Editorial

Smart Hospitals … Gen Next

Healthcare in India is undergoing paradigm shift. Globalization and shrinking of the world has necessitated the way to rethink and re-engineer how healthcare is delivered. Today the need is of instant updates and quick solutions. Technology is surging ahead by leaps and bounds and hospitals are also metamorphosing into technology embedded organizations. Facing increased competition, tighter spaces, staff retention and reduced reimbursement, today's hospitals are looking at strategic ways to use technology to manage their deliverables. This is where a system called smart hospital steps in. Concept of the smart hospital is about adding intelligence to the traditional hospital system by covering all resources and locations with patient information. Patient is the defining factor for all the hospital's performance criteria, earlier hospitals used to be oriented around the specialties and the beds therein, but now hospitals are no more a conglomeration of infrastructure and trained personnel, it is more about re-engineering the patient comfort and providing him personalized treatment. Patient's information is an important component of the patient privacy in any healthcare system that is based on the overall quality of each patient in the healthcare system. The main stakeholders in the healthcare process are healthcare consumers (patients). Consumer-oriented care, where patients are directly involved in the process of care, will greatly improve the healthcare process. Today, there is a need of such computer environment where treatment to patients can be given on the basis of his/her previous medical history at the time of emergency at any time, on any place and anywhere. Portable and wireless mobile information communication technologies (MICTs), such as computers on wheels (COWs) or workstations on wheels (WOWs) are used in some healthcare setup to further facilitate access to information technologies at the point of care.

The concept of smart hospital has been designed from the ground up to achieve safety and clinical quality, productivity, ease of use for patients, doctors, families and caregivers, service excellence, optimal use of technologies. Today, hospital executives have to look closer at their work flow processes earlier in the game, in order to capitalize on the latest technology to optimize clinical, financial and administrative processes. It involves more than advanced healthcare information systems. It also includes ancillary technology, such as medical-device integration, advanced nurse call and advanced patient tracking.

Technology is the major driver of all facets of healthcare delivery. Hospitals have introduced the advanced information and communication technologies to improve the processes and outcomes of medical care, improve efficiency and reduce waste in the processes of medical services. This can happen by enhancing the teamwork and multidisciplinary care.

Technology can play key roles in consumer-oriented healthcare (e.g. making information accessible to consumers, integrating consumers preferences into hospital information systems (HISs), remote monitoring, communication, etc. internet of things (IOTs), the fourth dimensional technological revolution of world information, following technological revolution of computer, internet and mobile communication network, is a network connecting any items with internet to implement information exchange and communication, furthermore to implement intelligent recognition, positioning, tracking, monitoring and management, by means of radio-frequency identification (RFID), infrared sensors, GPS, laser scanners and other information sensing equipment, according to conventional protocol. Internet of thing is through wireless communication technology that it automatically transmits the information stored in RFID tag to central information system, so wireless communication technology is core technology in IOT and several common wireless communication technologies mainly include Bluetooth, wireless fidelity (WiFi), ultra wide band (UWB), Zigbee, infrared data association (IrDA), etc. Healthcare applications open up new possibilities for supporting diagnosis and therapy, by bridging temporal and spatial gaps between patients and physicians. Smart hospitals are based on technology of IOT and are embedding newer applications which has integrated the function of diagnosis, treatment, management and decision. The features of IOT, such as comprehensive perception, reliable transmission, intelligent processing and so on provides technique support platform for the construction and implementation of smart hospital. In essence, IOT is an embedded system based on internet. As more and more intelligent terminal products have the requirements to network, it hasten the production of IOT concept, so IOT is the inevitable outcome of embedded technology development.

The smart hospitals also build in the intelligent hospitals which have high hospital safety index, and aims to bridge the gap between environmental performance or climate-proofing and hazard resilience and disaster risk reduction in health facilities. It is necessary to develop higher design and construction standards for new hospitals, incorporating lower energy

and water use to help withstand expected climate variability and change. Energy efficiency must be combined with disaster resiliency. Countries need to be smart about what is useful, needed and cost-effective.

It is time to realize the importance of technology and understand that technology helps to reduce patient visits to hospital, thus, decreasing the footfall and also reducing the hospital infection drastically. Personal mobile devices enable autonomous and unobtrusive collection of clinical data and support the continuous transmission of physiological information between patients and remote healthcare provider. For patients with chronic diseases, like chronic heart failure diabetes, mobile e-health systems help to minimize hospital stays and in doing so enable an independent life in a domestic environment. In order to meet the needs of future user groups, an integrative and multidisciplinary approach is required, which combines engineering and medical knowledge with theoretical and methodological contributions of the humanities. Various hospitals like Winthrop University Hospital Research and Academic Centre, New York and Cleveland Clinics have showcased the value of technology in healthcare. Smart hospitals are gradually making headway to stay and coexist, implementation of technolgy-based changes will surely help the overall healthcare indices and patient satisfaction level.

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RESEARCH ARTICLE

Beyond Accreditation: Issues in Healthcare Quality

Feroz Ikbal

ABSTRACT

In the last few years, there is an increased interest among Indian Healthcare institutions to get accredited from bodies, such as national accreditation board for hospitals and healthcare providers (NABH), Joint Commission International (JCI), Australian Council on Healthcare Standards (ACHS), and college of american pathologists Laboratory accreditation programme (CAP), etc. Hospital administrators, clinicians, academicians, promoters of the hospitals, policy makers and even government feel that accreditation is a panacea for all the problems associated with healthcare quality. But with the incidence of fire in one of the NABH accredited hospital in a metropolitan city, questions began to be asked on the correlation between quality and accreditation. Most of the hospitals use accreditation as a promotional tool, rather than a tool for continuous quality improvement. Often the entire focus of quality in a hospital is confined to the process of accreditation and re-accreditation. Time has come to think on the entire process of accreditation of hospitals in India, though it has a history of less than a decade. This paper intends to discuss various issues of quality in hospitals, outside the realms of accreditation. Need for strengthening and re-engineering the accreditation is also discussed. Accreditation essentially identifies the capability of the hospital to deliver quality care. It does not assure that hospitals delivers quality care. This aspect of accreditation has been often forgotten by the various stakeholders in healthcare. In this paper, an attempt is made to discuss other issues of quality, such as spurious drugs, quality of biomaterials, such as stents and biomedical equipments, quality of human resources, etc. which are often neglected by health institutions in its obsession to accreditation.

Keywords: Quality, Healthcare institution, Obsession, Accreditation.

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INTRODUCTION

Hospital services in India are highly unregulated and fragmented. Eighty percent of healthcare services are provided by private sector, which ranges from small clinic of a quack to multispeciality hospitals, which attracts medical value travelers. The facilities in government sector vary from a sub-center to All India Institute of Medical Sciences (AIIMS).

There are serious discussions about the quality of care provided in hospitals, both in private and public sector. There are reports of medical negligence, medical error, poor patient safety, etc. in Indian hospitals. Institute of medicine (1998) in its report reveals that between 44,000 and 98,000 people die in United States due to medical errors every year.[1] Number of deaths due to medical errors in India is anybody's guess as we have poor reporting systems and disclosure norms. Many a times if the disease cannot kill a person, treatment does.

Licensing and regulation by the government, certification by approved bodies and voluntary accreditation have been used as tools to improve and standardize the healthcare across the world. Among the three accreditation is generally considered to be the best tool to improve the patient safety and quality.

Hospital accreditation has been defined as 'A self-assessment and external peer-assessment process used by healthcare organizations to accurately assess their level of performance in relation to established standards and to implement ways to continuously improve'.[2] Since, late 1990's, various stakeholders in Indian health sector have been advocating for accreditation of Indian healthcare facilities. National Accreditation Board for Hospitals and Healthcare Providers (NABH), a constituent board of Quality Council of India (QCI), was set-up to establish and operate accreditation program for healthcare organizations in India was established in the year 2006. Before NABH was established, Indraprastha Apollo Hospitals obtained the prestigious accreditation from Joint Commission International (JCI) in the year 2005. Since 2006, over 150 hospitals have obtained NABH accreditation and several hundred's are in the line. Around 13 hospitals have obtained JCI accreditation.

The important question which needs to be asked is whether getting accreditation the finishing point of race toward quality. Activity of quality management department in any hospital these days are focused only on the agenda of accreditation. But there are several issues of healthcare quality which are currently beyond accreditation which this paper intends to discuss.

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REVIEW OF LITERATURE

O'Connor PT and Wolff AM (1993) feels Hospital accreditation has been criticized for its emphasis on structure and documentation. Less attention is given to the clinical process and outcomes of care. To make accreditation process become a meaningful part of day-to-day hospital management, four approaches are considered. These includes the development of industrial type quality assurance programs that detect negative patient outcomes and improve patient care, The appointment of a Quality Assurance/Accreditation Coordinator with appropriate authority, the establishment of an effective Quality Assurance/Accreditation committee, and the continuous review of accreditation standards through normal committee function and department review and trial surveys. Such strategies will enable hospital accreditation to develop beyond a paper exercise and to provide the foundation for excellence in healthcare delivery.[3]

Greenfield, and Braithwaite in their study try to identify and analyze research into accreditation and accreditation processes. A multi-method, systematic review of the accreditation literature was conducted and 66 studies were retrieved and analyzed. The results, examining the impact or effectiveness of accreditation were classified into 10 categories: professions' attitudes to accreditation, promote change, organizational impact, financial impact, quality measures, program assessment, consumer views or patient satisfaction, public disclosure, professional development and surveyor issues. They concluded that attempts are being made to develop evidence for the effectiveness of accreditation.[4]

Hinchcliff et al examined 122 empirical studies that examined either the processes or impacts of accreditation programs in healthcare. Study components were recorded, including: dates of publication, research settings, levels of study evidence and quality using established rating frameworks, and key results. A content analysis was conducted to determine the frequency of key themes and subthemes examined in the literature and identify knowledge-gaps requiring research attention. There was not much strong evidence about the effectiveness of health service accreditation.[5]

Pomey et al discuss hospital accreditation as a tool for organizational change in France. According to this study, preparations for accreditation provided an opportunity to reflect non-hierarchically on the treatment of patients and on the hospital's operational modalities by creating a locus for exchanges and collegial decision making. These preparations also led to giving greater consideration to results of exit surveys and to committing procedures to paper, and were a key opportunity for introducing a continuous quality program. However, this study expresses doubts on cost of returns on accreditation.[6]

Ravi Mariwalla expresses doubt whether accreditation will improve healthcare delivery or whether it will be a mere documentation process. His concern is, once the accreditation was conferred, the hospital can slip back into old ways of functioning and worse, the strain of complying made staff go into a 'relax mode' that made service levels reach a low. Administrators as well as the media, experts and observers became particularly critical of the JCI approach when the Institute of Medicine publications brought to the fore the 'lack of safety' and the 'likelihood of harm during treatment' in healthcare institutions.[7]

STATEMENT OF THE PROBLEM

Accreditation has become the panacea for the poor quality and safety issues in Indian hospitals. The incidence of fire and subsequent death of around 100 people including patients and employees at AMRI Hospital, an NABH accredited hospital have raised serious questions on correlation between quality and accreditation. This paper intends to discuss the certain issues pertaining to quality, but which are beyond the broader dimensions of accreditation. Also, there is a need to understand what is covered in accreditation and what it does not stand for.

MATERIALS AND METHODS

This study has used secondary data from various textual sources. Various documents from newspapers, journals, healthcare magazines, Accreditation documents have been reviewed. Data analysis is through textual analysis.

DISCUSSION AND FINDINGS

Structure, process and outcome are the components of quality in healthcare system as per Donabedian. Most of the accreditation systems like JCI, NABH and ACHS have deliberated elaborately on these three components. The structure includes physical infrastructure, manpower, materials including medicines and biomaterials, and machinery including biomedical equipments. The processes in the hospital include diagnostic, therapeutic, administrative and supportive service delivery. But there are a few issues which affect the quality of healthcare delivery, which is vaguely covered in the accreditation which requires more serious attention. These include as follows:

Spurious Drugs

Hospitals spend roughly 25 to 40% of their annual operating budget on medicines. Safe medical has been widely

discussed in NABH accreditation. Five R's of right medication include right patient, right medication, right dose, right time and right route. But unfortunately hospitals to a larger extend cannot have control over the quality of medicine which they are using. According to central drug standard control organization, an official body under ministry of health and family welfare only 0.3% of drugs in the Indian market is only spurious.[8] But, several unofficial studies put the percentage of spurious drugs to as high as 20%. Any drug, from an antibiotic to a pain medication, can be spurious. In 2007, fake drug makers sold more than 600 different types of branded, generic and over-the-counter drugs and used improved packaging to make their fake and spurious goods harder to detect. The spurious drugs act came into effect from August 2009 with the objective of eliminating the menace of manufacturing and sales of spurious drugs in the country. But, unfortunately like several other legislations in the country, though it appeared to be very stringent, it did not brought down the menace of spurious drugs to a larger extend.

Biomedical Devices

In India, Biomedical devices industry is highly unregulated and quality of biomedical devices used is highly dubious, including the imported devices. Ramachandran (2004) discusses the proposal to set up an Indian Medical Devices Regulatory Authority. Almost all countries that have a medical device industry have policies and regulatory processes or mechanisms in place. While the assurance of the quality of any marketed product is the responsibility of the manufacturer, the state also has the responsibility to protect the right of the consumer. In the case of medical devices, with potential health risks, the responsibility is even greater. In this scenario, it is indeed amazing that there is virtually no regulatory system in the country that ensures the reliability of these devices given that, like a drug or a vaccine, medical devices too, particularly those that are implanted in the human system, have attendant health risks. The more sophisticated is the underlying technology, the more complex becomes its calibration and operation and more serious are the potential errors due to malfunctioning and consequent harmful effects on a patient's clinical status. Therefore, like any drug, a medical device also requires to be evaluated for its quality, efficacy, reliability and safety before and after procedure for approval for its use in public health. If the device is implantable, it would also require systematic and rigorous preclinical and clinical studies, much like a drug.[9]

India lacks any kind of regulatory framework for certification, quality assurance, safety evaluation and post-market surveillance of both imported and indigenous medical devices. Even the Drug Controller General of India (DGCI) does not have any mandate to regulate the medical devices market and the use of the devices in medicine. Apparently, the practice followed by the DGCI is to refer to matters relating to medical devices to the Indian Council of Medical Research (ICMR) on a case-to-case basis. Some low-technology devices like thermometers and weighing machines seek certification from the Bureau of Indian Standards (BIS)—for ISI marking—and that too is optional. Some imported high-tech devices, approved or cleared by their country of origin, as done by the United States' Federal Drug Administration (FDA), are apparently permitted to be marketed in India.

Many of the Indian hospitals use refurbished medical equipments, which can also cause potential harm to the patients. Some experts have opined that India has become the dumping ground for medical devices, implants and equipments. The exorbitant price and nexus between the physician-supplier is also serious concern with respect to medical devices particularly with respect to Drug Eluding Stents (DES). After dimensions of quality includes affordability and accessibility.

Poor Industrial Relations

The year 2011 to 2012 saw the issue of poor industrial relations in hospitals in India. Thousands of nurses across India have started an indefinite strike for better pay and conditions even in hospitals which have JCI and NABH accreditation. Nurses form the single largest professional group in hospitals. They are directly involved in the patient care. An unsatisfied internal customer can never satisfy an external customer. Historically unorganized, Indian nurses have formed a new union, creating over 400 branches in 2 months. Enquiry commissions by some state governments have revealed that many of the hospitals are not even paying the statutory minimum wages to the nurses. Many of the nurses feel they are being tortured and are not provided reasonable accommodation and quality food. Similar grievance has been raised by paramedical staff and supportive staff of hospitals. Hospitals being highly labor intensive needs to look into the industrial relations more seriously than ever before along with getting accredited.

There are other issues of quality which needs to be looked into while hospitals go in for accreditation. Over emphasis on documentation can be one weakness of accreditation. The transformation from 'letters' to 'spirit' is of great importance in quality improvement through accreditation. Another issue is the role of consultants in the accreditation program. Many of the hospitals depend too much on consultants for the accreditation program. Undoubtedly consultants bring in technical expertise

and can improve the process. But hospitals needs to understand their own inherent strength and weakness, and should develop their own team for the continuous improvement. Quality and credibility of assessors of NABH will also be discussed in the near future. Often most of the assessors are practicing managers in hospitals. So, many independent observers doubt there can be quid pro quo in the assessment and final accreditation. Also efforts should be made to make the assessing team with multidisciplinary backgrounds of medicine, nursing and management.

There are several tools which can be used as tools to improve the quality beyond various accreditations. These are as follows:

Medical Audit

Medical audit or clinical audit is the comparison of actual practice against agreed, documented, evidence based standards with the intention of improving patient care.[10] Once corrective action has been taken about problems identified through a review process, performance is re-measured after an appropriate time period. Though most of the accreditation programs includes medical audit, it is not done with the right rigor in the Indian hospitals.

Donabedian model: The Donabedian model is a conceptual model that provides a framework for examining health services and evaluating quality of care. The model was developed by Avedis Donabedian in 1966, which comprises of structure, process and outcome.[11] The structure refers to the physical infrastructure, man power, materials and equipments. The core process in hospital includes diagnostic processes and therapeutic processes. These processes will be supported by other processes, such as administration, supportive services, engineering and maintenance, etc. The most important expected outcome is cure of the patient, improvement in the condition, death, left against medical advice. Other outcomes include profit or surplus, market share, utilization and efficiency of services.

Bench marking: Benchmarking is the process of comparing one's business processes and performance metrics to industry bests or best practices from other companies. In modern day management, the concept was introduced by Xerox in the year 1986. Benchmarking can be used as a tool to improve the processes in hospitals. In fact, hospitals can also benchmark their services with other industries for improving their supportive services.

CONCLUSION

Accreditation undoubtedly is an important tool in quality improvement. Many of the new hospital projects as well expansion plans are working for accreditation at the planning and designing stage itself. Few of the government hospitals are also already accredited and many of the state governments are taking efforts to get their hospitals accredited. But many existing hospitals both at the government and private sector cannot go for the accreditation as their physical infrastructure is not fit enough to go for the accreditation, processes not standardized and outcome not measured.

But accreditation is only component of quality in healthcare. Getting accredited and sleeping on that laurel till the time of re-accreditation can be dangerous for the safety of the patient and quality of the service as we have seen in some hospitals which are accredited. If we examine history of academic discipline of management at a given time there will some concept which will be widely discussed, but eventually fade out. Hope accreditation in hospitals do not have the fate of concepts like BPR, Bench Marking, Six sigma and other concepts.

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RESEARCH ARTICLE

Application of 3D Music Inventory Control Technique for the Controlled Drugs in Intensive Care Unit of a Tertiary Care Hospital

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ABSTRACT

Approximately 35% of annual hospitals budget is spent on buying materials and supplies, including medicines. The medical store is one of the most extensively used facilities of the hospital and hence it is essential that health managers use scientific methods to achieve efficient management and patient satisfaction.

Aims and objectives: To apply selective inventory control techniques for the drugs used in intensive care unit of tertiary care teaching hospital.

Materials and methods: The annual consumption and expenditure incurred on each item of controlled drugs in medical intensive care unit (ICU) for the years 2013 to 2014 was analyzed, and inventory control techniques, i.e. ABC, VED and ABC-VED matrix analysis, were applied.

Results: It was observed that 13 medicines (43.33%) out of 30 were classified in the category1 (AV + BV + CV + AE + AD) for stringent control.

Conclusion: Scientific inventory control management to be applied for efficient management of medical stores.

Keywords: ABC, VED analysis, Inventory control.

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INTRODUCTION

Approximately 35% of annual hospitals budget is spent on buying materials and supplies, including medicines. This requires effective and efficient management of the medical stores. Efficient priority setting, decision making in purchase and distribution of specific drugs, close supervision on drugs belonging to important categories, and prevention of pilferage depend on the drug and inventory management.[1]

Quality of care in tertiary care hospitals is also sensitive to the timely availability of facilities including drugs. The medical store is one of the most extensively used facilities of the hospital and one of the few areas where a large amount of money is spent on purchases on a recurring basis. This emphasizes the need for planning, designing and organizing the medical stores in a manner that results in efficient clinical and administrative services.[2]

The goal of the hospital supply system is to ensure that there is adequate stock of the required items so that an uninterrupted supply of all essential items is maintained.[3] A study from a 1500-bedded state-funded hospital has claimed that review and control measures for expensive drugs brought about 20% savings.[4]

Drug inventory management aims at cost containment and improved efficiency.[5] Inventory control is very essential in a developing country like India. India is a country of scarce resources and it is the primary responsibility of each hospital to ensure optimum utilization of available resources to provide good service or quality patient care.[6]

It is essential that health managers use scientific methods to maximize their returns from investment at a minimal cost.[7-9]

Inventory analysis seeks to achieve maximal output with minimal investment input, based on the economic principle of stretching the limited means to meet unlimited ends.[10] There is no denying that stocking hospital

pharmaceuticals and supplies can be expensive and tie up a lot of capital, and bringing efficiencies to such important cost drivers—often 30 to 40% of a hospital's budget—can present meaningful savings.[11]

Thus, a hospital materials manager must establish efficient inventory system policies for normal operating conditions that also ensure the hospital's ability to meet emergency demand conditions.[12] Inventory is a necessary part of doing business and provided by most organizations in any sector of economy.[13]

AIMS

Application of selective inventory control techniques for the drugs used in intensive care unit (ICU) of tertiary care teaching hospital.

