, generates less waste, and provides healthier spaces for occupants, as compared with a conventional building

Commercial	Health and wellbeing	Industrial	Built environment
IGBC green new buildings	IGBC green health care facilities rating	IGBC green factories	IGBC green cities
IGBC green existing buildings	IGBC wellbeing rating*	IGBC green SEZ	IGBC green villages
IGBC green interiors			IGBC green township
IGBC green campus			IGBC green landscape
IGBC green data centers	**Residential**	**Education**	**Transit**
	IGBC green homes	IGBC green schools	IGBC green metro stations
	IGBC green residential society		IGBC green existing metros
	IGBC green affordable housing*		IGBC green railway stations

Photo 2: Launch of IGBC Green Healthcare Facilities Rating System

BENEFITS OF GREEN HEALTH CARE FACILITIES

Green health care facilities can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water and energy consumption right from day one of occupancy. The energy savings could range from 20 to 30% and water savings around 30 to 50%. The intangible benefits of green health care facilities include enhanced air quality, faster patient recovery, daylighting for patients, connectivity to outdoor environment, health and hygiene of occupants and patients, and safety benefits.

The national benefits addressed in IGBC Green Health Care Facilities include the following:

- Reduces resource consumption (power and water)
- Would address sustainability aspects in health care facilities
- Augments the health care policies of the country
- Minimizes hospital-acquired infections (HAIs)
- Ultimately enhances public health.

KEY FEATURES IN GREEN HEALTH CARE FACILITIES

Healing Architecture

The elements of healing architecture play a major role in designing the health care facilities. The architecture in the hospital should be designed in such a way that the natural daylight is fully optimized. The nature and greenery should be integrated well within the building. The color psychology also adds up in creating a healing and therapeutic environment for faster recovery of the patients. The selection of colors can be based on the health problem of the patients.

Occupant and Patient-centric Design

Green health care facilities also ensure the comfort and well-being of patients, doctors, and other occupants. By design, in a Green Hospital, acoustical comfort of all the occupants are taken care and full efforts to minimize noise disturbances are ensured. Lower reverberation time is ensured in all the critical spaces of the hospital setup.

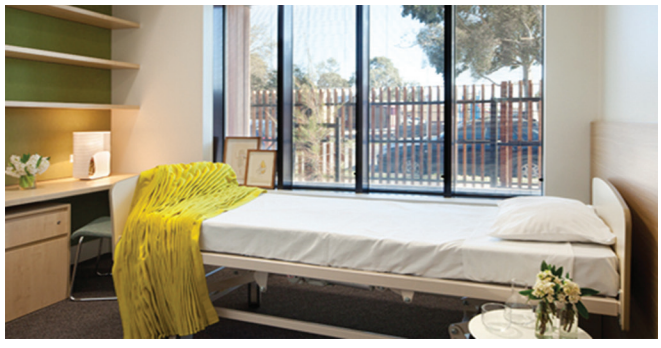
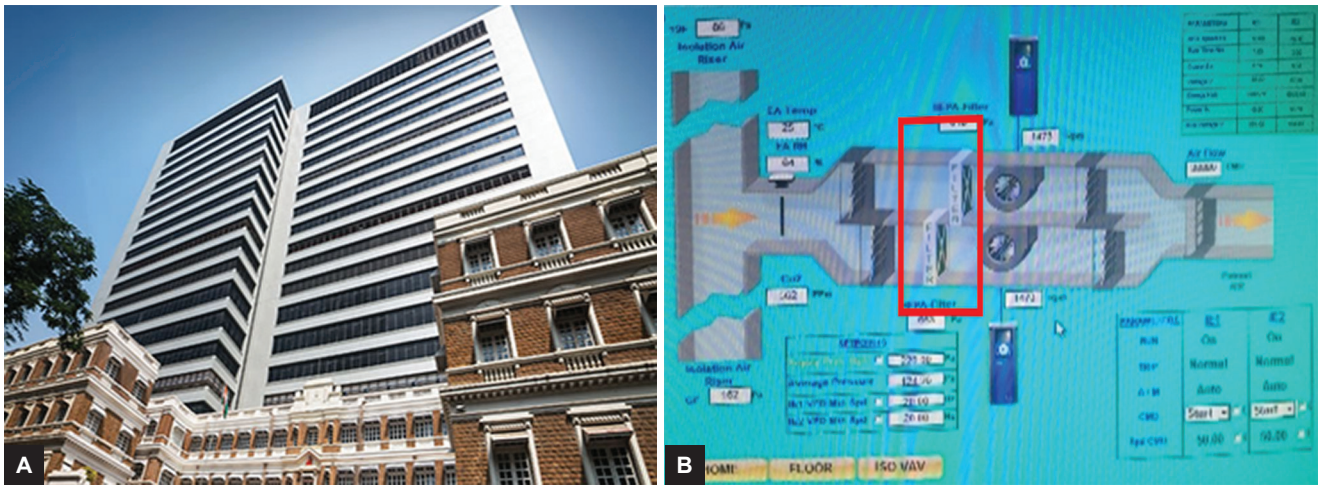


