

Original Research Article

Resource optimization through process re-engineering of inhalational therapy unit at a tertiary care public hospital

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ABSTRACT

Background: Salaries, supplies and machinery account for bulk of public funding necessitating efficient utilisation. Studies suggest that process re-engineering helps improve cost, quality, service, and speed. Disbanded once and re-commissioned, a centralized Inhalational Therapy Unit (ITU) banked and provided portable mechanical ventilators to the inpatient wards. A demand for new ventilators from ITU led to the present study involving its critical review and cost analysis.

Methods: An interventional study was conducted at a large tertiary care public hospital in India from April 2015 to June 2015. Critical review of process of providing portable ventilators and cost analysis were conducted. Review of records of and interview with ITU personnel and nursing staff were carried out. Fundamental rethinking and radical redesign of the process was done with attention to human resource, costs, space and actual medical equipment utilization. Two fundamental questions of process re-engineering were deliberated upon: "Why do we do what we do?" "And why do we do it the way we do?" Fundamental rethinking for new process was organized around the outcome.

Results: Average utilization coefficient was 6.2% (3.3% to 12.1%). Ventilators utilized per day were 1.43. Expenditure on salaries was INR 315000 per month and INR 10500 per day. Low utilization offered low value for expenses incurred. All activities in ITU focused on "provision of ventilators" (outcome) and the old rule was, "If one needed a ventilator one must contact ITU". Since nurses were using the "outcome" and performed activities of arranging, they were handed-over the ventilators (based on utilisation patterns). ITU was disbanded, human resource and space were re-allocated to various hospital areas (costs tied were done away with) with no adverse effect on hospital functioning.

Conclusions: Process re-engineering led to improved healthcare delivery, curtailed delays in hospital processes, optimised costs involved in human resources and medical equipment.

Keywords: Equipment and supplies utilization, Hospital costs, Hospital personnel, Process re-engineering

INTRODUCTION

Transport ventilators are among core/ priority medical equipment considered necessary for treatments carried out in most health care facilities.^{1,2} Medical equipment as

such represent approximately 9% of the healthcare market.³ In many countries there is a shortage of qualified clinical engineers and biomedical equipment technicians.⁴ Having some lower level general staff to undertake less technical work is acceptable, but most of the maintenance

staff will need to have electronics training and an understanding of the functioning of test equipment, concepts of electronic calibrations and the operating principles of the medical equipment in order to do the job effectively.⁴ The bulk of public funding goes for wages and salaries of employees in public facilities (an estimated 70% of public budgets in India), in lieu of the financing of technologies or advanced services (12% of budgets for drugs and supplies, 8% for machinery and equipment in India).⁵ Hence this calls for efficient utilization of both the human resource and medical equipment.

Conceptual framework of process re-engineering

Re-engineering is the fundamental rethinking and radical redesign of process to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed. It means tossing aside old systems and starting over. It involves going back to the beginning and inventing a better way of doing work.⁶ At the heart of re-engineering is the notion of discontinuous thinking-of recognizing and breaking away from the outdated rules and fundamental assumptions that underlie operations.⁷ That means neglect all existing structures around the procedures, inventing new ways to end, accomplish work and get the job done in record time. Re-engineering is the re-renewal of the process and starts with assumptions and does not take anything for granted.⁸ It addresses process redesign, emphasizes project management and organizational issues, and focuses on information technology.⁹ It involves discovering how processes currently operate, how to redesign these processes to eliminate the wasted or redundant effort and improve efficiency and how to implement the process change in order to gain competitiveness. It is seeking to invent new ways of organizing tasks, people and redesigning IT systems so that processes support the organization to realize its goals.¹⁰

Redesigning processes can lead to remarkable improvements in performance and customer service.¹¹⁻¹³ Patients are increasingly informed, questioning, cost-conscious, technologically savvy, and demanding and therefore, practice success is linked to re-engineering operations to offer consumers and patients greater choice, control, autonomy, and service.¹⁴ It positively improves delivering speed of service organizations.¹⁰

The broad principles of re-engineering focus on organizing around outcomes, not tasks; having those who use the output of the process perform the process, subsuming information-processing work into the real work that produces the information, treating geographically dispersed resources as though they were centralized, linking parallel activities instead of integrating their results, putting the decision point where the work is performed, and building control into the process and capturing information once and at the

source.⁷ Various steps of process re-engineering are hereby enumerated (Table 1).⁹ Enterprise-wide collaboration is key to successful re-engineering when employees from clinical operations, process improvement, finance and health information management join forces with physicians.¹⁵ Computer simulation can assist re-engineering.¹⁶

Table 1: Steps of process re-engineering.⁹

S. no.	Step
1	Recognize the need for change
2	Collect and analyse data
3	Analyse process and operations
4	Revise process and operations
5	Revise information technology
6	Revise the physical setting
7	Evaluate
8	Sustain improvement

The Process Re-engineering Life Cycle (PRLC) has been described by Guha et al (Figure 1).