OBJECTIVES

- To identify the categories of drugs in medical ICU which need stringent management control.
- To identify the item categories requiring greater supervisory monitoring.
- Application of collective inventory control techniques to analyze and effectively and efficiently manage medical stores in the ICU.

MATERIALS AND METHODS

The data of annual consumption and expenditure incurred on each controlled drugs in medical ICU for the financial years 2013 to 2014 were collected from the receipt—expense register. The data were then transcribed in an MS Excel spreadsheet. The statistical analysis was carried out using the MS Excel statistical functions. Annual expenditure for each controlled drug used in ICU were calculated for Jan 2014 to Dec 2014.

ABC Analysis

ABC analysis of all the controlled drugs used in the ICU was done. For this, the annual expenditure of individual items was arranged in descending order. The cumulative cost of all the items was calculated. The cumulative percentage of expenditure and the cumulative percentage of number of items were calculated. This list was then subdivided into three categories: A, B and C based on the cumulative cost percentage of 70, 20 and 10% respectively.

VED Analysis

The VED criticality analysis of all the listed items was performed by classifying the items into vital (V), essential (E) and desirable (D) categories. Intensive care unit (med) panel of specialists were used to decide upon the criticality of items. VED value given as per consensus of more than 50% members of the specialist panel. The final list of drugs arranged on the basis of criticality by medical experts was analyzed for concurrence of opinion regarding classification.

ABC-VED Matrix

The ABC-VED matrix was formulated by combining the ABC and VED analysis to evolve a management system, which can be used for prioritization. From the resultant combination, three categories were classified (I, II and III). Category I was constituted by items belonging to AV, AE, AD, BV and CV subcategories. The BE, CE and BD subcategories constituted category II, and the remaining items in the CD subcategory constituted category III. In these subcategories, the first alphabet denotes its place in the ABC analysis, while the second alphabet stands for its place in the VED analysis.

Music 3D

Drugs with high and low consumption were determined based on ABC analysis. A drugs with 70% of annual expenditure were considered to be high consumption value and those with 10% of annual expenditure to be low consumption value. Both high and low consumption items were further classified based on criticality (VED analysis) to avoid any stock outs.

LIMITATIONS OF STUDY

- Study conducted for only controlled drugs in medical ICU.
- Only medical specialist were discussed for VED analysis.

RESULT AND ANALYSIS

ABC analysis of all the controlled drugs used in the ICU as shown in (Table 1).

ABC Distribution Cost

Distribution of cost of drugs as per ABC analysis is shown in Graph 1.

VED Analysis

VED analysis of all the controlled drugs used in medical ICU. VED value given as per consensus of more than 50% members of the specialist panel as shown in (Table 2).

Number of drugs and percentage of expenditure incurred for the drugs are shown in Graph 2.

Table 1: ABC analysis of all the controlled drugs used in ICU

		Category			
Sl. no.	*Drug analysis*	*A*	*B*	*C*	*Total*
1.	Total annual consumption (%)	71.8%	19.7%	8.5%	100%
2.	Value of annual consumption (₹)	46,90,296	12,77,075	5,56,229	65,23,600
3.	No. of items	5	6	19	30
4.	Percentage of items	17%	20%	63%	100%

Table 2: VED analysis of all the controlled drugs

Category	*No. of drugs*	*Percentage of total*
V	11	36.6
E	10	33.3
D	9	30
Total	30	100

ABC-VED Matrix

The ABC-VED matrix analysis classification of the inventory reveals the nine different subcategories (AV, AE, AD, BV, BE, BD, CV, CE and CD). These nine subcategories (Table 3) were further grouped into three main categoriess: categories I, II and III. Out of the total inventory of 30 drugs, there were five (16.7%) items in category I, 6 (20%) items in category II and 19 (63.3%) items in category III, amounting for 71.9% (₹ 4,690,296), 19.6% (₹ 1,277,075) and 63.3% (₹ 5,56,229) respectively, for each category out of a total budget of ₹ 65,23,600/- of the medical stores.

CATEGORY-WISE COST DISTRIBUTION

Graphs 3 and 4 show cost distribution for each category and graphical representation of cost.

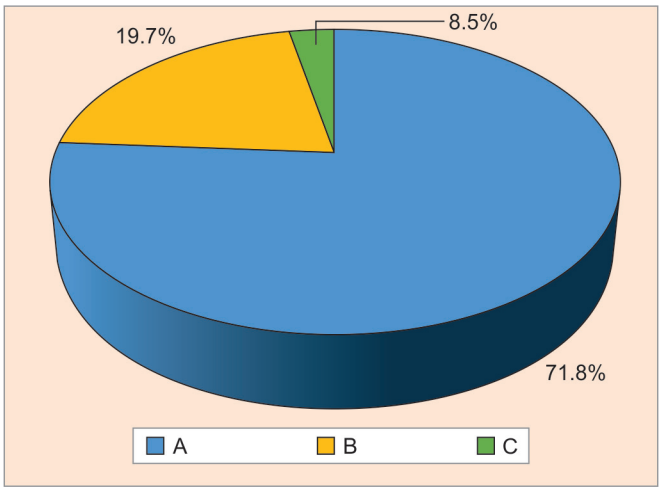
DISCUSSION

ABC analysis of controlled drugs used in ICU of 1000 bedded tertiary care hospitals revealed that out of 30 items in the drug list worth ₹ 65,23,600 considered for the study, 17% (5), 20% (6) and 63% (19) items were found to be A, B and C category items, respectively, amounting for 71.80% (₹ 46,90,296.00/-), 19.70% (₹ 12,77,075.00/-) and 8.5% (₹ 5,56,229.00/-) of ADE of the medical stores.

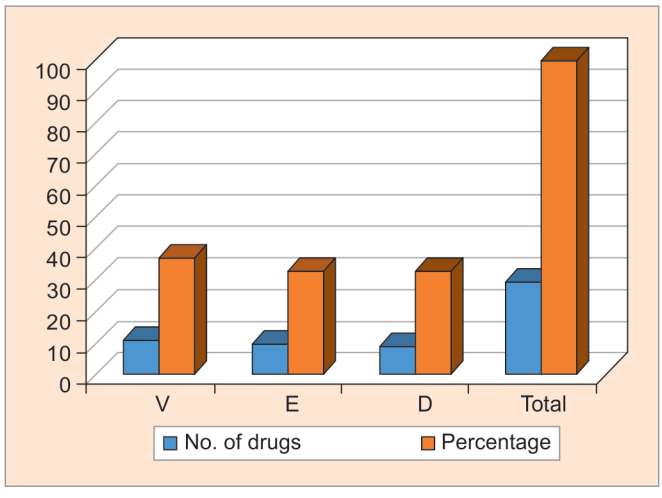
VED analysis revealed that vital items (V) accounted for 36.60% (11), essential items (E) accounted for 33.60% (10) and desirable items accounted for 30% (9). The total value of drugs in each category I, II and III were 82.40% (₹ 53,72,070.00/-), 14.90% (₹ 9,73,800.00/-) and 2.70%

Table 3: The ABC-VED matrix analysis

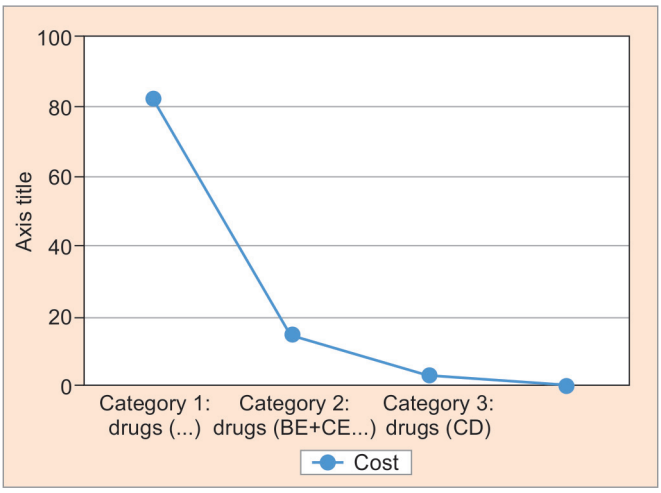
ABC \ *VED*	*V*	*E*	*D*	*Total*
A	AV (2 items) 6.7%	AE (2 items) 6.7%	AD (1 item) 3.3%	(5 items) 16.7%
	₹ 22,02,600 (33.8%)	₹ 21,00,120 (32.2%)	₹ 3,87,576 (5.9%)	₹ 46,90,296/- (71.9%)
B	BV (2 items) 6.7%	BE (3 items) 10%	BD (1 item) 3.3%	(6 items) 20%
	₹ 5,15,900 (7.9%)	₹ 5,10,600 (7.8%)	₹ 2,50,575 (3.8%)	₹ 12,77,075/- (19.6%)
C	CV (7 items) 23.3%	CE (5 items) 16.7%	CD (7 items) 23.3%	(19 items) 63.3%
	₹ 1,65,874 (2.5%)	₹ 2,12,625 (3.3%)	₹ 1,77,730 (2.7%)	₹ 556229/- (8.5%)
Total	(11 items) 36.7%	(10 items) 33.4%	(9 items) 29.9	(30 items) 100%
	₹ 28,84,374/-	₹ 28,23,345/-	₹ 8,15,881	₹ 65,23,600/-



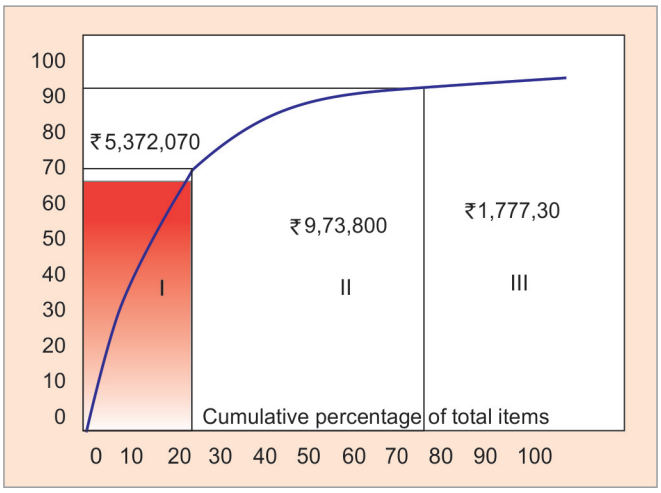
Graph 1: Distribution of cost of drugs as per ABC analysis



Graph 2: Number of drugs and percentage of expenditure incurred for the drugs



Graph 3: Percentage cost distribution for each category of the drugs



Graph 4: ABC-VED matrix analysis

(₹ 1,77,730.00/-) of total annual drug expenditure (ADE) of the medical stores respectively. The result of the present study in comparison with similar studies[14] (Table 4).

If ABC analysis was alone considered for inventory control, it would have taken care of just 6.77% of the drugs pertaining to category A. This would have completely neglected the vital drugs from category B and C which comprises of 11.47%. Similarly if only criticality factor VED analysis) was taken as a basis for inventory control, ideal control can be exercised only on the identified vital and/or essential items accounting for 69.51% (1076). However, this would have easily missed the category A items in the desirable group. Hence an inventory control method which takes into consideration both the cost factor and the criticality factor (Table 5) proves to be a better method for efficient control of inventory.

It is quite evident from the results of the present study that the combination of ABC and VED analysis, in terms of the ABC matrix enhances the ability to narrow down our attention on 13 items belonging to category I for strict managerial control; these items are either costly or vital. The annual expenditure of category I items was 82.40% of annual drug expenditure of the medical store. Category II items represent 14.90% of the ADE. Category III items consume 2.70% of the ADE. Hence, based on ABC and VED analysis various inventory management functions can be performed by managers at different levels (Table 6).

In addition, application of multiunit selective inventory control analysis (MUSIC 3D) method of inventory control can also be applied in the same matrix which enables a better and more stringent management of the inventory to prevent stock out (Table 7). The control criteria of three dimensions are finance, operations and material. Hence, this approach ensures a simple method of fixing ideal stock level of each drugs taking into account of criticality, availability and consumption value (Table 8).

Table 4: Comparison of various Indian studies with present study

Category	*Neuropsychiatry hospital, New Delhi*	*GMCH, Goa study*	*PGI, Chandigarh study*	*AFMS study*	*Present study*
A	3.45	12.93	13.78	14.46	17
B	6.9	19.54	21.85	22.46	20
C	89.65	67.53	64.37	63.08	63
V	32.41	12.36	12.11	7.39	36.6
E	61.38	47.12	59.33	49.23	33.3
D	6.2	40.52	28.51	43.38	30.0
I	33.8	22.99	22.09	20.92	82.4
II	60	41.67	54.63	48.92	14.9
III	6.2	35.34	23.28	30.16	2.7

Table 5: Categorization of the drugs

Category	*Comprise*	*Drugs (no.)*	*Percentage of cost*	*Cost (₹)*
I	AV + AE + AD + BV + CV	13	82.4	53,72,070
II	BE + CE + BD	10	14.9	9,73,800
III	CD	7	2.7	1,77,730

Table 6: Inventory management

Functions	*Category I*	*Category II*	*Category III*
Forecasting	Accurate	Accurate	Approximate
Budget control	Close check	Reasonable check	No check
Pre purchase functions	Maximum attention	Some attention	Least attention
Negotiations	Top management	Middle management	Lower management
Follow-up	Regular	Infrequent	Rare
Inspection	Close control	Simple check	Visual check
Inventory control	Constant	Vigilant	Routine
Level of control	Top	Middle	Storekeeper
Review	Monthly	3 monthly	Yearly
Safety stock	Minimum	Reasonable	Large
Order quantity	Fixed EOQ	Fixed EOQ	Fixed ROL
Stock taking	Frequent	Less frequent	Least frequent

Table 8: Inventory management by application of music 3D

Sl. no.	*Category*	*Management*
1.	1 and 2	a. Service level—100% to be maintained
		b. Cannot go for bulk purchase
		c. Inventory control-top management
		d. Reorder level is to be maintained
		e. Effort to bring down lead time
2.	3 and 4	a. Stockless purchasing
		b. Safety stock can be maintained using long lead time
		c. Efforts to bring lead time
		d. Can go for bulk discount during purchasing
3.	5	a. Strict inventory control
		b. Frequent order
		c. Consult reorder plan
4.	6	a. Purchase order
5.	7	a. Bulk purchase
6.	8	a. Purchase at regular interval
		b. Bulk purchase
		c. Avoid expiry

CONCLUSION

This study analyzed the inventory control method taking into account the controlled drug list of a tertiary care service hospital. Sound inventory control method is of utmost importance in efficient management of the scarce resource in the healthcare setting. Moreover, sound inventory control method will facilitate the management in controlling the cost and also ensure the timely availability of vital and essential items in the hospital which will definitely go a long way in achieving patient satisfaction and even patient delight.

Table 7: Music 3D value

	High consumption value		*Low consumption value*	
Critical	LLT	SLT	LLT	SLT
	Critical	Critical	Critical	Critical
	LLT	SLT	LLT	SLT
	HCV	HCV	LCV	LCV
	1	2	3	4
Noncritical	N critical	N critical	N critical	N critical
	LLT	SLT	LLT	SLT
	HCV	HCV	LCV	LCV
	5	6	7	8

LLT: Low lead time; SLT: Short lead time; HCV: High consumption value; LCV: Low consumption value

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RESEARCH ARTICLE

Personal Protective Equipment used for Infection Control in Dental Practices

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ABSTRACT

The potential size of India's dental market is vast and is expected to become one of the largest single country markets for overseas dental products and materials. The total market for the dental equipment and materials is estimated to be around US$ 90 million annually. There are more than 1, 80,000 dental professionals in India, 297 dental institutes and over 5,000 dental laboratories. Thus, there is a huge potential for the market of personal protective equipment (PPE) used for infection control in dentistry. India's market for dental products is extremely dynamic, with a current estimated growth rate of between 25 and 30%. Overall, the dental market is expected to grow by 20%.[1]

The personal protective equipment used in the practice of dentistry in India. Since dentistry is predominantly a surgical discipline, it leads to exposure to the pathogenic microorganisms harbored in blood, body fluids and other potentially infectious material. Thus, the use of adequate and good quality PPE is imperative for infection control in dental practice. With the growing potential of India's dental market, the growth of the market for PPE is inevitable. But, it is equally important to raise the awareness among dental community about good quality products adhering to required standards to prevent the usage of low-cost, uncertified and sub-standard products that decrease the safety levels of personnel.

The present study is conducted with a view to observe the personal protective equipment used for infection control in dental practices.

Keywords: Personal protective equipments, Infection control, AAMI standard, Dental practice.

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INTRODUCTION

Exposure to the pathogenic microorganisms harbored in blood, body fluids and other potentially infectious material (OPIM) can lead to occupationally acquired infections (OAIs) in healthcare workers (HCWs). That is why it is critical that healthcare providers don key pieces of personal protective equipment (PPE) and understand the levels of barrier protection these PPE items can afford them in patient-care and surgical situations.

The association for the advancement of medical instrumentation (AAMI) standard, 'Liquid Barrier Performance and Classification of Protective Apparel and Drapes Intended for Use in Health Care Facilities' (ANSI/AAMI PB70), has served as the gold standard for the manufacturing of medical gowns' barrier performance, which is key in preventing fluid and microbial strike through—a contributor to occupationally acquired infections. The AAMI standard addressed the issue raised by the occupational safety and health administration's (OSHA) standard on occupational exposure to bloodborne pathogens, which mandated that the employer provide the HCW with protective apparel that is commensurate with the task and degree of exposure anticipated. In addition to strikethrough, the standard addresses parameters for flammability resistance and linting, which can serve as a carriage vehicle for microbial particles.

At the heart of this AAMI standard are the four levels of barrier protection, ranging from level one, which is the lowest level of protection, to level four, which is the highest level. Utilizing these classification levels, manufacturers are able to label their products according to the level of protection their product provides, and HCWs can more easily select the appropriate barrier they need. All gowns and surgical drapes are subject to this classification system.

Personal Protective Equipment used in Dentistry

Personal protective equipment is designed to protect the skin and the mucous membranes of the eyes, nose, and mouth of dental healthcare personnel from exposure to blood or other potentially infectious material. Occupational safety and health administration mandates that dental HCWs wear gloves, surgical masks, protective eyewear, and protective clothing in specified circumstances to reduce the risk of exposures to bloodborne pathogens.[2,3]

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Factors influencing Selection of Personal Protective Equipment

A number of factors affect the selection of PPE. These are:

- The first involves the nature of the exposure anticipated—infectious, heat or chemicals. Is the PPE reasonable, necessary, and appropriate for the hazard?
- Fit is also important when it comes to PPE since comfort improves compliance.
- Biocompatibility
- Longevity
- Style, fashion
- Cost

Indian Market for Personal Protective Equipment

Increasing awareness among end users about improving the safety standards of their employees and safety against occupational hazards opens up opportunities for manufacturers of PPE.[4,5]

However, low-cost, uncertified and sub-standard products that decrease the safety levels of personnel and erode the market shares of certified PPE manufacturers currently dominate the market. The high price sensitivity among end users discourages market growth in terms of revenues. Further, no incentives are available for those who adopt high quality product offerings. Some end users even tend to re-use disposable PPE, especially protective clothing and gloves. 'The Indian PPE markets' foremost challenge is to create more awareness among end users about the correct PPE products—especially protective gloves—to be used in various industries. Lack of enforcement of government's occupational and safety regulations only reduce the potential of the total PPE market. Hence, PPE manufacturers face the responsibility to encourage industries to invest in certified quality products despite the products' high price.

AIM OF THE STUDY

The aim of the study is to identify PPE used by dental doctors in India.

OBJECTIVES

- To study the factors affecting the selection of PPE by dental doctors.
- To study how the PPE manufacturers face the responsibility to encourage industries to invest in certified quality products despite the products' high price.

SCOPE OF THE STUDY

The scope of the study is limited to the disposable items used by the dental doctors for personal protective methods while managing their patients.

MATERIALS AND METHODS

This paper is based on a survey conducted amongst 70 dental practitioners in Pune and Thane regions using tools of data collection such as observation, questionnaire, and personal interviews, etc. to gauge the current trends of PPE dominating the Indian market and the factors influencing the purchase of PPE by the dental practitioners.

Tools of data collection: Questionnaire, observations, personal interviews with practitioners.

Factors influencing the Purchase of Personal Protective Equipment by the Surveyed Dentists

The results of a factor analysis with ten probable factors influencing the purchase decisions of dentists pertaining to PPE revealed the following outcome:

Cost effectiveness of the product: Derived by clubbing together cost of the material, availability of discounts + reusability of the product.

Quality of the product: Derived by clubbing together comfort whiles using the product + no itching or allergy on usage of the product.

Fit for purpose: Derived by clubbing together the factors of high resistance to fluid exposure and compatibility with the methods of sterilization such as steam and ethylene oxide.

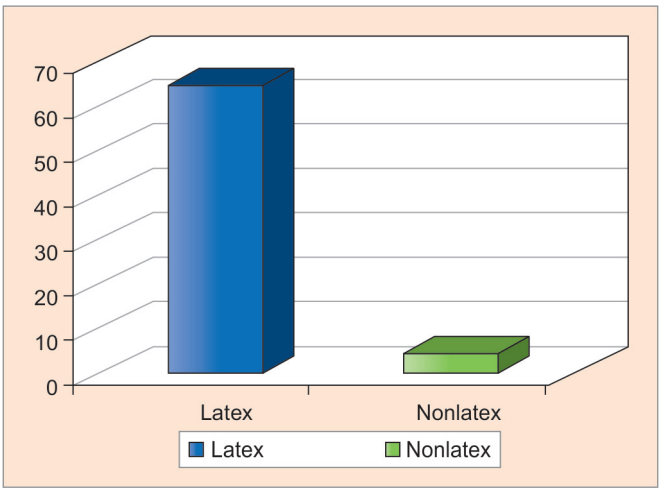
These factors are probably the ones exerting a high degree of influence on the purchase of PPE by dentists.