Photo 3: GNRC, Guwahati, IGBC gold certified

The hospital would also be ergonomically designed for the doctors and the medical staff. Design of furniture, such as height and depth of the shelves, ease of approach along with adequate circulation movement is ensured in a Green Hospital. Further, basic services, such as automated teller machine, restaurants, supermarket should be prominently located and readily accessible for the visitors, patients, and doctors.

Infection Control

Controlling HAI is one of the key features in a Green Hospital. The infection control strategies revolve around the concept of dilution, filtration, pressurization, and purification. Dilution of stale air by infusing fresh air is encouraged. The minimum outdoor air changes should be as per ASHRAE-170 "Ventilation of Health Care" standard. Filtration at two levels should be installed in critical areas, such as surgery rooms, laboratories, patients' rooms, etc. The use of high-efficiency particulate arrestance (HEPA) filters is encouraged in all the isolation and operation rooms. Infection can also be controlled by incorporating antibacterial coatings and copper-based surfaces at all high touch areas, such as



Photos 4A and B: Installation of HEPA filters in isolation rooms at Sir HN Reliance Hospital, Mumbai, IGBC gold-rated hospital

bed rails, telephone, toilet seat, toilet flush handle, and inner washroom doorknob.

Purification techniques, such as germicidal/ultraviolet lamps in cooling coil of air handling unit and photo hydro ionized oxidation + at duct level should be installed to ensure the eradication of nosocomial infections.

Design of Isolation Room

Green health care facilities ensure adequate and well-designed isolation rooms, thereby eliminating the risk of HAI. Minimum 10% of the total in-patient bed capacities should be provided based on isolation room design. The HEPA filters can be installed at return air duct to treat the stale air before exhausting it to the external environment.

Sanitization and Hygiene

Green hospital encourages sanitation design and cleaning practices based on the protocols developed by the Centers for Disease Control. The guidelines recommend frequent cleaning of high touch surfaces like bed rails, telephone, toilet seat, toilet flush handle, and inner doorknob.

Biomedical Waste Management

Waste management within hospitals is one of the key and sensitive issues that need extensive attention at all the stages: Design, construction, and operation. Automated waste management system should be installed for segregation of biomedical waste. This system ensures reduction of human intervention by 90%. Waste management plan for solid and liquid biomedical waste should be planned based on the Ministry of Environment & Forests' Bio-Medical Waste (Management and Handling) Rules 2016.

Water Conservation

Hospitals are one of the water-intensive sectors. A green health care facility should encourage the concept of reduce, recycle, and recharge in both design and operation phase. Water-efficient fixtures, such as dual flush system, aerators, and waterless urinal should adopt the specifications of Uniform Plumbing Code, India. The treatment and recycling of wastewater should be encouraged. The recycled water can be used for various applications, such as landscaping and flushing. Further, water meters should be installed at various applications, thereby improving the water performance of the health care facilities. Water savings around 30 to 50% can be demonstrated in a Green Hospital.

Energy Efficiency

Promoting energy efficiency is one of the top priorities of Green Hospitals. The energy savings could range from 20 to 30%. By adopting efficient envelope, lighting and

Photo 5: Around 40% of water savings are achieved in Ruby Hall Clinic, Pune, IGBC gold certified

Photo 6: Energy efficiency of around 30% is achieved in Max Super Specialty, Bhatinda, IGBC gold certified

HVAC systems, and building management system, the energy consumption will come down significantly.

These facilities also encourage the installation of onsite and offsite renewable energy sources, including solar, wind, and geothermal.

CONCLUSION

The health care sector in India is growing at a rapid pace and contributing immensely to the growth of the quality of services. The sector is expected to grow several-fold in the next decade. While this augurs well for the country, there is an imminent need to incorporate green concepts and techniques in this sector, which can aid growth in a sustainable manner. Going the green way will facilitate a greener and healthier India.