Challenges faced by the Indian PPE market are as follows:

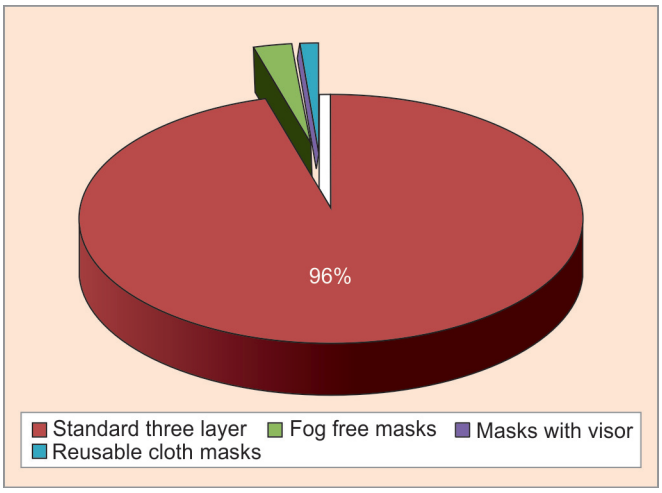
- Lack of established infection control and prevention guidelines and standards.
- Low-cost, uncertified and sub-standard products that decrease the safety levels of personnel and erode the market shares of certified PPE manufacturers currently dominate the market.[5]
- High price sensitivity among end users.
- Lack of incentives for those who adopt high quality product offerings.
- Low awareness among end users about the correct PPE products—especially protective gloves—to be used in various industries (Graphs 1 to 3).
- Lack of enforcement of government's occupational and safety regulations only reduce the potential of the total PPE market (Graphs 1 to 3).

RECOMMENDATIONS

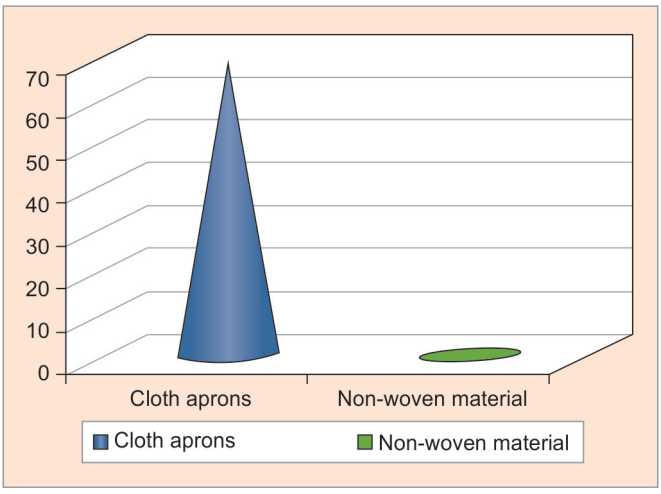
- Manufacturing and supplying a diverse range of products to cater to various price segments.[5]
- A well-planned distribution network will further ensure that the products reach the right end users.



Graph 1: Gloves used by survey participants



Graph 2: Face masks used by survey participants



Graph 3: Protective gowns used by survey participants

- Introduce training initiatives with superior quality PPE at dental institutes and lectures and conferences for continued dental education conducted by bodies, such as Indian Dentists Association, to increase awareness about the products of high standards.
- Invest in branding
- Set up a consortium/organization to initiate stringent enforcement of safety standards.

CONCLUSION

As dentistry is predominantly a surgical discipline, it is imperative to practice stringent measures of infection control. Exposure to the pathogenic microorganisms harbored in blood, body fluids and OPIM can lead to OAIs in HCWs. To protect the HCWs, it is important to use good quality PPE designed to match the requirements of HCWs and adhering to standards, such as the AAMI guidelines. It is also of significance to increase the awareness among HCWs about the standards of infection control that should be followed at their dental clinics and to introduce training initiatives with superior quality PPE to ensure personnel and patient safety. Thus, the need of the hour is to enforce and implement superior measures of infection control to improve the practice of dentistry in India.

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RESEARCH ARTICLE

To Study the Antimicrobial Stewardship Program in a Large Tertiary Care Teaching Center

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ABSTRACT

Introduction: As antimicrobial resistance continues to increase and new antimicrobial development stagnates, antimicrobial stewardship programs are being implemented worldwide. The goal of antimicrobial stewardship is to optimize antimicrobial therapy with maximal impact on subsequent development of resistance. Thirty to fifty percent of hospitalized patients receive antimicrobial therapy. Previous data suggest that inappropriate use results in higher mortality rates, longer lengths of stay, and increased medical costs. Antimicrobial stewardship programs (ASPs) reduce the improper use of antimicrobials and improve patient safety. Despite increased awareness about the benefits of these programs, few medical and surgical ASPs exist and fewer comprehensive studies evaluate their effects.

Aim: To study the antimicrobial stewardship program in a large tertiary care teaching center.

Objectives

- To study the antibiotic prescribing practices in a tertiary care government hospital
- To compare the antibiotic prescribing practices with the standard guidelines available with the hospital
- To make recommendation if any for rational use of antibiotics.

Materials and methods

- Review of literature
- Prospective study of 15 days in selected general medicine and general surgery ward in which 5 to 6 reading will be taken in to know the antibiotic prescribed to patients.
- Retrospective study of 15 days for study of patient records to know the antibiotic prescribed to patients.
- Interaction with faculty and senior residents of general medicine and surgery to know about the pattern of infection and antibiotic prescription.
- Interaction with microbiology department and their faculty to know the microbial resistance pattern and possible suggestion which need to be incorporated in antibiotic Stewardship program.

Results: The present study on antibiotic prescribing practices was undertaken in a super specialty hospital at New Delhi. A sample size of 100 case records was considered. There is no such stewardship program in tertiary care hospital, although it was demanded in various forum and meetings. There are no recommendations available either for patients of renal failure or other such compromised metabolic or immune states in the form of written antibiotic stewardship program of the hospital. The appropriateness of antibiotics prescribed in the case records was examined in light of the antibiotic stewardship program of the hospital. It was found that the overall adherence to antibiotic stewardship program was nil as no existing antibiotic stewardship program is exiting in this hospital. Gautum Dey in a study conducted at this hospital in New Delhi found that in 40.7% preoperative cases and 60.3% postoperative cases two or more than two antibiotics were given. The author has also commented that there was no evidence of adhering to antibiotic stewardship program or utilising culture and sensitivity reports to guide the therapy. The data obtained from the present study on further analysis has shown that in seven cases, the antibiotics prescribed were inadequate in terms of dose and duration. Thus resulting in an apparently lower cost of treatment than what was recommended by the antibiotic stewardship program of the hospital. Although such inappropriate prescription results in increased chances of antibiotic resistance, the immediate or short-term effects are not very conclusive. It is observed that there were 26 (26%) cases in medical and 12 (12%) cases in surgery disciplines in which the initial and final diagnosis was different. Uncertainty about the final diagnosis promotes empirical prescribing practices.

Conclusion: Antimicrobial stewards are a prominent part of local and national efforts to contain and reverse antimicrobial resistance. A range of intervention options is available with varying levels of resources and can yield substantial improvements in morbidity, mortality, quality of care, and cost. The cost of delivering such programs is dwarfed by the benefits and provides an opportunity for hospital epidemiologists to garner support. This suggests that antimicrobial management programs belong to the rarefied group of truly cost saving quality improvement initiatives. Considering the enormous implications of antibiotic resistance, it is necessary that we act in haste, lest our wonder drugs and magic bullets become ineffectual. Future systems promise greater integration and analysis of data, facilitated delivery of information to the clinician, and rapid and expert decision support that will optimize patient

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outcomes while minimizing antimicrobial resistance. They may also offer our best hope for avoiding an 'Antibiotic armageddon'. In addition, the ASP plays an integral role in providing guidance to clinicians and ensures that the appropriate antimicrobial agents are used.

Keywords: Antibiotic, Stewardship program, Antimicrobial resistance, Rational use.

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INTRODUCTION

The majority of the hospitalized patients receive antibiotics for therapy or prophylaxis during their inpatient stay. It has been estimated that at least 55% of patients receive antibiotics needlessly. Reasons include inappropriate prescribing for antibiotic prophylaxis, continuation of empiric therapy despite negative cultures in a stable patient, and a lack of awareness of susceptibility patterns of common pathogens.

Over prescribing not only increases the costs of healthcare, but may result in super infection due to antibiotic resistant bacteria, as well as opportunistic fungi, and may increase the likelihood of an adverse drug reaction. On the other hand, not prescribing (when there is an urgent need at the bedside) may also lead to serious consequences.

Up to 30% of hospital patients receive antimicrobial agents, and expenditure for these drugs may comprise 10 to 40% of the hospital pharmacy budget.

Antimicrobial resistance (AMR) has emerged as a major public health problem all over the world. Infections caused by resistant microbes fail to respond to treatment, resulting in prolonged illness and greater risk of death. Treatment failures also lead to longer periods of infectivity, with increased numbers of infected people moving in the community. This in turn exposes the general population to the risk of contracting a resistant strain of microorganisms. When these become resistant to first-line antimicrobials, the prohibitive high cost of the second-line drugs may result in failure to treat these diseases in many individuals. Most alarming of all are the diseases caused by multidrug-resistant microbes, which are virtually nontreatable, and thereby create a 'postantibiotic era' scenario.

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

The irrational use of drugs including improper indication, dosage, duration, combination and associated instruction results in increased incidence of resistance to commonly used antibiotics and increased expenditure on healthcare. It is estimated that almost one-third of the hospitalized patients receive antibiotics, half of which is unnecessary.[4]

In view of the above, it is necessary that healthcare institutions should have a stewardship program/guidelines according to which antibiotics should be prescribed. Antibiotic stewardship program is a set of guidelines laid down to optimize the use of antibiotics in many healthcare institutions. The proper use of such stewardship program helps in decreasing antibiotic resistance and to provide maximum benefit to the patients both in terms of clinical as well as economic outcome. The antibiotic stewardship program should take into consideration various clinical, diagnostic, bacteriological and pharmacological criteria.

It is observed though that the guidelines for the use of antibiotics/antibiotic stewardship program exist in many hospitals but the same are not implemented strictly. The cost incurred in inappropriate antibiotic therapy not only adds to the cost of healthcare expenditure but also adds to the disease burden by increasing the incidence of resistance to antibiotics among bacteria.[6,7] This aspect can only be ascertained with the help of an evidence based study.

The global spread of bacteria carrying the New Delhi metallo-β-lactamase-1 (NDM-1) enzyme through India, Pakistan, and the United Kingdom—and now half a dozen other countries—has sparked much media coverage. The outbreak's importance stems from the broad resistance to all antibiotics except tigecycline and colistin seen in bacterial strains carrying the gene for NDM-1 and from the ready transmission across borders.

Sharing of expertise, cooperation, and collaboration between the clinicians using antibiotic therapy and the clinical microbiologists at the regional levels may be simplest and most useful public health measure to optimize the use of antibiotics and manage infectious diseases.

A master antibiogram for a region would allow a tertiary care institution to consider resistance patterns in hospitals referring patients and to select appropriate antimicrobial therapy or change drugs in nonresponding patients. Antimicrobial resistance data generated by this approach will have better day to day application.

The concept of 'empirical antimicrobial therapy' would then be changed to that of 'presumptive antimicrobial therapy' based on common pathogens, known susceptibility pattern and host factors in any given region. It is necessary to define an antimicrobial stewardship program as ongoing effort by a healthcare institution to optimize antimicrobial use among hospitalized patients to improve patient outcomes, ensure cost effective therapy and reduce adverse sequelae of antimicrobial use.

Antimicrobial stewardship lies at the intersection of infectious disease. Infection control, safety and quality improvement, and cost containment. It has been defined as the 'appropriate selection dosing, and duration of antimicrobial therapy to achieve optimal efficacy in managing infections. It has been, thus, an important tool in the effort to reduce inappropriate use of antimicrobials and subsequent development of both resistant microorganisms and drug related adverse events.

Effective antimicrobial stewardship requires the collaboration of many disciplines, including medical, surgical services, nursing, infection control, laboratory, and pharmacy. Monitoring antimicrobial use is an important component of stewardship because of the close relationship between use of antimicrobial agents and the emergence of bacterial resistance. For example, excessive use of 3rd generation cephalosporin and of vancomycine has been linked to emergence of several resistant organisms, including MRSA, VRE and ESBL producing *E. coli* and *Klebsiella spp*.[1]

In view of the above present study was undertaken in a tertiary care government hospital at New Delhi to study and analyze the antibiotic prescribing practices of doctors in relation to its antibiotic stewardship program, duly considering the concepts of evidence based medicine.

NEED OF THE STUDY

- To ensure that antibiotics are used properly
- To reduce the overuse/misuse of antibiotics
- To reduce the development of drug resistance
- To reduce the side effect of the drugs
- To reduce the overall cost of treatment
- To reduce the morbidity and mortality
- To promote evidence based medicine
- To improve patient care by promoting the best practice in antibiotic prophylaxis and therapy, and make better use of resources by using cheaper drugs wherever possible.
- To retard the emergence and spread of multiple antibiotic resistance bacteria by improving education of the related doctors by providing guidelines for appropriate therapy.

Exclusion Criteria

- Specific instruction regarding difficult to treat organisms or infections are not included within the scope of this study
- Antibiotic for surgical prophylaxis, urinary tract infection prophylaxis, post-splenectomy prophylaxis or any other form of prophylaxis
- Antibiotics for use as a motility stimulants
- Any topical antimicrobial applied to skin, eye, ear, nasal passages or genital area for local effects
- Antiretroviral, antiprotozoal, or anthelmintic preparations.

MATERIALS AND METHODS

- Review of literature
- Prospective study of 15 days in selected general medicine and surgery ward in which five to six reading will be taken into know the antibiotic prescribed to patients as format sown as Appendix B and C.
- Retrospective study of 15 days for study of patient records to know the antibiotic prescribed to patients as format shown as Appendix A and D.
- Interaction with faculty and senior residents of general medicine and surgery: to know about the pattern of infection and antibiotic prescription.
- Interaction with microbiology department and their faculty to know the microbial resistance pattern and possible suggestion which need to be incorporated in antibiotic stewardship program.

RESULTS AND OBSERVATIONS

1. The study was conducted in a super specialty tertiary care government hospital at New Delhi. The hospital is also a teaching center for undergraduates, postgraduates, nurses, and paramedics. There are total 2,178 beds with 21 wards in this hospital having an average bed occupancy rate of more than 79.9%. The average length of hospital stay is 5.9 days while net death rate is 2.7%. The crude infection rate is 7.60%. The hospital has an average of 2,93,086 admissions per year and approximately 25,14,854 outpatient attendance.
2. The data collection in the study was conducted over a period of 3 months from May to July 2011. For the purpose of the study, the case sheets of in-patients admitted in the acute care areas of the hospital were studied. These case sheets were obtained from the medical records department of the tertiary care hospital. The case sheets of discharged patients having antibiotic prescriptions initiated by the treating doctors were considered as a study population to draw the sample.

Appendix A

Retrospective study of patient in general medicine ward					
Name					
Age					
Sex					
Adm no.					
Specialty					
Date of adm.					
Date of discharge					
Ward/bed no.					
Initial diagnosis					
Final diagnosis					
Details of antibiotic	Name of antibiotic	Dose	Route	Date on which antibiotic started	Date on which antibiotic stopped
Criteria for prescribing antibiotic					
As per antibiotic stewardship program or not					
Instruction entered in notes or not					

Appendix B

Prospective study of patient in general medicine ward					
Name					
Age					
Sex					
Adm no.					
Specialty					
Date of adm.					
Date of discharge					
Ward/bed no.					
Initial diagnosis					
Final diagnosis					
Details of antibiotic	Name of antibiotic	Dose	Route	Date on which antibiotic started	Date on which antibiotic stopped
Criteria for prescribing antibiotic					
As per antibiotic stewardship program or not					
Instruction entered in notes or not					

3. A total of 100 such case records, obtained by systematic random sampling, were studied and the following information was obtained from it and compiled in an MS Excel data sheet and later analyzed with the help of SPSS:
- Admission and discharge number of the patient
- Final diagnosis
- Initial diagnosis
- Sex
- Specialty
- The antibiotics given—dose and duration
- Criteria used for prescribing antibiotics
- Whether the prescription was as per the antibiotic stewardship program of the hospital
- Instructions/notes entered in the case records as regards the antibiotic administration.

4. Study of antibiotic stewardship program of the hospital as follows:
- The antibiotic stewardship program is not existing in this hospital although hospital infection control program is there for which there is a hospital infection control program and committee.
- No documentary evidence was available that the senior specialists were consulted prior to starting

Appendix C

Prospective study of patient in general surgery ward: C7/D7					
Name					
Age					
Sex					
Adm no.					
Specialty					
Date of adm.					
Date of discharge					
Ward/bed no.					
Initial diagnosis					
Final diagnosis					
Details of antibiotic	Name of antibiotic	Dose	Route	Date on which antibiotic started	Date on which antibiotic stopped
Criteria for prescribing antibiotic					
As per antibiotic stewardship program or not					
Instruction entered in notes or not					

Appendix D

Retrospective study of patient in general surgery ward					
Name					
Age					
Sex					
Adm no.					
Specialty					
Date of adm					
Date of discharge					
Ward/bed no.					
Initial diagnosis					
Final diagnosis					
Details of antibiotic	Name of antibiotic	Dose	Route	Date on which antibiotic started	Date on which antibiotic started
Criteria for prescribing antibiotic					
As per antibiotic stewardship program or not					
Instruction entered in notes or not					

higher and newer antibiotics and in case of treatment failure.

5. *Demographic profile of the sample population*: The demographic profile of the sample population was studied as per the age, sex and category (Civilian, EHS patient) as follows:

- *Sex*: The genderwise distribution of case records is shown in Table 1 and Figure 1.
- *Age*: the agewise distribution of the case records is as shown in Table 2. The mean age of the sample population was 47.7 with a standard deviation of 17.09884207. Figure 2 shows the distribution of cases as per various age groups. The maximum number of cases are in age group of 61 to 70 years (21%), followed

Table 1: Genderwise distribution of sample population

Sex	*Number of case records*	*Percentage*
Male	62	62
Female	38	38
Total	100	100

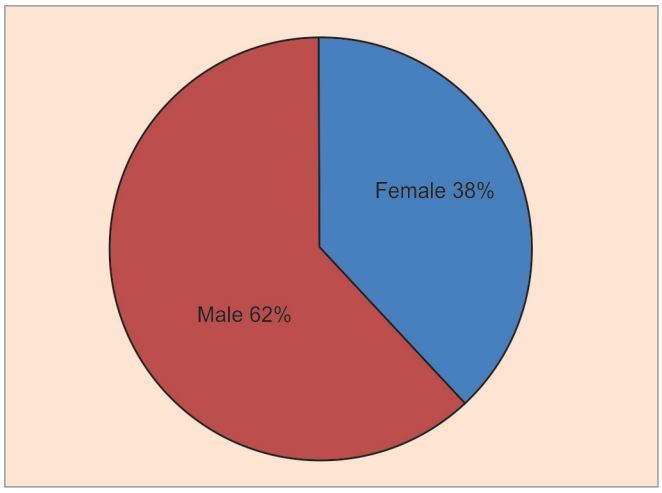

Fig. 1: Male female ratio of entire sample

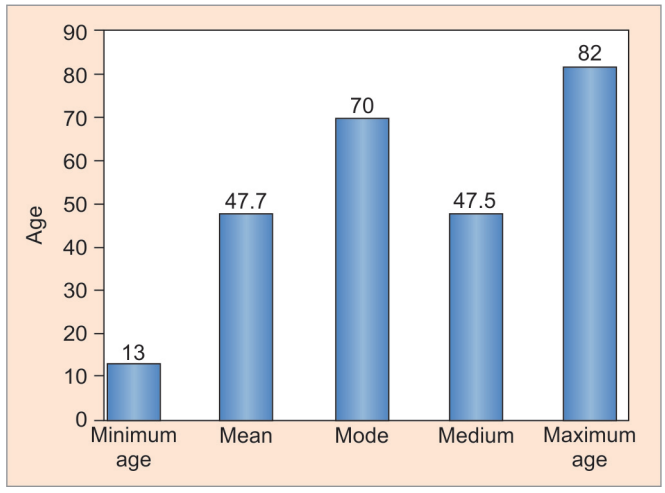

Fig. 2: Age distribution of entire sample

by the age group of 31 to 40 years (20%) (Table 3). The maximum age of patient was recorded 82 while minimum was 13 years.

Age distribution of female sample population: Table 4 illustrates the age distribution of sample cases among the female patients. Table 4 shows that mean age of the female population was 40.43 years with a standard deviation of 16.4351.

Age distribution of male sample population: Table 5 illustrates the age distribution of sample cases among the male patients. Table 5 shows that mean age of the male population was 47.35 years with a standard deviation of 17.00.

Table 2: Mean age of sample population

Observation	*Mean*	*Std. dev.*	*Mode*	*Median*
100	47.7	17.09	70	47.5

Table 3: Mean age of sample population

Age group	*Number of cases*	*Percentage*
0–10	Nil	0
11–20	6	6
21–30	11	11
31–40	20	20
41–50	16	16
51–60	19	19
61–70	21	21
>70 years	7	7

Table 4: Mean age of female case record

Female observations	*Total sample*	*Mean*	*Std. dev.*	*Vari-ance*	*Mode*	*Median*
38	100	40.43	16.43	317.84	70	43.0

Table 5: Mean age of male case record

Male obser-vations	*Total sample*	*Mean*	*Std. dev.*	*Variance*	*Mode*	*Median*
62	100	47.35	17.0057	286.983	61	52

Diagnosis Commonly encountered in the Sample Population

During the course of the study following diseases were commonly encountered under the broad disciplines.

- *Surgical case records*: Table 6 shows the diseases commonly encountered among the surgical cases in the study along with their frequency distribution.
- *Medical case records*: Table 7 shows the diagnosis commonly encountered among the medical cases.
- *Final diagnosis not matching with the initial diagnosis*: In a large number of cases, the final diagnosis

Table 6: Common surgical diagnosis among the sample records

Diagnosis	*Frequency*	*Percentage (out of total sample case including medicine cases)*
Abdominal Koch's with Rt hemicolectomy	III	3
Abscesses	III	3
Adrenal mass	I	1
Appendicitis	III	3
Biliary stricture/sepsis/ carcinoma	IIIII	5
Ca. breast	III	3
Ca gallbladder	I	1
Ca. caecum/rectum	IIIII	5
Cholecystitis (acute and chronic)	IIIII, III	8
Dentigerous cyst	I	1
Fistula	II	2
Gastrointestinal stromal tumor	I	1
Inguinal hernia	III	3
Orchitis	II	2
Perforation peritonitis	II	2
Sepsis	III	3
Sigmoid volvulus	II	2
Testicular tumor	II	1
Traumatic pancreatitis	I	1

Table 7: Common medical diagnosis among the sample records

Diagnosis	*Frequency*	*Percentage (out of total sample case including surgical cases)*
Pneumonia	IIIII	5
Upper respiratory tract infection	I	1
Fever (inv)	IIIII	5
Malaria	I	1
Exudative pleural effusion	IIIII	4
Pancytopenia	I	1
Type II respiratory failure	IIII	4
Asthma	IIIII	5
Koch's disease	III	1
Obstructive pulmonary disease	IIIII, IIIII	7
Seizures	I	1
Septic shock	II	2
Severe sepsis	II	2
Hip replacement with infection	I	1
Tuberculosis meningitis with septic shock encephalitis	I	1
Diabetes mellitus, hypertension, multiple myeloma and URTI	I	1
Diabetes mellitus, hypertension and tuberculosis	I	1
Oraganophosphorus poisoning	I	1
Diabetes mellitus, hypertension and severe sepsis	I	1
Non-insulin dependent diabetes mellitus and IDL	II	2
Tubercular meningitis	I	1
Cystic kidney disease and sepsis	I	1
Hypothyroidism and amenorrhea	I	1

Table 8: Surgical case records with different initial and final diagnosis

Final diagnosis	*Initial diagnosis*	*Frequency*	*Percentage (out of 50 surgery case)*
Acute appendicitis	Pain abdomen (inv)	3	6
Acute cholecystitis	Pain abdomen	2	4
Symptomatic cholecystitis	Pain abdomen	1	2
Total			12

was not matching with the initial diagnosis as given below:

- *Surgical case records with different initial and final diagnosis*: The surgical case records in which the final diagnosis did not match with initial diagnosis are shown in Table 8.
- *Medical case records with different initial diagnosis and final diagnosis*: The medical cases records in which the initial and final diagnoses were different are shown in the Table 9.
- Comparison of the antibiotics prescribed in the case sheets in the light of antibiotic policy:

– The case records selected through a systematic random sampling method were studied in respect of the various antibiotics prescribed. The antibiotics prescribed were analyzed according to the correctness of dose and duration as recommended by the antibiotic policy of the other hospitals and standard textbooks. Wherever, there was an ambiguity in the selection, duration, dose or combination

Table 9: Medical case records with different initial and final diagnosis

Final diagnosis	*Initial diagnosis*	*Frequency*	*Percentage (out of 50 medical case)*
Bronchitis	Fever (inv)	3	6
Upper respiratory tract infection		1	2
Obstructive pulmonary disease	Breathlessness	3	6
Septic shock	Giddiness	2	4
Tubercular meningitis	Headache	1	2
Cystic kidney disease and sepsis	UTI	1	2
Hypothyroidism and amenorrhea	Weakness	1	2
OP poisoning	Unknown poisoning	1	2
Total			26

of therapy the concerned senior specialists were consulted.

– Many a times (seven out of 100), it was found that the patients were prescribed less duration of antibiotics as compared to that recommended by the antibiotic policy. Such cases which result in an apparently lower cost of treatment, but may lead to long-term effects of bacterial resistance in the individual spreading later to the community, have been excluded from the final calculation regarding cost implication of not adhering to the antibiotic policy of the hospital.

DISCUSSION AND CONCLUSION

1. The present study on antibiotic prescribing practices was undertaken in a super specialty hospital at New Delhi. A sample size of 100 case records was considered. The observations made on antibiotic stewardship program and on the records of the hospital are discussed in succeeding paragraphs in accordance with objectives of the study.
2. Antibiotic stewardship program of the hospital:
   - There is no such stewardship program in this hospital, although it was demanded in various forum and meetings.

Mol et al[2] in a time series intervention analysis, carried out at a University teaching hospital in Groningen, Netherlands, showed that updating the antimicrobial guidelines in close collaboration with the specialists and distributing it in a paperback and electronic format improved the prescribing compliance by 15.5%.

The antibiotic stewardship program of the Calderdale and Huddersfield Hospital, under NHS Trust,[3] deals in great detail with the surgical antimicrobial prophylaxis, its timings and the details of drugs given in various kinds of surgeries.

- There are no recommendations available either for patients of renal failure or other such compromised metabolic or immune states in the form of written antibiotic stewardship program of the hospital. However, in many countries, the antibiotic stewardship program also includes the recommendations and precautions to be observed while prescribing for renal failure and other miscellaneous diseases.[4]
- Many hospitals in other countries display their antibiotic policies on their website. One may also download it on request. Christian Medical College, Vellore,[5] has published its antibiotic stewardship program in the form of a small booklet, which is laminated and easily fits inside a pocket. This allows the antibiotic stewardship program to be carried easily by the junior residents and is, thus, easily accessible (copy enclosed with the document as enclosure 2). The stewardship program has incorporated a number of flowcharts and clinical guidelines which allows easy referral. Wiffen and White[6] in a study conducted over 41 hospitals under trust of NHS, found that the policies provided had a wide range of presentation styles ranging from an interactive computer program to a single-folded card. The most popular formats were A4 (11 policies), pocket size (12 policies) or A5 (11 policies).

3. The appropriateness of antibiotics prescribed in the case records was examined in light of the antibiotic stewardship program of the hospital. It was found that the overall adherence to antibiotic stewardship program was nil as no existing antibiotic stewardship program is exiting in this hospital.

Studies by authors in other countries have shown a much higher prevalence of adherence to antibiotic stewardship program. Ozkurt et al,[7] in a study conducted in a Research Hospital of the Atakurk University Medical School in Turkey, showed an overall prevalence of adherence to antibiotic stewardship program as 47.3%.

4. Fijn et al[8] in a multicentric retrospective explorative cohort study found that, in 24.3% cases, the antibiotic prescribed was not indicated and, in 55.2% cases, the antibiotic prescribed was not the first drug of choice. In a prospective, multicenter audit of elective procedures, carried out in 13 Dutch hospitals with a sample size of 1,763, by Van Kasteren et al[9] the overall adherence of antibiotic guidelines was found to be 28%. It was seen that antibiotic choice, duration, dose, dosing interval and timing of the first dose were concordant with the hospital guideline in 92, 82, 89, 43 and 50% cases respectively.

In the study conducted by Ozkurt,[7] it was found that appropriateness of antibiotics was 45.3 and 21.7% in surgical and medical wards respectively. Dey,[10] in a study conducted at AIIMS, New Delhi, found that in 40.7% preoperative cases and 60.3% postoperative cases two or more than two antibiotics were given. The author has also commented that there was no evidence of adhering to antibiotic stewardship program or utilising culture and sensitivity reports to guide the therapy.

5. The data obtained from the present study on further analysis has shown that in seven cases, the antibiotics prescribed were inadequate in terms of dose and duration. Thus, resulting in an apparently lower cost of treatment than what was recommended by the antibiotic stewardship program of the hospital. Although such inappropriate prescription results in increased

chances of antibiotic resistance, but the immediate or short-term effects are not very conclusive.

6. It is observed from Tables 8 and 9, that there were 26 (26%) cases in medical and 12 (12%) cases in surgery disciplines in which the initial and final diagnosis was different. Uncertainty about the final diagnosis promotes empirical prescribing practices.

RECOMMENDATIONS

1. The study on antibiotic prescribing practices in a tertiary care hospital was undertaken by studying the case records of 100 inpatients admitted to the acute wards (medicine and surgery) of the hospital. Keeping in view the observations made during the study, certain recommendations are offered on appropriate prescription of antibiotics. The same are presented in succeeding paragraphs.
2. *Antibiotic stewardship program*: The following recommendations are proposed for the antibiotic stewardship program of the hospital:
   - The aim of antibiotic stewardship program of the hospital should be promotion of rational prescribing practices and prevent emergence of new and reduction of existing resistant strains of pathogens.
   - The stewardship program should be reviewed six monthly on the basis of the microorganism sensitivity pattern. The clinicians pertaining to major disciplines must be an integral part of committee formulating the antibiotic stewardship program.
   - The stewardship program should be as comprehensive as possible and nothing should be left to imagination as it is used by the senior most to the most junior doctors of the hospital.
   - The stewardship program must cover all the common diseases and also important uncommon conditions for different age groups.
   - The stewardship program should include the dose, duration and schedule of antibiotics for an average adult and also mention the per kg dose of the medicine.
   - It is recommended that the latest drug of choice specific to the micro-organisms on the basis of the sensitivity pattern pertaining to a particular diagnosis should be mentioned than on the basis of the type of cases, like OPD/IPD or major/minor case, etc.
   - The stewardship program should also indicate if the choice of antibiotics differs in case of OPD patients for the same diagnosis. However, as far as possible, the clinical and more preferably the bacteriological reports to be kept in mind prior to any prescription of antibiotics.
   - The stewardship program should include associated instructions as following:
     – *For the clinicians*: In terms of dose, duration, sample/repeat sample with intervals to be sent, interactions with other drugs or combinations of drugs to be used and precautions to be used in case of compromised metabolic/immunocompromised status of the patient.
     – *For the patients*: These instructions should be conveyed by hospital staff to the patients and should be pertaining to the timing of the dose, duration, relation with meals, side effects and interaction with other drugs.
     – *For the nurses*: In addition to the relevant information given at serial (i) above, instructions to include any side effects which is to be monitored.
   - The antibiotic stewardship program of the hospital should be easily accessible preferably on its website. It should also be made available in the form of a small booklet to all concerned.
   - An effective program of antibiotic reform requires a team approach. This starts with formation of an antibiotic utilisation committee, chaired by a member of the infectious disease (medicine). There should also be representatives from pharmacy, microbiology, and infection control; depending on the size and structure of the hospital, representation from several other departments may be helpful (Table 10).

Direct involvement of a key administrator provides liaison to higher levels of hospital leadership, as well

Table 10: Composition of an antimicrobial stewardship committee

Infectious disease Head (medicine): Chairman
Faculty incharge pharmacy
Head of microbiology
Head of pharmacology
Infection control practitioners
Head of surgery
Head of pediatrics
Head of gynecology
Head of ENT
Head of Eye
Intensivists
Head of emergency medicine
Member from hospital administration (preferably Medical Superintendent)
Quality control manager
Data manager
Staff nurse

as vital support when reform efforts must be promoted among the medical staff. In addition, collaboration with quality improvement team may bring substantial administrative resources to bear and facilitates innovation and change. A small working group, including the chairman and pharmacy in charge with data manager, provides most of the effort, with advice from the larger committee.

Following components of antimicrobial stewardship program are as below:

- Data collection and target identification
- Formulary revision
- Microbiology testing and reporting
- Education
- Restriction policies
- Ordering policies
- Drug administration
- Limiting contact with pharmaceutical representatives.

There are some Caveats when any hospital implements an antimicrobial stewardship program as shown in Table 11.

For maintaining and evaluating the success of program, it is essential to make administrators aware of significance of antimicrobial stewardship efforts and to periodically reinforce the importance of these endeavors. In addition to pharmacy budget savings, the volume and scope of interventions can be tallied, as well as rates of medication errors and adverse events. Antimicrobial usages and resistance patterns should be monitored to document successes and to provide alerts to new problems. Costs associated with specific diagnosis related groups may drop if targeted programs result in shorter length of hospitalization. These data should be shared with hospital administrators to reinforce the financial and clinical value of the program.

Benefits can be further expressed in measures of prevented morbidity, mortality, resistance, errors, adverse events, wasted medications and excess length of hospital stay, as well as the 'added value' of decreased adverse publicity and liability. Estimates of savings associated with these parameters may be based on published data if cost measuring databases are unavailable.

3. *Prescribing practices*: The supportive investigative results should be made available as early as possible in the hospitalised patients if technically feasible. This will enable the clinicians to reach a conclusive diagnosis earlier and to start treatment based on bacteriological or investigative results rather than empirical therapy. The administrator and senior specialists should stress upon all the clinicians to endorse the necessary associated instructions and prescribe legibly duly endorsing their signatures and stamps wherever necessary. Always send samples for microbiological workup before starting or changing antibiotics. There should be differentiation between contamination, colonisation and infection is important to prevent overuse of antibiotics. De-escalation of antibiotics should be done on the basis of clinical condition and microbiology report, for judicious use of antibiotics the appropriateness, efficacy, dosage and side effects must be reviewed on the daily basis. Shift to oral antibiotics from parenteral antibiotics as early as possible. It should be known to all that there is no substitute of hand washing in prevention of spread of nosocomial infections.
4. *Sensitising the undergraduate students and postgraduate students to antibiotic stewardship program*: It is recommended that undergraduate and postgraduate medical students must be sensitised about the concepts of antibiotic stewardship program and importance of maintaining a discipline in prescribing practices as they are at the most impressionable age.
5. *Continuing medical education*: It is strongly recommended that a continuing medical education program should be developed by the hospital incorporating various departments on regular basis to promote the adherence to antibiotic stewardship program. More stringent efforts should be made for adherence to the stewardship program by medical and surgical division as their compliance to adherence was minimum and they are supposedly the maximum users.

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

6. *Surveillance studies*: There should be surveillance procedure to monitor the rate of healthcare associates infections. Following steps are recommended for surveillance procedure:
   - Constitution of an antibiotic use committee in the hospital which should participate in surveillance activities.

Table 11: Caveats when implementing an antimicrobial stewardship program

• Provide antimicrobial agent stewardship; do not become a policeman or zealot
• Avoid formulary changes for only short-term gain
• Financial concerns should not be more important than clinical efficacy and safety
• Formulary changes may necessitate changes in automated susceptibility testing

- Antibiotic susceptibility testing of appropriate microorganism.
- Antimicrobial testing for selected resistant isolates.
- Monitor the trends in prevalence of bacterial resistance to antimicrobial agents.
- To notify Hospital Infection Control Committee, if there is any unusual resistance pattern.

7. *Monitoring antibiotic use*: It is recommended that antibiotic use of the hospital should be monitored by the medical stores/pharmacy department. It should be reported to a committee responsible for appropriate utilization of medicines.
8. Weekly Bulletins should be circulated to all wards and regarding the availability of antibiotic in the stores.
9. *Audit of antibiotic prescribing behavior*: It is recommended that periodic audit should be undertaken to examine the appropriateness of antimicrobial use. The audit committee should comprise of clinicians from all major discipline among others and the committee should analyze following aspects:
   - Use of antimicrobials as per the guidelines.
   - Resistance pattern of pathogens in consultation with microbiology department.
   - Reasons for poor outcome of patients if any.
10. *Liaison and collaboration with local and regional healthcare institutions and laboratories*: The hospitals and laboratories of a region should be organized in the form of a body wherein data about surveillance studies, resistance patterns, and antibiotic use can be shared between the members of the group. The antibiotic stewardship program of all hospitals/healthcare institutions should be made in collaboration with each other, as resistance patterns and disease outbreaks are likely to be similar in a defined region. The use of software like WHONET for surveillance reporting and antibiotic prescription should be utilized. The government healthcare authorities should take a proactive approach in this regards.
11. *Use of information technology*: In the present era, it is recommended that a conscious effort should be made to utilize the information technology tools for spreading awareness about the antibiotic stewardship program and to make it available easily, through personal digital assistants, hospital website, computers in the wards, etc. If the hospital has a hospital information system, there should be provision for inbuilt prompting of prescription.
12. In order to save the colossal amount of funds and gainfully utilise the resources, it is strongly recommended that there should be multidisciplinary approach to streamline the antibiotic prescribing practise with key pillars comprising of medical and antibiotic audits and surveillance studies supported by periodic training program.

CONCLUSION

Antimicrobial stewards are a prominent part of local and national efforts to contain and reverse antimicrobial resistance. A range of intervention options is available with varying levels of resources and can yield substantial improvements in morbidity, mortality, quality of care, and cost. The cost of delivering such programs is dwarfed by the benefits and provides an opportunity for hospital epidemiologists to garner support. This suggests that antimicrobial management programs belong to the rarefied group of truly cost saving quality improvement initiatives.

The rational use of drugs is of great importance in not only preventing the emergence of drug resistance but also to enable effective utilization of resources and bring down the cost of medical care. Antibiotics are an invaluable resource in our fight against infectious diseases which still today claim millions of lives. Irrational use of antibiotics is one of the reason cited for the increasing incidence of bacterial resistance. Antibiotic Stewardship program is one way, whereby we can ensure rational prescription of drugs.

Antimicrobial stewardship programs in hospitals seek to optimize antimicrobial prescribing in order to improve individual patient care as well as reduce hospital costs and slow the spread of antimicrobial resistance. With antimicrobial resistance on the rise worldwide and few new agents in development, antimicrobial stewardship programs are more important than ever in ensuring the continued efficacy of available antimicrobials. The design of antimicrobial management programs should be based on the best current understanding of the relationship between antimicrobial use and resistance. Such programs should be administered by multidisciplinary teams composed of infectious diseases physicians, clinical pharmacists, clinical microbiologists, and infection control practitioners and should be actively supported by hospital administrators. Strategies for changing antimicrobial prescribing behavior include education of prescribers regarding proper antimicrobial usage, creation of an antimicrobial formulary with restricted prescribing of targeted agents, and review of antimicrobial prescribing with feedback to prescribers. Clinical computer systems can aid in the implementation of each of these strategies, especially as expert systems able to provide patient-specific data and suggestions at the point of care. Antibiotic rotation strategies control the prescribing process by scheduled changes of antimicrobial classes used for empirical therapy. When instituting an antimicrobial

stewardship program, a hospital should tailor its choice of strategies to its needs and available resources.

There have been a large number of studies carried out worldwide on various aspects of antibiotic policies, including their impact in saving healthcare costs. But there are hardly any studies conducted in India on antibiotic policies or the prescription patterns of antibiotics.

The present study carried out in a tertiary care government hospital retrospectively analyzed the case records of 100 patients admitted in the acute care wards of the hospital.

The study had also observed and discussed the criteria used for prescription of antibiotics, wherein it was seen that clinical criteria were used for antibiotic prescription of antibiotics in nine (9.%) cases and, in the remaining 91 (91%) cases, antibiotics were prescribed empirically. In these 91 cases, with antibiotics prescribed empirically, there was only four cases in which antibiotic was changed after culture and sensitivity tests.

The antibiotic stewardship program which is evolved after due deliberation and consideration over the resistance patterns, surveillance studies is aimed at providing scientific evidence based guidelines. It will help us to prescribe empirically on the various conditions mentioned in the stewardship program without fear of over or inappropriate prescription.

The study had also the analyzed as to whether associated instructions were mentioned clearly in the case records. The duration, dose, date of starting or stopping, other instructions regarding till what time the antibiotics were to be continued after discharge, legibility of prescription were inferred from the case records. The overall adherence to associated instructions including legibility of prescription was 52% with the highest incidence among case records belonging to surgical speciality. Keeping in view the growing incidence of legislation against doctors and introduction of right to information act in our country as well as patient safety point of view, it is highly imperative that this aspect of patient care is adhered to more stringently.

To conclude, this was a single worker study, and only carried out on inpatients of the hospital, the study did not take into account the outpatients patients and the knowledge and attitudes of prescribing clinicians and their apprehensions if any regarding the stewardship program. Since the acute wards considered in the study are the ones in which the chances of prescription of antibiotics is highest the study was confined to them. The study proposed to bring forth the enormous economic implications of inappropriate prescription of antibiotic not taking into account the economic burden of resistance created by it. The findings observed in the study are only the proverbial tip of the Iceberg, as it has not considered the gross over prescription of antibiotics being done over the counter and by incompetent and inadequately trained practitioners in the country.

It is essential considering the current scenario that the health administrative authorities enforce hospitals/ healthcare institutions to devise and implement antibiotic policies. Ideally, this stewardship program should be devised in consultation with other regional healthcare institutions and microbiology laboratory. The authorities should also take some steps towards curbing the inappropriate over the counter sale of antibiotics. Along with enforcing measures to prevent inappropriate prescription, the subject of antibiotic policies and issues related to it should be introduced in the curriculum of undergraduate medical students. The issues related to careful and appropriate prescription should be publicized with the help of health bulletins among the general public.

Considering the enormous implications of antibiotic resistance, it is necessary that we act in haste, lest our wonder drugs and magic bullets become ineffectual. Future systems promise greater integration and analysis of data, facilitated delivery of information to the clinician, and rapid and expert decision support that will optimize patient outcomes while minimizing antimicrobial resistance. They may also offer our best hope for avoiding an 'Antibiotic armageddon'.[1]

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RESEARCH ARTICLE

Optimal Utilization of Government Assisted Financing for Poor Patients: Facilitation by a Hospital

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ABSTRACT

Introduction: Sole objective of healthcare financing is that rich and poor should be treated equally as poverty is not a disability and wealth is not an advantage. Approximately, 78% of Indian population spends for healthcare from out of pocket expenditure, remaining by salary, agriculture, business, etc. Only 3% population is covered by health insurance. Prime minister (PM) fund is one of the methods to offset the treatment cost from poor.

Objective: Present paper is aimed to highlight the contribution of PM fund for patients getting treatment at Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS) hospital and efforts made by hospital for its optimal utilization.

Materials and methods: Retrospective studies were carried out in 2010 and July 2013 for contribution received form PM fund for indoor poor patients treatment during last 5 years, number of patient availed/not availed financial assistance, reasons for not availing, on the line of problem solving process. Efforts made by SGPGIMS for its optimal utilization were also highlighted.

Result: During financial year 2007-2008 to 2009-2010, total 1246 patients received the fund of worth USD 1.30 million (₹ 78792750.00) and only USD 1.09 million (₹ 65569869.00) was utilized by 1110 (89%) patients. One hundred and thirty-six (10.91%) patients did not utilize. Hospital administration made efforts for optimal utilization by minimizing the barriers, consequently it improved the utilization by 8.20%. During financial year 2010-11 to 2011-12, USD 1.85 million (₹ 111081789.00) was received for 1450 patients, out of which 730 patients have already utilized and 682 are still using the fund (total 1412/97.40%) and 38 patients (2.60%) did not use it.

Conclusion: Simple efforts made by hospital improved the utilization of PM fund by 8.20% and poor were really benefited. Hospitals should also fulfill the social responsibility by facilitating the patients.

Keywords: Healthcare financing, Developing country, Out of pocket expenditure, Below poverty line, Prime minister fund.

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INTRODUCTION

Due to advancement in technology, emergence of different diseases and many other factors, expenditure on healthcare, especially tertiary care treatment, is increasing unabatedly, and is beyond the reach of the common man. This, in turn, becomes one of the hindrances in the social development of any country.[1] Healthcare expenses in India are increasingly going up. A onetime heavy expenditure or a recurring cost of treatment of a chronic disease can erode all the savings and even drive people into debt. India is a developing country and approximately 30% population lives below poverty line. With such widespread penury, people do not aspire to save money for future expenditures on their health. Henceforth, tertiary care facility is inaccessible to majority of patients in India. Investment in healthcare is a necessary social investment so that, despite omnipresent destitution, majority of Indians can realize good health and contribute vehemently to the growing economy. In India, though the state has a large stake in the health sector, investment has not been effectively utilized.[2] The situation becomes more abysmal as majority of Indians are unable to afford the entire cost of healthcare treatment especially the enormous cost of tertiary care treatment. Thus, financing of healthcare is of paramount importance so as to deliver quality healthcare services in the country and, thus different modes of HCF should be explored.[3]

There are four major modes of healthcare financing viz. free services, fee for services (FFS), diagnosis related groups (DRGs) and capitation.[4] Sole objective of health-care financing is that rich and poor should be treated equally as poverty is not a disability and wealth is not an advantage. But, developing country having 30% population living with below poverty line (BPL) can accomplish this objective, is a millions of dolor question.

Free treatment to all is out of reach poor as country can not afford. Tertiary care is more expensive. A study of HCF conducted between 2007 and 2010 at SGPGIMS Lucknow, UP, India revealed the followings outcome.[5]

Financing Mode

Sl. no.	Source	Percent (Approx.)
1.	Self but no reimbursement (out of pocket*)	75
2.	Self but will be reimbursed	19
3.	Advance payment by the employer	5
4.	Insurance	1

*Detail of out of pocket expenditure

Sl. no.	Source	Percent (Approx.)
1.	Salary	10
2.	Pension	03
3.	Deposit	17
4.	Cash in hand	20
5.	Loan from bank	03
6.	Loan from friends/relatives	30
7.	Selling of assets	08
8.	Mortgaging the asset	07
9.	Others	02

India, having approx. 1.25 billion population spends 4.5% of GDP in health sector and 2% of union budget is spent for health sector. Though health is a matter of state but union government simultaneously releases funds for states. Presently approximately 78% of Indian population spends for healthcare from out of pocket expenditure, remaining by salary, agriculture, business, etc. Only 3% population is covered by health insurance. In India, slowly people are now receptive to insurance as a cost-effective method of risk-mitigation to take care of possible healthcare expenditure. A thriving insurance sector is of vital importance to every modern economy. First, because it encourage savings habit, second because it provides a safety net to rural and urban enterprises and productive individual and perhaps most importantly it generates long-term investable funds for infrastructure building.[6]

Literature Review

The government of India and state governments have started many fully or partially financing schemes for economically deprived/BPL patients (less than 1.50 USD per day earning). Rashtriya Swasthya Bima Yojana (RSBY) is one of the best community financing scheme. Rashtriya Swasthya Bima Yojana, literally 'National Health Insurance Program',[7] is a government-run health insurance scheme for the Indian poor. It provides for cashless insurance for hospitalization in public as well private hospitals. The scheme started enrolling on April 1, 2008 and has been implemented in 25 states of India. A total of 23 million families have been enrolled as of February 2011. The RSBY is a project under the Ministry of Labor and Employment.[8] Prime Minister's (PM) fund is ALSO one of the financing mechanisms for poor patients.

Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS), a tertiary care hospital, Lucknow, India also gets the PM fund for treatment of poor patients from same source. The Uttar Pradesh (UP) government is also financing the poor through Antyodaya/BPL Nidhi,[9] Asadhya Rog Nidhi[10] and Chief Minister's (CM) discretionary fund. The SGPGIMS has also developed an in-house financing mechanism for poor patients getting treatment at this hospital through a society named 'Kamdhenu Ati Nirdhan Chikitsa Sahayata Society' (KANCSS). So for 8367 patients have received USD 1.67 million as financial assistance from KANCSS and benefited. The care institution across the third world countries should take KANCSS as a prototype.[11] To receive the CM and PM fund, patients have to make many efforts but despite of all efforts made for financial assistance by the patients, the PM Fund released from New Delhi was not utilized by all patients. It was a general observation by the hospital that many patients used to visit hospital account's department frequently to enquire about fund availability from PM office, and account's department denial caused much inconvenience to patients. In most of the such cases, the money was not utilized due to delay in receipt by hospital. This situation led the hospital administration to find out the reasons in delay in receiving the money by hospital and non utilization by some patients. The present study is based on situation and to facilitate the utilization of PM fund by patients at SGPGIMS as a part of its social responsibility.

OBJECTIVE

Present paper is aimed to highlight the contribution of PM fund for patients getting treatment at SGPGIMS and efforts made by hospital for its optimal utilization.

MATERIALS AND METHODS

The methodology adopted was on the line of problem solving process and divided in three parts, i.e. Pre-strategy, strategy and post-strategy.

Pre-strategy: A retrospective study was carried out in August 2010 for contribution received for patients from all sources with a special reference to PM fund during last 3 years (2007-2008 to 2009-2010), number of patient availed/not availed financial assistance.

Strategy: Forty patients/relatives of who could not avail the facility were contacted to know as to why

they could not avail the same to find out reasons for not availing, based on feed back received from patients, hospital administration tried to eliminate/reduce the possible hurdles. The PM office was contacted and informed about nonutilization of money, problem faced by patients and reasons for nonutilization of money as per feed back received from patients. Efforts were made by SGPGIMS for its optimal utilization by advising the elimination of delay factors.

Post-strategy: A similar retrospective study was carried out in July 2013 for contribution received for patients from all sources with a special reference to PM fund during post-strategy 2 years period (2010-2011 to 2011-2012) for number of patient availed/not availed financial assistance.

The improvement in utilization (effect of efforts made) was observed during 2010-2011 to 2011-2012.

RESULT/ANALYSIS

As evident from hospital statistics, the SGPGIMS hospital had catered to approximately 388362 outpatients in the years 2012 to 2013. Out of these nearly 1,00,000 were new patients rest were old OPD patients. On an average, 300 new patients and 650 old patients were registered per day at SGPGIMS. The annual discharge is 34926 with a bed occupancy of 87%. These registered patients are availing facilities of various superspecialities like cardiology, renal sciences, neurosciences, gastroenterology, endocrinology, immunology, hematology and genetic medicine, pulmonary medicine, pediatric GE, pediatric surgery, MRH, etc. The institute hospital receives financial assistance for poor indoor patients from many sources and also contributes the same through a society formed, the detail of which given below.

Various financial assistance (FA) schemes offered for poor patients at SGPGIMS

Sl. no.	*Name of scheme*	*Year of commencement*	*No. of patients benefited so far*	*Amount of FA (₹/USD)*
1.	Kamdhenu Ati Nirdhan Chikitsa Sahayata	2009	8367	105804354 1763406
2.	Chief minister's fund	1995	4826 (wef FY 2009-10)	413349000 6889150
3.	Prime minister's fund	2007	2696	189874539 3164576
4.	BPL/antyodaya nidhi	2011	295	45901950 765032
5.	Asadhya rog nidhi	2013	30	9173000 152885

Prime Minister's Fund

Prime minister's fund is a voluntary scheme governed by PM office, New Delhi. Fund allocation varies from patient to patient, and approaches by given application. It also depends upon the need and availability of fund.

Status of PM fund released to SGPGIMS—at a glance

Financial year	*PM office fund*	*No. of patient*	*Money utilized*	*Percent of money utilized*	*Money not utilized*	*Percent of money not utilized*
2007-08	25643500	418	23968366	93.47	1675134	6.53
2008-09	29454250	479	23680390	80.40	5773860	19.60
2009-10	23695000	349	17921140	75.63	5773860	24.37
2010-11	38230500	647	26548898	69.44	11681602	30.56
2011-12	72851289	803	60302392	82.77	12548897	17.23

Comparison between pre- and post-strategy period

Financial year	*PM office fund received*	*No. of patient*	*Money utilized*	*Money not utilized*	*No. of patient utilized the fund*	*No. of patient did not utilize the fund*
2007 to 2010	78792750 ($1.30 million)	1246	65569869 ($1.09 million)	13222881	1110 (89%)	136 (10.91%)
2010 to 2012	111081789 ($1.85 million)	1450	86851290 ($1.44 million)	24230499	730 + 682 (97.40%)	38 (2.60%)

Pre-strategy: During financial year 2007-2008 to 2009-2010, total 1246 patients received the fund of worth USD 1.30 million (₹ 78792750.00) and only USD 1.09 million (₹ 65569869.00) was utilized by 1110 (89%) patients. A 136 (10.91%) patients did not utilize.

Strategy: The feedback response of patients/relatives, who could not utilized the PM's fund revealed delay in communication by PM office with patients, non clarity in details of patients received by hospital, delay in receiving the money through cheque by hospital and no more money required as the patient is already treated or dead, are the main reasons for nonutilization of money. Hospital administration made efforts for optimal utilization by minimizing the barriers by contacting PM office and advising accordingly.

Post-strategy: As a result, by efforts made by hospital for timely information to patients by PM office, accuracy in detail of patients and transfer of money through RTGS by PM's office, improved the utilization by 8.20%. During financial year 2010-2011 to 2011-2012, USD 1.85 million (₹ 111081789.00) was received for 1450 patients, out of which 730 patients have already utilized and 682 are still using the fund (total 1412/97.40%) and only 38 patients (2.60%) did not use it.

Thus, the situation was improved and problem up to many extent was solved.

CONCLUSION

The SGPGIMS hospital is getting financial assistance from various sources and the funds are also being utilized optimally. The CM fund, Kamdhenu fund, BPL fund and Ashadya rog fund being released locally Lucknow/ institute are properly traced and followed, therefore being used optimally. But PM fund, which is released from New Delhi was not properly traced and followed. Simple efforts made by hospital with the help of PM' office, in the form of timely information to patients, accuracy in detail of patients and transfer of money through RTGS improved the utilization of PM fund by 8.20% and poor were really benefited and problem was solved.

RECOMMENDATION

Accuracy in details, timely communication about availability of fund and transfer of fund through RTGS facilitate the utilization of money. Hospitals should also fulfill the social responsibility by facilitating the patients.

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ORIGINAL ARTICLE

A Descriptive Study of Length of Stay at an Intensive Care Unit

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ABSTRACT

Background and aims: As intensive care units (ICUs) are very resource intensive, length of stay (LOS) is of prime importance. This study was done to analyze the LOS in different ICUs and analyze it against a set benchmark.

Materials and methods: This retrospective study was conducted from April to June 2013 on patients admitted during January to March 2013 in the neurosurgery ICU (NICU), medical ICU (MICU), high dependency unit (HDU) and isolation ICU of a large multispecialty hospital in Pune (India). As per the quality manual of the hospital, benchmark LOS was considered as 3.08 days for ICU. Mean and median LOS was analyzed through Student's t and Chi-square test; proportion of short (<2 days) and long stay (>4 days) patients was also computed.

Results: Out of 835 patients admitted to the NICU, MICU, HDU and Isolation ICU, the overall mean LOS was 3.37 ± 5.54 days which was statistically significant at a p-value <0.001 (t = 17.58, 95% CI 3-3.75). The overall mean LOS was higher than the benchmarked 3.08 days but still within the optimal range of 2 to 4 days. Mean LOS was statistically significant when tested for department-wise variations with a Chi-value of 173.56 (p-value < 0.001, LR = 113.75). Highest mean LOS was observed for isolation ICU and lowest for MICU. 360 (43.1%) were short stay, 141(16.8%) were long stay and remaining were optimal stay patients.

Conclusion: The mean LOS for the ICUs varied significantly across the type of ICUs which needs to be continuously monitored. Mean LOS variation across ICU type indicates need for separate benchmarks.

Keywords: Benchmark, Hospital, ICU, Length of stay.

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INTRODUCTION

Intensive care units (ICUs) are specialized inpatient units that provide care for the critically ill patients. The previous studies on improving quality of care provided to the critically ill patients, focus largely on patients with prolonged length of stay (LOS).[1] Prolonged stay in ICU is costly, can impact the bed availability, and lead to cancellation of elective surgeries.[1]

There is a need for optimizing the use of ICU beds.[1] LOS is one such indicator used to assess quality of care and resource utilization in ICU.[2]

Intensive care unit consumes around 20% of the total hospital costs;[3,4] thus prolonged LOS can have cost implications and may be utilized as the economic performance measure of hospital. However, Indian studies with data on LOS across different types of ICUs are rare. Hence, we conducted this study to fill the knowledge gap by analyzing the LOS in different departmental ICUs and study the variations across other characteristics.

MATERIALS AND METHODS

Study design and settings: This was a retrospective record based study conducted from April 2013 to June 2013 on patients admitted during January to March 2013 at a large multispecialty hospital in Pune, Maharashtra (India). The study was done in the neurosurgery ICU (NICU), medical ICU (MICU), high dependency unit (HDU) and isolation ICU of the Hospital.

Selection of participants: All patients admitted in the above-mentioned four ICUs were included after obtaining official consent from hospital authorities. The admission and discharge dates were noted from the respective registers of each of the 4 ICUs in the customized recording sheets developed for the study.

Through this data, LOS was computed[5] as follows: LOS (in days) = Total discharge days/total discharges. Total discharge days defined as the sum of the number of days spent in the ICU for each inpatient who is discharged during the time period regardless of when admitted and total discharges were the number of inpatients discharged from the ICU during the time period. The overall calculated LOS value was compared against the LOS benchmark set by the hospital. The benchmark to compare the LOS was obtained from the Quality Manual

of the Hospital.[6] The LOS benchmarked value for all the ICUs were 3.08 days.

Inclusion and exclusion criteria: All the patients admitted during January to March 2013 in the NICU, MICU, HDU and Isolation ICU were included along with the deaths and transfers in these departments. Only the days when the patient was in ICU (excluding step down or observation) was counted as ICU LOS. The neonatal ICU and kidney transplant unit were excluded due to managerial reasons. Further, LAMA cases (Leave against Medical Advise) were excluded from the study.

Primary and secondary outcomes: Primary outcome under study was the length of stay for each ICU. Secondary outcomes were analysis of LOS across different department and months, comparing it with the benchmark value and study of short and long stay patients.

Data analysis: The data were computerized and statistical analysis was done with SPSS v.17 for Windows (SPSS Inc, Chicago, II, USA). Statistical analysis was performed at 95% confidence interval and results with p-value ≤0.05 were considered statistically significant. We calculated mean and median LOS for each of the four ICUs. For univariate analysis, the overall LOS, LOS across months and departments was tested for statistical significance using one-sample test. Chi-square test was applied to test for statistically significant differences in LOS across departments and months. Median LOS was computed and the mean LOS was individually tested through one-sample t-test for statistical significant variations across departments and months. Bi-variate analysis was conducted through independent samples t-test for month-wise variations in LOS across different departments. Length of stay was compared and analyzed against the benchmark values defined in the quality manual of the hospital. We also analyzed the LOS of patients by categorizing them as short stay and long stay patients wherein long stay was defined as patient stay in ICU for >4 days and short stay as <2 days. Stay of between 2 and 4 days was considered optimal duration of stay based on the benchmark value. All analysis was done at 95% confidence level.

RESULTS

Records of 835 patients admitted during January 2013 to March 2013 in NICU, MICU, HDU and Isolation ICU were analyzed. The overall mean LOS in the study was 3.37 ± 5.54 days which was statistically significant at a p-value <0.001 (95% CI 3-3.75). The median LOS was 2 days. The overall mean LOS was higher than the benchmarked 3.08 days but still within the optimal range. Mean LOS was statistically significant when tested for department-wise variations with a Chi-value of 173.56 (p-value < 0.001, LR = 113.75). However, mean LOS was not significantly different across the 3 months.

Out of total 835 subjects, 327 (39%) were from the NICU, 363 (43%) from MICU, 121 (15%) from HDU and 24 (3%) from isolation ICU. The analysis of mean LOS across the four departments showed that in HDU (n = 121) the median LOS was 2 days and mean LOS was 4.79 ± 8.77 days which was statistically significant (p-value <0.001, 95% CI 3.21-6.36). The median LOS in NICU (n = 327) was 1 day but mean LOS was 3.39 ± 5.1 days which was also statistically significant (p-value <0.001, 95% CI 2.84-3.95). The results were statistically significant for MICU and isolation ICU. The median LOS in MICU (n = 363) was 2 days and mean LOS was 2.6 ± 3.2 days (p-value <0.001; 95% CI 2.28-2.95). In isolation ICU (n = 24), the median LOS was 4 days and the mean LOS was 7.54 ± 11.76) days (p-value <0.001; 95% CI 2.57-12.51).

The overall mean LOS when statistically analyzed for month-wise variation as in indicated that in January (n = 263) mean LOS was 3.82 ± 6.85 days (p-value <0.001, 95% CI 2.99-4.65). The overall mean LOS in February (n = 276) was 3.49 ± 5.2 days (p-value <0.001, 95% CI 2.87-4.1) and in March (n = 296) the mean LOS was 2.88 ± 4.4 days (p-value <0.001, 95% CI 2.37-3.38). Table 1 shows the results of month-wise comparison of the overall mean LOS for the four ICUs and its comparison against the benchmarked mean LOS value and the optimal range of patient stay in ICU. The values higher than the benchmark are highlighted by underlining in Table 1. It is evident that the mean LOS in MICU was well within the optimal limits in contrast to NICU where mean LOS was slightly higher than the benchmarked value for the 3 months. However, the value was within the optimal range across the 3 months period for NICU. Mean LOS in HDU was marginally higher than benchmark in March and February but extremely high in the January which was also the highest across the month of January on comparison to MICU and NICU. On further comparison the mean LOS in Isolation ICU was marginally higher in February as compared to NICU, MICU and HDU. It was highest in March and exceptionally high in January as compared with the NICU, MICU and HDU. Apart from January and February months in Isolation ICU, all results were significant at p-value <0.0001.

Table 1: Month-wise comparative ALOS for the four ICUs

	Average LOS (benchmark: 3.08 days; optimal range 2-4 days)		
	January'13	*February'13*	*March'13*
NICU	3.13 ± 3.86	3.83 ± 5.90	3.27 ± 5.35
MICU	3.04 ± 4.34	2.61 ± 2.90	2.24 ± 2.32
HDU	6.02 ± 11.56	4.90 ± 7.32	3.22 ± 6.05
Isolation ICU	16.60 ± 22.03	5 ± 7.90	5.43 ± 2.50

The analysis of mean LOS across the months and departments showed that mean LOS in NICU was statistically different (p-value <0.0001) for January (n = 104) February (n = 98) and March (n = 125). Mean LOS was 3.13 ± 3.86 days (95% CI 2.38-3.89), 3.83 ± 5.90 days (95% CI 2.64-5.01) and 3.27 ± 5.35 days (95% CI 2.32-4.22) respectively for January, February and March. Eighteen percent (n = 59) of the total subjects in NICU had a prolonged stay (>4 days).

The mean LOS in MICU was statistically significant (all p-values <0.0001) for variations across months. Mean LOS in January (n = 111) was 3.04 ± 4.34 days (t = 7.356 95% CI 2.22-3.85), February (n = 125) was 2.61 ± 2.90 days (t = 10.040, 95% CI 2.09-3.12) and 2.24 ± 2.32 days in March (t = 10.859, 95% CI 1.84-2.65) respectively. Twelve percent (n = 43) of the subjects in MICU had a prolonged stay (>4 days).

The mean LOS in HDU was different across the 3 months when tested statistically (all p-value <0.0001). The mean LOS in January (n = 43) was 6.02 ± 11.56 days (t = 3.415, 95% CI 2.46-9.58), February (n = 41) was 4.90 ± 7.32 days (t = 4.288, 95% CI 2.59-7.21) and March (n = 37) was 3.22 ± 6.05 days (t = 3.233, 95% CI 1.20-5.23) respectively. 23% (n = 28) of the total subjects in HDU were long stay (>4 days).

The mean LOS in Isolation ICU in January (n = 5) was 16.60 ± 22.03 (t = 1.685, 95% CI-10.75-43.95), February (n = 12) was 5 ± 7.90 (t = 2.190, 95% CI-0.02-10.02) and in March (n = 7) was 5.43 ± 2.50 days (t = 5.729, 95% CI-3.11-7.75). The mean LOS in Isolation ICU was statistically significant in the month of March (p-value <0.0001) but not significant for the month of January and February. 46% (n = 11) of Isolation ICU patients had a prolonged stay (>4 days).

Table 2 shows the comparison of short and long stay patients in each of the four ICUs. It is evident from Table 2 that the isolation ICU had the least % of short stay patients as compared to the NICU, MICU and HDU. The MICU has the lowest % of long stay patients compared to NICU, HDU and Isolation ICU.

The overall mean LOS of the four ICUs was found to be 3.37 ± 5.54 days. Figure 1 shows the comparison between the overall calculated mean LOS and benchmarked mean LOS. It revealed that overall calculated mean LOS of the four ICUs was higher than the benchmarked 3.08 days. Thus, mean LOS in the ICU was prolonged as compared to the benchmarked reading.

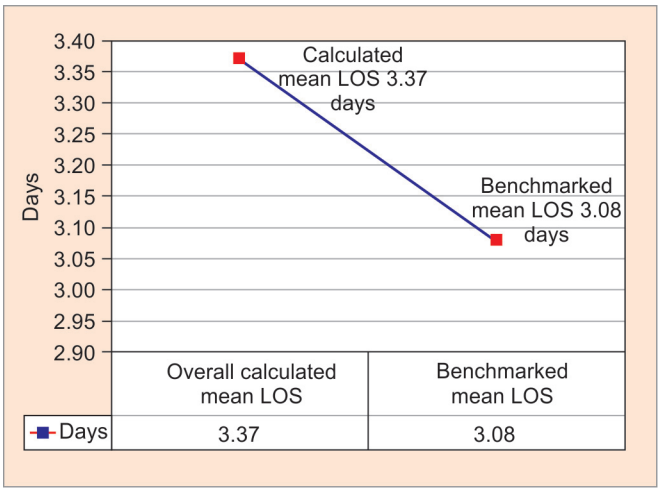

Fig. 1: Comparison of overall mean LOS and benchmarked LOS

DISCUSSION AND CONCLUSION

The present study aimed to calculate the overall mean LOS in 4 ICUs and compare it with the benchmarked mean LOS proposed in the quality manual of the hospital. We observed that overall mean LOS of our study was similar to a previous study[7] where the mean LOS was 3.86 days. In a Canadian study[8] done in a medical-surgical ICU of a tertiary hospital, mean LOS was 4.74 ± 0.2 days and median was 2 days. Other studies have also reported mean LOS of ICUs in the range of 2 to 5 days.[1,9] However, long stay patients have been observed to be about 11% of the total study subjects in which case mean LOS went as high as 27 ± 2 days and median LOS was 21 days.

We found that mean LOS was prolonged for some patients which may have a bearing on the hospital costs for providing care for additional days.[1] Studies have repeatedly shown that lengthy ICU admissions account for a small percentage (7-11%) but result in a large proportion (40-50%) of resource use.[7,8,10,11] Because patients with a prolonged ICU stay consume a disproportionate amount of resources, their early identification can assist in improving unit efficiency.[12-14]

In our study, highest mean LOS was in the Isolation ICU (8.01) days. Isolation ICU had longest stay of patients to prevent any adverse event like spread of the infections due to early discharges as Isolation ICU catered to patients with highly contagious diseases. We also observed that the proportion of short stay patients was highest in NICU followed by MICU and HDU and the least in Isolation ICU. This is because the admission and physiological characteristics of patients with prolonged ICU stay are quite different from those with shorter ICU

Table 2: Comparison of short and long stay patients in each of the four ICUs

	Patients n(%)			
Type of ICU	*Short stay (n = 360)*	*Long stay (n = 141)*	*Optimal stay (n = 334)*	*Total*
NICU	142 (43)	59 (18)	126 (39)	327
MICU	160 (44)	43 (12)	160 (44)	363
HDU	52 (43)	28 (23)	41 (34)	121
Isolation ICU	6 (25)	11 (46)	7 (29)	24
Total				835

stay. Patients with a short stay are those who likely die within a few hours of admission to ICU or other medical and administrative reasons.[15]

Some studies have shown that nonelective admissions, readmissions, trauma cases or those with other secondary infections or complications had a prolonged ICU stay.[1] However, cases other than isolation may also have a long stay in ICU like respiratory and trauma cases, gastrointestinal surgery followed by cardiothoracic surgery, trauma and neurosurgery.[1,16] A relation between the severity of illness and ICU LOS has also been observed. Patients with low severity of illness have short ICU stay in contrast with patients having very high severity of illness who may also have a shorter ICU stay as they die early in the ICU course.[1] Studies also show that the morbidity, mortality and cost of treatment of patients who stayed longer is higher than those who stayed for shorter periods in the ICU.[16] This is directly related to the incidence of nosocomial infections, especially with multidrug resistant and unusual organisms leading to long stay in ICU.[16]

Intensive care unit daily care costs are much higher than the general medicine and surgical costs reflecting both higher staffing ratios and greater resource consumption.[2] Hence, strategies to decrease ICU LOS and maintain it within the optimal range can improve patient turnover and increase ICU utilization resource constraint conditions.[2]

The strength of our study is that we computed the LOS for different ICUs. However, the limitation of our study is that the findings may not be generalizable to other settings where benchmark value of mean LOS is different or is undefined. Besides, setting a uniform benchmark for all ICUs also need some rethinking. Further studies are needed to validate the present findings across additional demographic characteristics. The LOS of LAMA patients may be 'lower than real' which will lead to misinterpretation of data. Further, they are lost to follow-up. Due to both these reasons they were excluded. Studies that provide the cost implications of prolonged stay in ICU on the hospital costs are also required in local context.

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ORIGINAL ARTICLE

Who is More Hands on with Hand-offs? A Comparative Study of Clinical Handovers among Doctors and Nurses in a Tertiary Care Center in India

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ABSTRACT

Background: Standardized handovers have been known to improve outcome, reduce error and enhance communication. Few, if any, comparative studies on clinical handovers have been conducted in the India.

Objective: To study clinical handover practices among nurses and doctors in a neurosciences center in India.

Design and setting: This descriptive and cross-sectional study was conducted over 4 months in a 200 bedded public sector tertiary care facility in New Delhi, India.

Materials and methods: The handover practices of nurses and resident doctors in a neurology ward were assessed across shifts, weekdays and weekends using a pretested checklist. Ten elements were observed under the categories of time, place, record, process, staff interaction and patient communication. Outcomes were analyzed using z-test, analysis of variance (ANOVA) and Spearman's correlation coefficient.

Results: Three hundred and eighty-two handovers each of nurses and doctors revealed varying adherence for time (44%), place (63%), documentation (50%), process (78%), staff interaction (50%) and patient communication (45%) related elements with overall compliance being 55%. Doctors fared better only in process elements and bedside handovers; however, only nurses had a statistically significant fall in levels over weekends and in night shifts. Staff interaction and patient communication were positively correlated and bedside handover was negatively related to handover duration in both groups. No statistically significant difference was found between the two groups when assessed as categories.

Conclusion: Study revealed a need for a system change and standardization of clinical handovers. Greater administrative commitment, use of technology, customized training and leadership development will aid in continuity of care, promote patient safety and ensure better outcomes.

Keywords: Clinical handovers, Shifts, Standardization.

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INTRODUCTION

Clinical handover has been defined as the process of transferring primary authority and responsibility for providing clinical care to a patient from one departing caregiver to one oncoming caregiver.[2] Nursing handover or shift report is a type of clinical handover that occurs between two shifts of nurses, whereby the specific purpose is to communicate information about patients under the care of nurses.[20] Multicentric prospective intervention studies have shown that implementation of hand-off programs are associated with reductions in medical errors and improvements in communication, without a negative effect on workflow.[32] Others have shown differences in handover practices across care- giver type.[42] Some studies have observed a decrease in length of hospital stay and, therefore, the cost of individual medical visits and fewer referrals.[11] Though, quality of doctors' handovers is now regarded as a key area for improvement in patient safety;[3] research on healthcare handovers is mainly on the nursing shift report.[18,19] However, physician-to-physician hand-offs have also been identified as a high-risk area of patient care that can result in serious safety events, near misses, suboptimal patient care, and poor coordination of care.[15]

Few, if any, studies have been conducted in the Indian public hospital scenario regarding clinical handover communication. The authors are not aware of any Indian study that compares nursing and physician handovers.

Considering the heavier patient load in Indian public sector hospitals, the lack of standardized protocols, it was considered to undertake the study on clinical handover practices in the neurosciences center.

MATERIALS AND METHODS

This descriptive and cross-sectional study was conducted in a 200 bedded neurosciences center of an apex public sector tertiary care referral hospital in New Delhi, India from January 2014 to April' 2014. Nonparticipant observation was conducted between groups of caregivers as follows:

- Nursing handovers during change of shifts
- Physician handovers between residents during change of shifts.

Morning and night shift handovers were observed in a neurology ward, representative of the neurosciences center, using a pretested checklist. Handovers in the ward were observed during weekdays and weekends as well. In each nursing shift, handover practices in relation to all the patients under the charge of one staff nurse was observed. The nurse handovers were observed in rotation to minimize individual variation. Since, resident handovers occur only in the morning and night shifts, nurse evening shift was excluded to permit comparability. The beds observed for both groups of caregivers were the same to overcome case based variability. Administrative nurses, physician-nurse handovers, consultant hand-overs, interhospital transfer handovers, intensive care unit (ICU) to ward and private ward beds handovers were excluded from the study. The sample size was determined in accordance with the World Health Organization (WHO) guidelines,[43] using the formula:

$N = (SD/\delta)^2 \times p(1-p)$

where SD = standard deviation at 95% confidence level, δ = width of interval, p = proportion.

The pretested healthcare worker-neutral handover checklist was adopted from the implementation toolkit promulgated by the Australian Medical Association and the United Kingdom National Patient Safety Agency (2004).[17,33] A pilot test of nursing and resident shift practices was carried out in both the shifts for 1 week. This modified, validated checklist was then used to carry out the study.

The handover checklist consisted of 10 elements under six categories with 10 boxes corresponding to the elements under each category (Table 1). The data collection was undertaken over a period of 40 days to include 5 weekends. The mean value of all the handovers for that shift were taken as representative for that shift. Weekends were also analyzed independently. One way and two way analysis of variance (ANOVA sig: < 0.05), z-test for difference of proportions (sig: < 0.01), and Spearman's correlation coefficient was used to analyze the data using SPSS 22 software.

RESULTS

The neuroscience center of the tertiary referral center is a seven storied structure with 200 beds including general wards, ICU and private wards. The nursing shift handover in the 30 bedded neurology ward (as in the rest of the hospital as well) selected for the study occurs over three shifts: morning (M), evening (E) and the night shift (N). Since each staff nurse is in-charge of 5 patients, and evening shifts were excluded, in a 24-hour period, 10 handover were observed. Using the formula for sample size calculation:

$N = (SD/\delta)^2 \times p(1-p)$, SD = 1.96, δ of 5% and p = 50% (for maximum sample size).

N was calculated to be 382. Thus, 382 nursing (191 morning and 191 evening shift handovers) and 382 resident handovers (191 morning and 191 evening shift handovers) were observed.

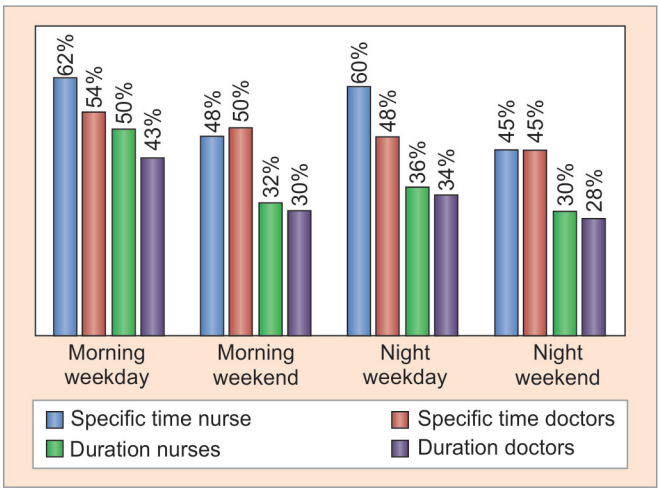
Table 1: Pretested checklist used as tool for clinical handovers with 10 elements in six categories

Category	*Element*	*Description*
Time	1. Specificity ☐	Whether the handover occurs at a specific pre-determined time
	2. Duration ☐	Whether duration of handover has been sufficient to convey relevant information
Place	3. Bedside handover ☐	Whether significant part of handover occurring at the bedside
Record	4. Documentation ☐	Whether important aspects of the handovers have been recorded
Process (SBAR)	5. Situation ☐	Whether the patient's diagnosis or reason for admission explained to the oncoming caregiver
	6. Background ☐	Whether the clinical background or context explained during handover
	7. Assessment ☐	Whether an assessment of current situation is provided and a professional opinion of the condition given
	8. Recommendation ☐	Whether professional recommendation or advice regarding further management is provided
Staff interaction	9. Read-back ☐	Whether sufficient interaction including between the caregivers has occurred
Patient communication	10. Counseling ☐	Whether relevant information has been conveyed to the patient

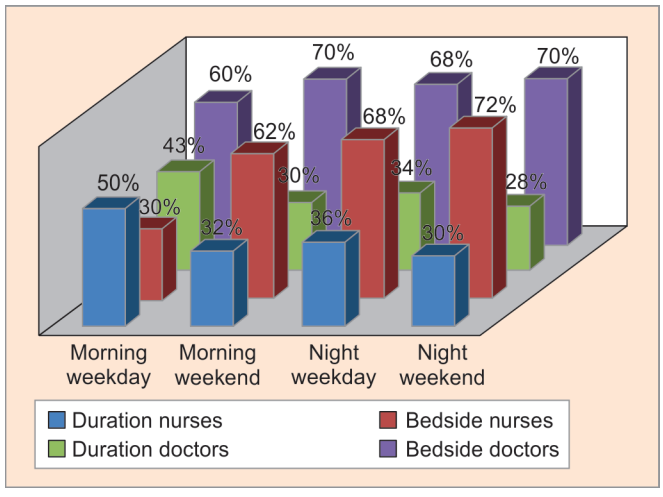
Outcome was analyzed with regards to the elements in following categories against group of caregivers, shifts, week days and over weekends:

- *Time*: These included whether handovers occurred at specific pre-determined time and duration. Doctors as well as nurses showed lower compliance over night and weekend for punctuality and the duration was shorter as well (Graph 1). However, the difference over the week end was statistically significant (z-test sig: 0.004) only in the case of nurses. The overall adherence was 43%. Two way ANOVA post hoc test revealed that the statistically difference between doctors and nurses was due to lack of handover punctuality (specificity) among doctors (ANOVA sig: 0.023).
- *Bedside handover*: Over the week and in both shifts, doctors had a greater propensity to conduct handovers at bedside than nurses (compliance nurses: 58%, resident doctors: 67%). Handovers that did occurred at bedside had shorter duration. In addition, bedside handovers were more often in both groups at weekend and night shift (Graph 2). One way ANOVA test revealed statistically significant difference only within nurses, bedside handover being significantly higher over the weekends (one way ANOVA sig: 0.03).
- *Documentation*: Adherence of handover documentation was overall 49%, with nursing documentation marginally higher at 52% (doctors: 47%). Documentation was poorer in both groups during weekends and night shifts; the difference being statistically significant only in the case of doctors (z = 0.004).
- *Process*: In both groups, process elements situation, background, assessment, recommendation (SBAR) were followed the best among all the five categories studied, with doctors performing better (Aggregate; doctors: 83%, nurse: 72%). Among nurses, across both shifts, elements of situation (76%) and background (74%) had better adherence than assessment (70%) and recommendation (68%). The reverse was true in case of doctors [situation (80%), background (82%), assessment (86%), recommendation (84.4%) (Graph 3)]. The difference was statistically significant between doctors and nurse (z-test; sig: 0.004). However, the difference between shifts and over weekends were statistically insignificant for both groups (two way ANOVA sig: 0.454).
- *Staff interaction*: The overall interaction among all nursing staff during handovers was higher than resident doctors (52.8 and 48% respectively) (Graph 4). The difference was statistically significant (z-test; sig: 0.006). The task of 'read back' or 'repeat back' by the incoming nurse was being followed less often during the night shifts and weekends, but was not statistically significant. Such a variation was not observed among resident doctors.
- *Patient communication*: Among all categories, patient communication was given the least priority (44.4%). However, the nursing staff fared significantly better than resident doctors [(nurse: 48%, doctors: 42%) (Graph 4) (z-test; sig: 0.004)]. Although, communication was observed to be lower in the weekends, it may have been a chance finding.

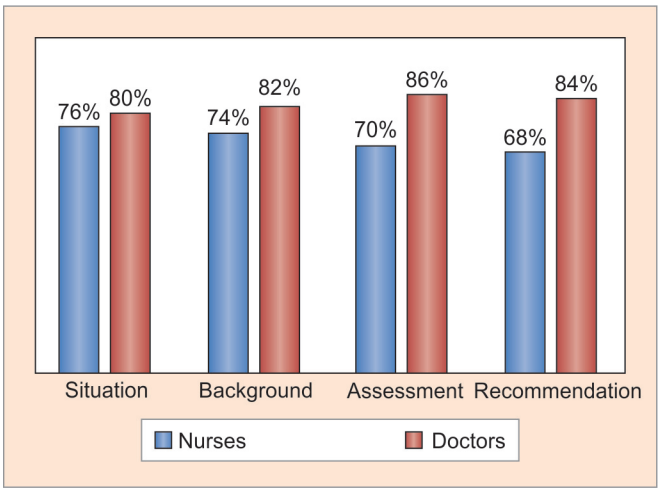
Strong negative correlation was observed between weekend shift and elements related to time (Spearman's coefficient of correlation –0.764) (Table 2) only in the case of nursing staff. Strong negative relationship was also observed between bedside handovers and duration of handover (Spearman's correlation coefficient –0.689 for nurses and –0.568 for doctors) for both groups (Graph 5). Positive correlation was observed with staff interaction and patient communication (Spearman coefficient: + 0.569



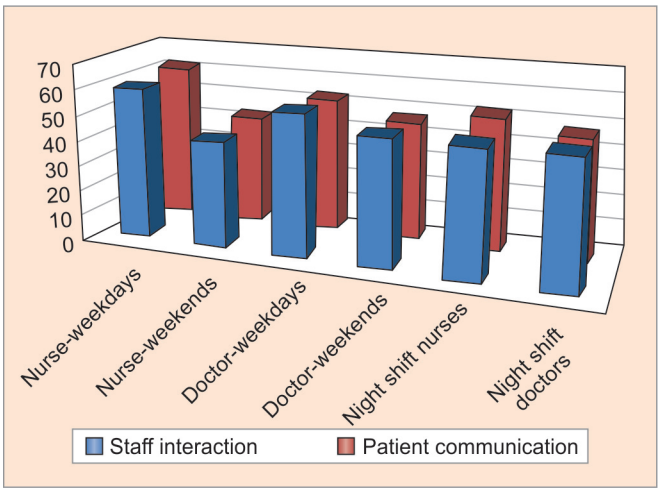
Graph 1: Handover compliance among nurse and resident doctors regarding time elements of specificity (punctuality) and duration is compared over morning and night shift, during weekdays and over weekends



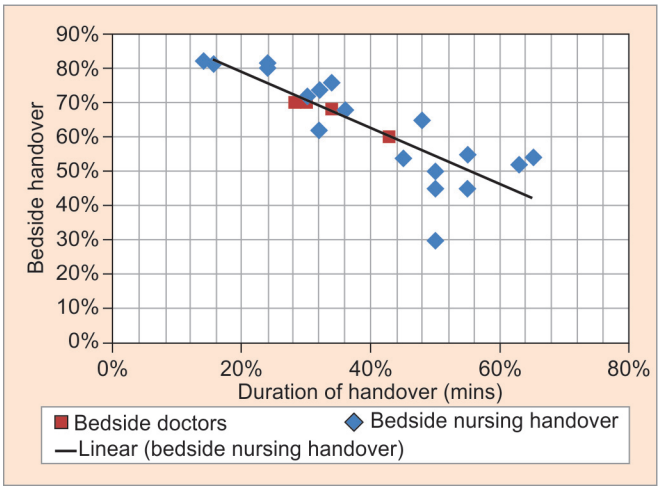
Graph 2: The relationship between the duration of handover and bedside handover compliance among nurses and doctors showing a dip over night shifts and weekends only among nurses



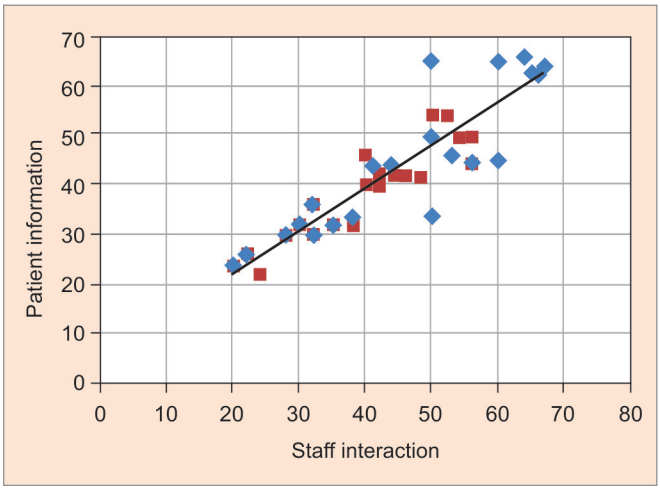
Graph 3: Comparison of process elements; situation, background, assessment and recommendation, between nurses and doctor showed doctors adhered better with SBAR



Graph 4: Staff interaction between nurses and their communication with patients was found better than that by doctors



Graph 5: Strong negative correlation between conducting handovers at bedside and duration of handover observed for both doctors and nurses



Graph 6: Positive correlation during handovers between interaction among nursing staff (blue dots) and among resident doctors (red dots) and patient communication

+ 0.562) for both groups, nurses as well as doctors (Graph 6). However, no correlation was observed between shifts and weekends among doctors. Compliance with respect to all the categories between groups offered similar trends over shifts and days (Graph 7). The difference was not statistically different between the groups (z-value = 0.023). The overall compliance was 55%.

DISCUSSION

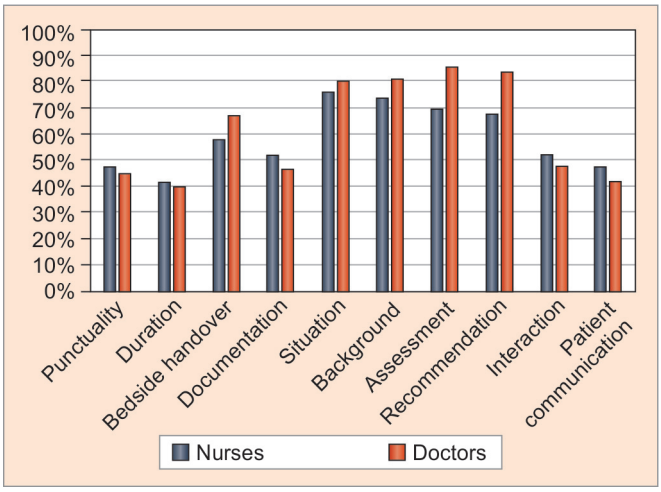
Shift handovers are essential, not only for maintaining the continuity and quality of care but also in planning.[22,27]

The objective of conducting a study of handover practices among nursing and resident doctors at the neurosciences center was not a competitive comparison, rather a measure of gaps in the groups. It was hoped

Table 2: Correlation between various variables of the caregiver groups

	Statistical analysis: Spearman's rank correlation coefficient		
Sl. no.	*Caregiver group*	*Variables*	*Spearman's coefficient of correlation*
1.	Nurses	Weekend shifts* time	–0.764
2.	Nurses	Duration* bedside handover	–0.689
3.	Resident doctor	Duration* bedside handover	–0.568
4.	Nurses	Weekend shifts *process	–0.221
5.	Nurses	Night shifts *staff read back	0.311
6.	Nurses	Read back* patient information	0.569
7.	Resident doctor	Read back* patient information	0.562

*Variables have been analyzed using Spearman's coefficient of correlation. Positive and negative values represent positive and negative correlations respectively. Only significant correlations have been tabulated



Graph 7: Overall compliance among nurses and doctors for 10 handover elements across all shifts and weeks did not reveal statistically significant difference at a macro level

that a validated healthcare neutral tool provided an opportunity to assess the deficiencies in a system that functions with an unstructured handovers.

Studies indicate the importance of duration and specific time for handovers.[29] Yet, significant deficiencies were found, especially during the night shifts and weekends among nurses. The findings collaborate those of other studies.[37] Low morning compliance probably reflects delay in arrival of the morning shift oncoming practitioner, busy morning duty corresponding with doctors rounds and nurse fatigue factor due to night duty. The weekend fall of compliance may be a result of lack of supervision (absence of administrative nurses) and generalized fall in diligence observed in other studies as well. The lack of punctuality among doctors in our study seems to validate other study findings which suggest that in healthcare, most handovers do not occur under ideal conditions, and clinicians may fail to allocate enough time to appropriately transfer patient data.[38] It is likely that the 12 hours shift of doctors and the charge of the entire 30 beds as against an 8 hours shift with six beds charge among nurses would have affected both, the specificity and duration of handovers. That there was no variation between shifts, or weekends among doctors, point to a more systemic deficiency. However, shorter duration does not necessarily reflect poorer quality of handover or the lack of time. This study revealed that bedside handovers were inversely related to the duration of handover (Graph 5) for both groups and since more doctors preferred to conduct handovers at bedside, this may have led to their shorter handover. This also validates the findings of other studies which suggest that bedside handover takes less time.[23] This may be a subconscious adaptation by both groups to save time; doctors since they have more patients and longer shifts and nurses during night shifts and weekends. Bedside handover has been known to facilitate a partnership model in medication communication bring nursing team, together, providing a patient centered dimension of handovers, with an additional advantage of patients providing key essential information and an opportunity to participate actively in the process of their treatment.[6,10,21] In our study, poor levels of handover documentation in both groups (52%) was seen, despite conclusive evidence from other researchers suggesting that only 2.5% of patient information is retained using verbal only handover method, 85.5% is retained using verbal with note taking while 99% was retained using a printed handover.[5]

Documentation is this only element that showed a significant variation over weekends and night shifts among doctors calling for administrative intervention. It has also been suggested that the lack of documentation among doctors have contributed to the problems leading to this adverse event.[39]

The findings of a qualitative case study in two hospitals indicate that SBAR may aid in schema development that allows rapid decision making, provide social capital and legitimacy for less-tenured nurses, and reinforce a move toward standardization in the nursing profession.[41,42] A prospective interventional study among doctors reveals that SBAR improves communication and safety climate and decreases incident reports due to communication errors.[30] Encouragingly, our study revealed that process based elements had an overall better compliance in both groups, and SBAR, the core aspect of handover communication, was better adhered to by doctors, thus perhaps being a surrogate indicator for good clinical care. However, the fact that nurses lay less stress upon explaining patient care back ground and their own assessment of the patient, renders handover mechanical and not evdience based. This ritualized handover has been studied to be ineffective and a discourse of anxiety among nurses.[12] Authors have given various modification to support flexible adaptation, such as the standardized protocols identify-situation-observations-background-agreed plan-read (ISOBAR) back, or more recently the- 'hand me an isobar.'[28,44] No localized modification was observed in any of the handovers in our study. A weak negative correlation between week end shift and SBAR continues to point toward the possibility of the weekend effect. Detailed analysis of the content was beyond the scope of the study.

The importance of personnel interaction, especially read back is emphasised by WHO. However, this study revealed a poor level of compliance with read backs (52.8%) especially among doctors and was validated by other studies.[1,14] We also confirmed findings from other studies that read-backs are relatively infrequently

used during patient handovers in all caregiver groups.[31] Studies also suggest that nurses are less likely than physicians to be assertive, interject and disagree with the previous caregiver, especially when an error was believed to have occurred.[9,34] This finds reflection in our own study where the assement and recommendation (situations where interjection is likely to occur) were paradoxically lower among nurses despite readback being higher in the group. Positive correlation of nursing read backs with night shifts may indicate an absence other distractors, such as consultant rounds, morning investigations, etc. Surprisingly, our study revealed that greater percentage of bedside handover does not necessarily translate into better staff communication (as in the case of doctors). Further, though contents were not analyzed, observers noted that handovers were formulaic, partial and, used abbreviations and jargon. This has been observed in others studies which suggest that doctor interaction was cryptic, given at high speed often required socialized knowledge to interpret.[26] Thus, it brings out the importance of leadership and training in implementation of better handover practices, as enumerated by several studies.[24]

The patient and family are the only constant and are thus in a position to play a critical role in ensuring continuity of care.[8,42] Engaging patients are sometimes made more difficult due to low health literacy.[40] This is especially true in the Indian context where healthcare workers have a paternalistic view of patients and inequalities in levels of empowerment and opportunity affect medical decision making.[36] Teach-back is a technique used by caregivers to ensure that the patient has understood the information provided.[35] Our study showed that despite the type of patient clienetele in public sector Indian hospitals requiring better counseling, handover patient communication had the least adherence among all elements. Doctors engaged with patients less frequently than nurses. Though, the fact that the residents had nearly 5 times the number of beds to manage than nurses and had also academic and independent work commitment (e.g. OPD duties) renders such a comparison unequal; other complex factors besides time, such as language barriers, sociocultural norms may also be at play.[7,25] Encouragingly though, greater staff interaction was found to be directly related to better patient communication (Graph 6). Thus, an increased impetus on physician to physician interaction during handover is likely to improve communication with patients as well. A study of neurosciences residents concludes that there needs to be more focused education devoted to learning effective patient-care hand-offs in neurosurgical training programs, thus further emphasizing the need for training.[4]

This study had several limitation including that of Hawthorne effect on the staff performing handovers in the presence of the author.[16] The fact that resident doctors and nurses had different shift hours and beds to manages reduces the comparability. Further, the role of content of handover and patients and family members was not included in the study. Moreover, the large influence of extraneous factors, such as type of clinical environment, experience, culture of leadership, specialty, case mix, technology and local policies, cannot be underestimated. At a macro level, the study did not reveal a statistically significant difference between the groups of healthworkers when all 10 elements were assessed together. Perhaps, more tellingly, the findings being consistent across weekdays and shifts, brought out consistent gaps clearly pointing out system-based deficiencies and need for profession specific training.

CONCLUSION

This study was undertaken to assess and possibly compare the clinical handover practices among nurses and resident doctors in an apex neurosciences center in India. Relatively, inferior handover practices across all categories, in both groups, calls for a systems approach and greater administrative commitment for standardized handovers. Deficient physician interaction and patient communication by doctors needs to be addressed. Better performance among process elements across the spectrum is encouraging, however, nurses continued to give less importance on handing over their own assessment and recommendation to the incumbent, emphasizing the need for training. Since, better interaction showed direct relation with patient communication, promoting the former is likely to result in overall improvement.

The fact that no significant difference was found between the two groups at a macro level is itself a marker for eschewing the traditional one-size-fits-all simplistic solutions. Therefore, viewing it from the administrative lens, training in both groups has to be customized to plug the gaps identified. While this contextual study revealed an urgent need for standardizing handovers protocol, the use of technology, such as electronic handovers, role of leadership and training cannot be overemphasized.[13] Future studies need to focus on the postinterventional analysis, content of handovers, perception of residents and staff, and the role of leadership in handovers. This will assist in continuity of care, promote patient safety and ensure better outcomes.

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REVIEW ARTICLE

Planning and Designing an Isolation Facility in Hospitals: Need of the Hour

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ABSTRACT

Emerging infectious diseases represent an ongoing threat to the health and livelihoods of people globally. Over the past decade, numerous infectious diseases have shown up in the United States including SARS in 2003, H1N1 or 'swine flu' in 2009, and now, the Ebola virus.

Isolation of a patient is essentially an escalation of the core healthcare process. Best practice demands that isolation rooms be provided where care for the underlying medical condition is optimal. As uncontroversial as infection control may seem, the infrastructure required (such as washbasins and isolation rooms) is often lacking in hospitals. And if isolation rooms are available, proper maintenance of pressure gradients is an issue. In normal circumstances no purpose is served by routine cleaning of ventilation ducts. During replacement, dust is shed from old filters. All extract grilles and some types of supply grilles accumulate dust. These represent an infection risk. The dust reflects the air-borne flora at the time of deposition with organism death taking place at a rate determined by microbial, environmental and other factors.

It is vital that regular monitoring and maintenance of the ventilation system is in place. The physical design of a hospital is an essential component of its infection control measures to minimize the risk of transmission of any infectious disease. Today, with a more progressive outlook, it is the fundamental requirement to adopt a holistic view of the design and management of hospitals. This document will not only help in making strategy for planning or renovating an isolation room and also helps in cleaning or maintenance of ventilation.

Keywords: Infection control, Isolation room design, Ventilation system.

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INTRODUCTION

Infection control is emerging as a biggest challenge to health services around the world. All hospitals knowingly or unknowingly admit patients with communicable diseases. In recent years, emerging infectious diseases represent an ongoing threat to the health and livelihoods of people everywhere. Over the last few decades, there have been several emerging infectious diseases (EIDs) that have taken the global community by surprise and drawn new attention to EIDs, including HIV, SARS, H1N1, and Ebola.

For over a century, it has been recommended that patients with infectious diseases should be placed in segregated facilities to prevent the spread of infection.[1]

The effectiveness of a hospital's isolation precautions is dependent upon an amalgam of interactions between the appropriate:

- Physical environment, i.e. isolation room
- Healthcare policies;
- Healthcare staff behavior.

Isolation of a patient is essentially an escalation of the core healthcare process. As our understanding of the transmission of infection has improved, isolation practices have developed and moved away from early empirical approaches to become more evidence-based and targeted. Best practice demands that isolation rooms be provided where care for the underlying medical condition is optimal.

As uncontroversial as infection control may seem, the infrastructure required (such as washbasins and isolation rooms) is often lacking in hospitals. And if isolation rooms are available, proper maintenance of pressure gradients is an issue.

FUNCTIONS

- To separate patients who are likely to be infectious to other persons.
- To provide an environment that will allow reduction of the concentration of airborne particles through various engineering methods.

- To prevent escape of airborne particles from such rooms into the corridor and other areas of the facility using directional airflow.
- To protect patients who are immunocompromised from potential harmful pathogens.

Types of Isolation Rooms

There are two types of isolation rooms: (1) airborne infection isolation (AII) rooms and (2) protective environment (PE) rooms.

- Airborne infection isolation (AII)/Negative pressure isolation refers to the isolation of patients infected with organisms spread via airborne droplet nuclei <5 µm in diameter. These include patients suffering form measles, chickenpox and tuberculosis.
- Protective environment (PE)/Positive pressure isolation is a specialized area for patients who have undergone allogeneic hematopoietic stem cell transplant (HSCT).

Planning Premises of Isolation Rooms

Location: The isolation rooms should be located at one end of medical and surgical wards/critical care units/pediatric care units/newborn intensive care units/emergency service areas/also other areas, such as dialysis. Isolation wards for infectious cases to be kept out of routine circulation. The location of the proposed isolation room, such as those near elevator banks or doorways should be avoided if possible.

- *Number of beds for isolation beds*: About 2.5% of the beds of a large hospital in a special unit would probably be adequate except during periods of unusually high demand.[2]
- *Space*: An isolation room has to provide uncluttered space around the bed for equipment and the increased number of personnel involved in emergency care. A room area of about 22 m^2 is adequate within an isolation unit.[2]
- Adequate number of wash hand basins should be provided within the patient care areas and nursing stations with a view to facilitate hand washing practice.
- Separate arrangements for garbage and infectious waste removal from wards and departments in the form of separate staircases and lifts.
- One to two standard isolation rooms per ward unit should be planned throughout the hospital with wash hand basin in room, shower, toilet and wash hand basin in bathroom. Door with self closing device and a normal window AC to be provisioned for these rooms.
- Gasketing should be provided at the sides and top of the door, and at ceiling and wall penetrations, such as those around medical and electrical outlets.

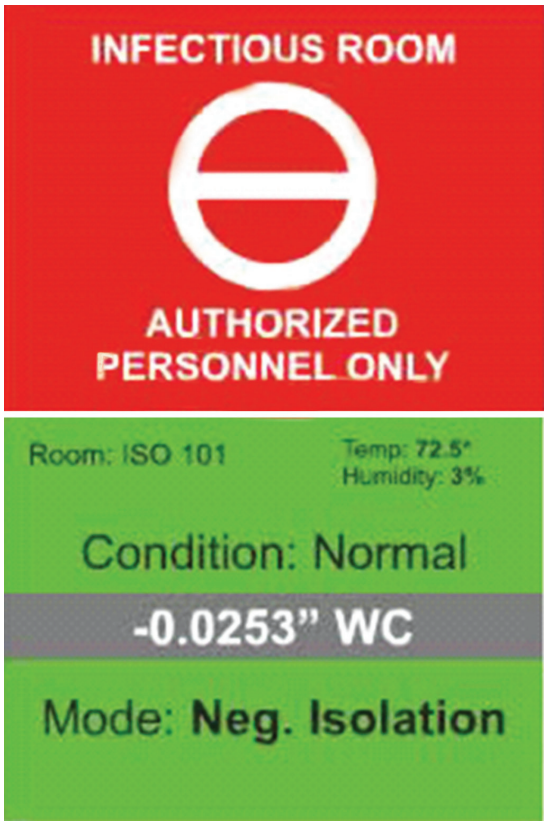
Bed Management System[3]

- Bed centers should be at least 3.6 m apart.
- Minimum possible number of beds[2-4] should be kept in a cohort as to prevent chances of cross-infection.
- Design, accessibility and space in patient areas all contribute to ease of cleaning and maintenance.
- Spacing must take account of access to equipment around the bed and access for staff to hand-wash facilities.
- Provision of permanent screens between bed spaces should be there as an aid to prevent frequent traffic and thus the potential for microorganism transfer.

General Planning Considerations

The design, materials and construction of the interior surfaces of an isolation room plays a critical role in the performance of the room in containing infections.

- Continuous impervious surfaces such as welded vinyl, epoxy coatings or similar durable surfaces.
- Welded vinyl floors coved up the walls, and wall finishes that are durable and easy to clean; for example, welded vinyl isolation rooms with smooth finishes, free of fissures or open joints and crevices that retain or permit passage of dirt particles. The use of carpet is discouraged because it is difficult to clean.[4]
- Minimisation of horizontal surfaces.
- Guard rails to protect the walls from damage by beds and mobile equipment.
- Epoxy-coated or stainless steel joinery that is easier to clean than uncoated timber.
- Windows designed to avoid pelmets and dust collection areas.
- Washable curtains.
- Wall-hung toilet pan and basin with non-hand operated taps.
- *Window setting*: Isolated patients can distinguish day and night by looking through the window panes at the isolation room. This is particularly important to the elderly as it relieves symptoms of disorientation.
- *Signs and labels*: All isolation room ductwork systems should be labelled with appropriate warning signs.[8] Appropriate signage should be prominently placed outside the door of isolation rooms. The bedside and other charts should also be labelled once isolation has been ordered for a patient.



- *Doors*: Sliding doors are not recommended but if space is an issue, sliding doors should only used as a last resort due to difficulties with maintenance and maintaining a seal. The pressure differential should force swing doors into the seal; that is, doors should open out of a NPR or open into a PPR) An alternative arrangement can be to have both doors swing into the anteroom. If doors have an interlocks mechanism fitted, an emergency breakout system must be provided.

- Communication system.
- A nurse call system with the capacity for direct communication between the nurse and patient should be available in each room.

CLASS N—NEGATIVE PRESSURE ISOLATION ROOM

Air in an open class N room, for example, should flow from corridors INTO the isolation room to prevent the spread of airborne contaminants from the isolation room to other areas. The purpose of this design is to eliminate the spread of infectious contaminants and pathogens into the surrounding environment via the airborne route. Other patient treatment areas that can also be benefitted from in-room negative pressure isolation with HEPA-CARE systems include:

- Bronchoscopy suites
- Endotracheal intubation and extubation
- Open suctioning of airways
- Invasive vascular procedures
- Er Triage and treatment rooms
- Waiting areas
- Morgue/autopsy.

Figure 1 shows HVAC air flow arrangement for class N rooms.[12] An anteroom designed to provide an 'air-lock' (no mix of air) between the infectious patient and the common space is placed adjacent to the patient room. The air would flow from the anteroom to the isolation room. Pressure control is maintained by modulating the main supply and exhaust dampers based on a signal from a pressure transducer located inside the isolation room.

Ventilation

Recirculation of exhausted air is discouraged, from class N rooms. The exhaust air should be directed to outside, away from air-intakes and populated areas. However, where recirculation may be deemed acceptable, HEPA filters (99.97% @ 0.3 µm DOP) capable of removing airborne contaminants on the supply side must be incorporated. The supply air should be located such that clean air is

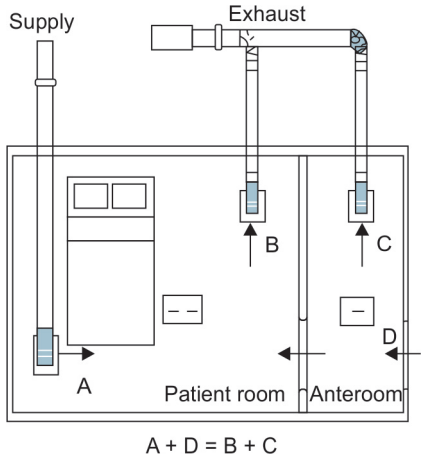


Fig. 1: Negative pressure isolation room (adapted from HVAC design for healthcare facilities by CED engineering)[12]

first passed over the staff/other occupants and then to the patient. Air distribution should reduce the staff's exposure to potential airborne droplet nuclei from infectious patients, accounting for the positions of the staff and the patient, and the procedures undertaken in the isolation room. Insider patient room, the supply air should be from the ceiling diffuser located at the perimeter near to the entry and the exhaust air should be drawn at lower levels approximately 6" above the floor in the room. Exhaust air ducts should be independent of the building's common exhaust air system to reduce the risk of contamination from back draught. The exhaust fan should be located at a point in the duct system that will ensure the duct is under negative pressure throughout its run within the building. The makeup air intakes should be located so that no contaminated air from nearby exhaust stacks or any sources of air contaminants is drawn into the makeup air system. Ensure supply air ducts are independent of the building's common supply air system. If sharing of supply ducts with other isolation rooms is unavoidable, provide the ducts with terminal HEPA filters (or other failsafe back draught prevention system). A high efficiency bag filter may be installed as a pre-filter to protect the HEPA filter.

Emergency Rooms and Reception Areas

The likelihood of airborne contaminants leaving these rooms is reduced by keeping these rooms under negative pressure, relative to surrounding areas. Air is exhausted from these rooms either directly to the outside or through high efficiency particulate air (HEPA) filters.

CLASS P—POSITIVE PRESSURE ISOLATION ROOMS

Class p—positive pressure isolation rooms are set at positive pressure relative to ambient pressure, meaning that air flow must be from the 'cleaner' area toward the adjoining space (through doors or other openings). This is achieved by the HVAC system providing more air into the 'cleaner' space than is mechanically removed from that same space.[6]

In the Figure 2, an airlock or anteroom is provided adjacent to the patient room. For a positive pressure room, air would flow from the isolation room to the anteroom and then to the corridor. Pressure control is maintained by modulating the main supply and exhaust dampers based on a signal from a pressure transducer located inside the isolation room.

Ventilation

Class P rooms can be either 100% fresh air or can use recirculated air usually a 60/40 mix of outdoor air/recirculated air. The supply air should be located such that clean air is first flows across the patient bed and exits from the opposite side of the room. Air distribution should reduce the patient's exposure to potential airborne droplet nuclei from occupants. Positive pressure rooms may share common supply air systems (Table 1).

ANTEROOMS[4]

If space and budget permit, an anteroom should be provided between the negative/positive pressure isolation room and the corridor (Fig. 3). It is always recommended for both positive and negative isolation rooms for three main reasons:

1. To provide a barrier against loss of pressurization, and against entry/exit of contaminated air into/out of the isolation room when the door to the airlock is opened.

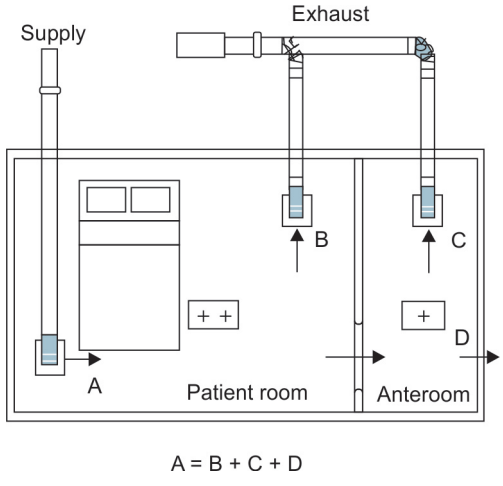


Fig. 2: Positive pressure isolation rooms (adapted from HVAC design for healthcare facilities by CED engineering)[12]

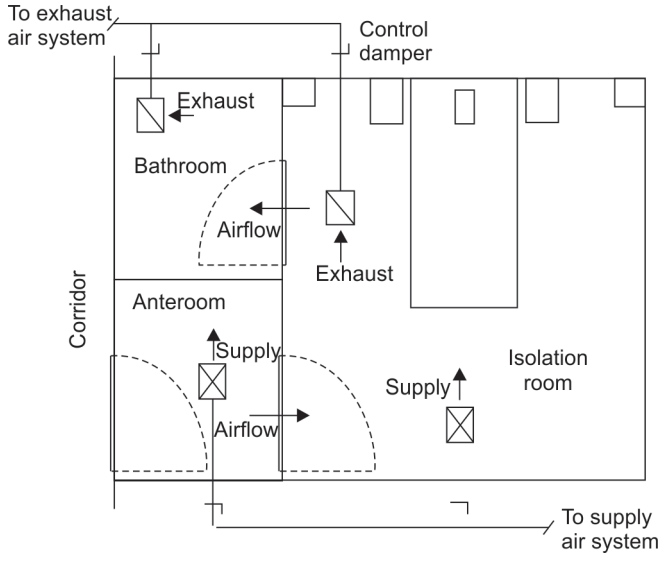


Fig. 3: Anteroom: outside and inside view (isolation room design by Thailand engineering company)[13]

Table 1: Isolation room checklist[5]

Features	*S (Standard)*	*N (Negative)*	*P (Positive)*
Non-hand operated Hand basin in room and anteroom	Yes	Yes	Yes
Ensuite (shower toilet and hand wash basin)	Yes	Yes	Yes
Pan sanitizer (near room)	Optional	Optional	Optional
Door or room with door closer	Yes	Yes	Yes
Anteroom		Yes	
Sealed room, door grilled for controlled air flow		Yes	Yes
12 ACHR or 145 liters per patient		Yes	Yes
100% outside air ventilation		Yes	
Local differential Pressure monitoring		Yes	Yes
Independent supply air[4]		Yes	
HEPA filters on supply air			Yes
Low level exhaust 150 mm above floor		Yes	Yes
Independent exhaust discharging vertically 10 m/s according to AS 1668.2 Type A exhaust[4]		Yes	
Exhaust dust under negative pressure within building with duplex fans		Yes	Optional
HEPA filters on exhaust for retrofit[3]		Optional	

2. To provide a controlled environment in which protective garments can be donned without contamination before entry into the isolation room.
3. To provide a controlled environment in which equipment and supplies can be transferred from the isolation room without contaminating the surrounding areas.

Other Requirements of Anteroom

- Provision of a sink, cabinets and work counter
- Provision of a view window in the door to the isolation room
- Alignment of door to corridor with door to isolation room
- Maximum of two isolation rooms per anteroom.

SPECIFIC DESIGN CONSIDERATIONS[6,7]

Environment control is very important in isolation facility. This is achieved by:

Maintaining air changes: A monitoring system should be provided to signal any malfunction of the supply/exhaust air system. A separation of 25 feet is recommended between exhaust from isolation rooms and other ventilation system intakes or occupied areas.[11]

1. Pressure gradient

Room type	*Room*	*Ensuite*	*Anteroom*
Class N	–ve 30 Pa	–ve 30 Pa	–ve 15 Pa
Class P	+ve 30 Pa	+ve 30 Pa	+ve 15 Pa
Class P room with negative pressure anteroom	+ve 15 Pa	+ve 30 Pa	+ve 15 Pa

2. Planned and unplanned leaks—rooms are well-sealed for better maintenance of pressure gradients that will also eventually reduce load on the air handling plant. Ensure air tightness by
   - Properly constructing windows, doors, and intake and exhaust ports
   - Maintain plasterboard ceilings that are smooth and free of fissures, open joints and crevices
   - Sealing all penetrations on the walls above and below the ceiling
   - Monitoring for leakage and making any necessary repairs.
3. Proper room pressurization can be checked using a smoke stick or smoldering match at doors held open approximately 1/4 inch to visually see which direction air is moving. Care must be taken when checking this to make sure that the door is not moving during the test since a door swinging can move more air than the design ventilation differential in the room. An alarm system (visual/audible) should be installed to warn of pressurisation failure.
4. *Thermal comfort*: Isolation rooms have relatively high air exchange rates in relation to other patient rooms. This implies high ventilation air supply and exhaust rates as well. Potentially uncomfortable air velocities (draughts) within the patient room can result, and therefore special attention must be given to thermal comfort, particularly for the patient, as a design issue.
5. *Air distribution (Fig. 4)*[12]
   - Air distribution systems should be designed to provide a high effective ventilation rate. The design and balance of the ventilation system should ensure that air flows from less contaminated to more contaminated areas. Air in an open

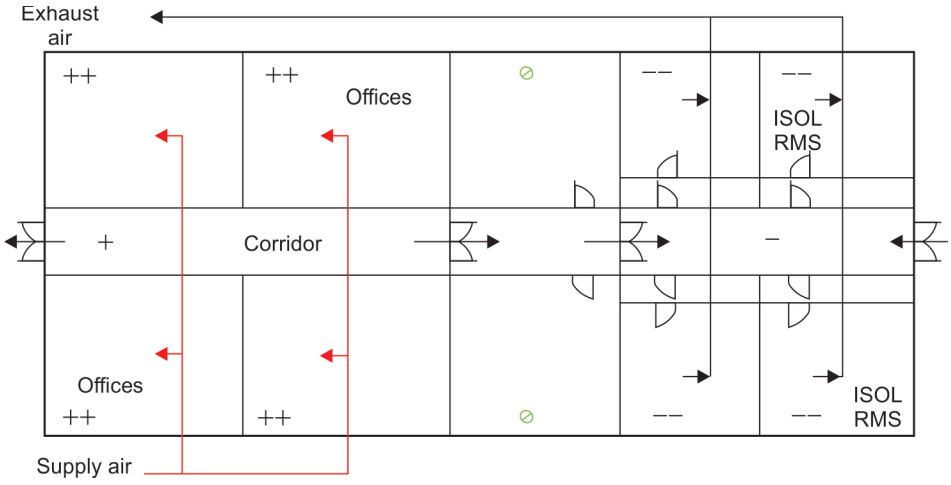


Fig. 4: Air distribution pattern (adapted from HVAC design for healthcare facilities by CED engineering)[12]

class N room, for example, should flow from corridors into the isolation room to prevent the spread of airborne contaminants from the isolation room to other areas. Within the room, the air should follow similar principles:

- In a class N room, the air should pass over first the staff then the patient
- In a class P room, the air should pass over first the patient then the staff
- Air distribution should reduce the staff's exposure to potential airborne droplet nuclei from infectious patients, accounting for the positions of the staff and the patient, and the procedures undertaken in the isolation room.

Renovating or Converting a Room (Appendix-2)

When an isolation room is being incorporated into an existing facility, it is rarely possible to create the ideal room. Physical and financial factors often constrain the construction. It is critical to create a room that is fit for its purpose; therefore, the design intent should be adhered to as closely as possible.

When converting existing accommodation into class N rooms, the easiest and least expensive option is to adapt existing single rooms with ensuite facilities. The following requirements should be met in any conversion:

- Furnishing and fittings:
- Clinical hand wash basin with non-touch, fixed temperature mixer tap
- Wall-mounted soap dispensers
- Disinfectant hand rub dispensers
- Disposable towel holders
- Glove dispensers
- Storage for clean personal protective equipment
- Clean waste bins
- Observation window in corridor wall with integral privacy blinds
- Investigate the use of a pressure stabilizer above the bedroom door
- Compliant exhaust system
- Compliant air supply (see below)
- Sliding transfer grille in room door
- Sealed, monolithic ceiling with sealed access panels
- Windows to the exterior to be locked shut and sealed
- Provision of two-way intercommunication system between the patient's room and the nurses' station.

Fire Strategy

- The isolation suite is intended to be built as a single fire compartment (Fig. 5).[9] The positive pressure in the lobby will detect smoke originating in the corridor from entering the room. Smoke from a fire in the room will be contained within the suite and extracted via the en-suite extract. Because of this the ventilation system serving the isolation facility should be kept running in the event of a fire.
- Ductwork thickness should be such that ducts can be considered an extension of the isolation suite. Fire dampers, where the ducts penetrate walls and floors will not then be required.
- A motorized smoke/fire damper should be fitted at the discharge of the supply air handling unit (AHU). The damper should close in the event of an AHU or intake fire under the control of a smoke detector mounted in the AHU.

CONCLUSION

The physical design of a hospital is an essential component of its infection control measures to minimize the risk of transmission of any infectious disease. Today, with a more progressive outlook, it is the fundamental requirement to adopt a holistic view of the design and management of hospitals.

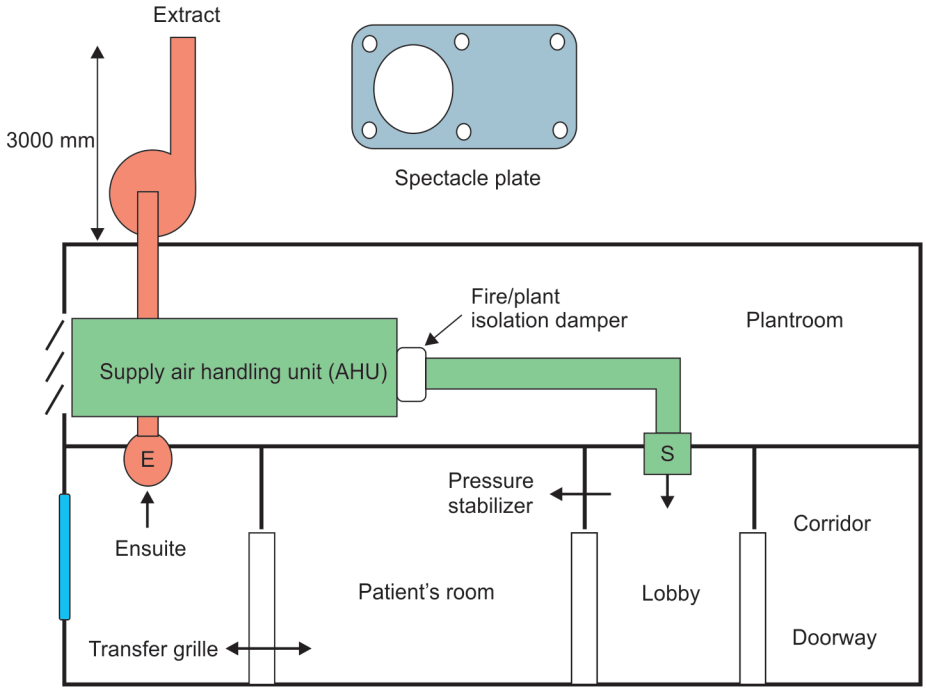


Fig. 5: Fire control (NHS estates health building note)[9]

With the challenges of new and emerging infectious diseases as well as higher public expectations and awareness of healthcare related issues, much consideration has to be given to these in the planning phase of building hospitals. For existing institutions and hospital buildings, renovation and upgrading plans must incorporate the necessary changes. Among the various methods for infection control two important environment factors are isolation and ventilation. Infected patients or those highly susceptible to infection need to be isolated in private rooms with proper ventilation systems in order to stop spread and reduce the possibility of developing a new infection. The more stringent guidelines stress the importance of utilizing an engineering team that has experience in designing the mechanical systems for AII rooms. Collaboration between the mechanical engineer and architect early in the design process is essential in avoiding issues that may arise relating to the placement of supply and exhaust locations and maintaining the standard pressure differential.

Appendix I

Newly built single isolation room with anteroom (NHS estates health building note) (Fig. 6).[9]

Minimum Requirements

1. Clinical hand washbasin with non-touch, fixed temperature mixer tap.
2. Provide suitable extract fan.
3. Install transfer grille to en-suite door.
4. Supply air.
5. Pressure stabiliser.
6. Observation window in corridor wall with integral privacy blinds to allow for staff observation and patient views out.
7. Double door for personnel and bed access.
8. Disposable apron dispenser.
9. En-suite WC to be non-touch flush and wash basin to have single tap with flow and temperature control.
10. Ceiling to be sealed solid construction, external window to be sealed.

Appendix II

Upgrading three existing single rooms to provide two single rooms with anteroom in common (NHS estates health building note) (Fig. 7).[9]

Minimum requirements to upgrade existing facilities.

1. Add clinical hand-wash basin with non-touch fixed temperature mixer tap.
2. Provide suitable extract fan.
3. Install transfer grille to ensuite door.
4. Observation window in corridor wall with integral privacy blinds to allow for staff observation and patient views out.
5. Ensuite WC to be non-touch flush and wash basin to have single tap with flow and temperature control.

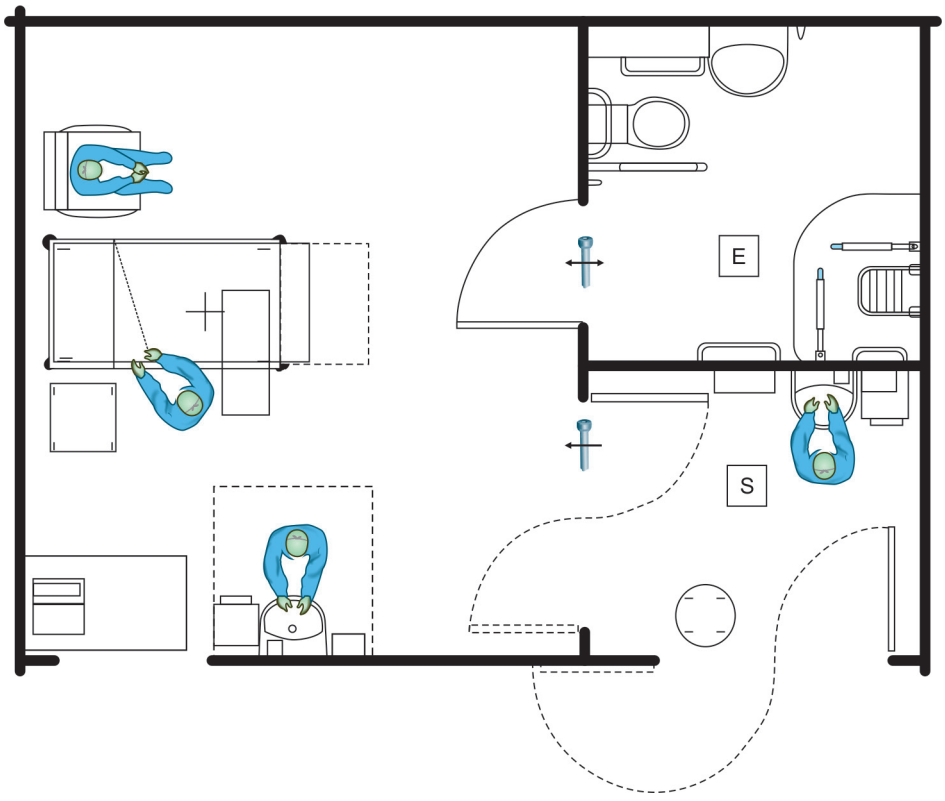


Fig. 6: Newly built single isolation room with anteroom (adapted from NHS estates health building note)[9]

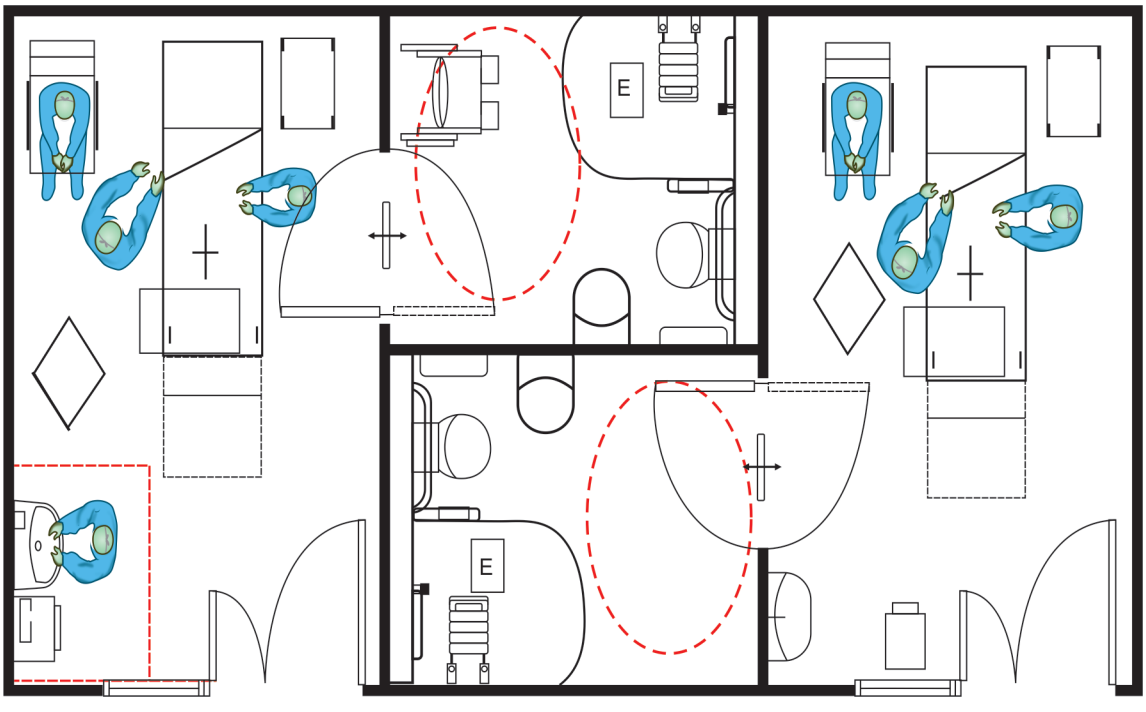


Fig. 7: Upgrading existing rooms into isolation room with anteroom (adapted from NHS estates health building note)[9] instead of existing bedrooms

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