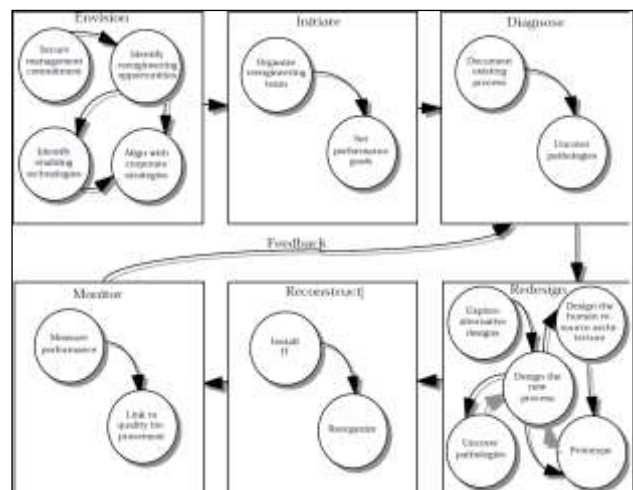


Figure 1: Graphical description of the PRLC approach.

In the hospital under study, although adequate ventilators were provided in all treatment areas, transport ventilators were used for transferring patients in/ out of the critical and non-critical areas or between emergency and other wards or ICUs. This was partly done due to cumbersome nature of ICU ventilators posing difficulties for shifting, and partly due to ownership and maintenance issues. For this, an Inhalational Therapy Unit (ITU), a “centralized facility” existed which banked and provided mechanical ventilators to all wards of main hospital and all super-specialty Centres of the Institute. It comprised of two rooms in one of the inpatient floors of the hospital and was equipped with 30 transport mechanical ventilators procured in 1994 by ITU and run by technicians supported by hospital attendants. The ITU was first commissioned in 1965, under the Department of

Anaesthesia. Low utilization rates led to closure of the facility in 1976 and the staffs were shifted to serve in manifold services. It was re-commissioned in 1994. These ventilators had basic settings. A demand was received for procuring 20 new ventilators. The existing ventilators were retained in view of functional status. In view of the history of the ITU and new requirements, a study was done to analyse the process and cost involved in providing ventilators, utilization and process re-engineering was contemplated.

METHODS

Study design was interventional. The study settings were the centralized Inhalational Therapy Unit (ITU) and the inpatient wards of a large tertiary care public hospital in India. The ITU banked and provided portable ventilators to inpatient wards required during patient transfers. The study period was over a period of three months from April 2015 to June 2015. The study population was all personnel and portable ventilators in the ITU and nurses of inpatient wards that contacted the ITU for arranging portable ventilators in their inpatient wards. Inclusion criteria were all personnel posted in ITU and nurses of inpatient areas involved in arranging ventilators. Functional ventilators were included in the calculations. There were no exclusion criteria. A team of resident doctors from Department of Hospital Administration was selected. It conducted a critical review of the process flow of providing portable ventilators along with cost analysis. Review of records in ITU and wards and interview with ITU personnel and nursing staff were carried out. Actual utilization (in hours), inpatient ward utilization pattern and utilization coefficient for a period of 14 months from January 2014 to February, 2015 were calculated.

Analysis was done using Microsoft Excel spreadsheet. The results were deliberated upon, fundamental rethinking and radical redesign of the process was done following the various steps of process re-engineering with attention to the costs related to human resource, actual medical equipment utilization, speed of providing ventilators and space used. Intervention: Two fundamental questions of process re-engineering were studied: “Why do we do what we do?” “And why do we do it the way we do? New process by fundamental rethinking was organized around the outcome, i.e. ‘provision of ventilator’, user and decision point.

RESULTS

Utilizations coefficients

During the study period, 24 ventilators were functional which were included in the calculations. The utilization coefficient across the various months ranged from 3.3% to 12.1% with an overall average of 6.2% (Table 2). The total instances of ventilators utilized were 608, average number of ventilators utilized per month were 43 and

average number of ventilators utilized per day were 1.43. Ward wise maximum utilization revealed that ventilators were mostly demanded from the Medicine ward.

Table 2: Monthly utilisation coefficient of portable ventilators.

Month	Utilisation (hours)	Available hours	Utilisation coefficient
January-14	2153	17856	12.1
February-14	584	16128	3.6
March-14	1314	17856	7.4
April-14	573	17280	3.3
May-14	1146	17856	6.4
June-14	920	17280	5.3
July-14	885	17856	5.0
August-14	833	17856	4.7
September-14	743	17280	4.3
October-14	922.5	17856	5.2
November-14	1316	17280	7.6
December-14	1105	17856	6.2
January-15	1031	17856	5.8
February-15	1640.5	16128	10.2
	15166	244224	6.2

Process flow

As per the existing system that operated with the ITU, the process initiated with call to ITU (Figure 2). It was evident that in case the ventilator was not available with the ITU, the same were made available form one of the wards of the hospital. Thus, ITU positioned itself as an added step in provisioning of the ventilators contributing as a delay point. Human Resource: There were nine personnel deployed for the ITU which included three technical assistants, one technician and five hospital attendants. Expenditure incurred on ITU personnel salary worked out to be INR 315000 per month and INR 10500 per day.

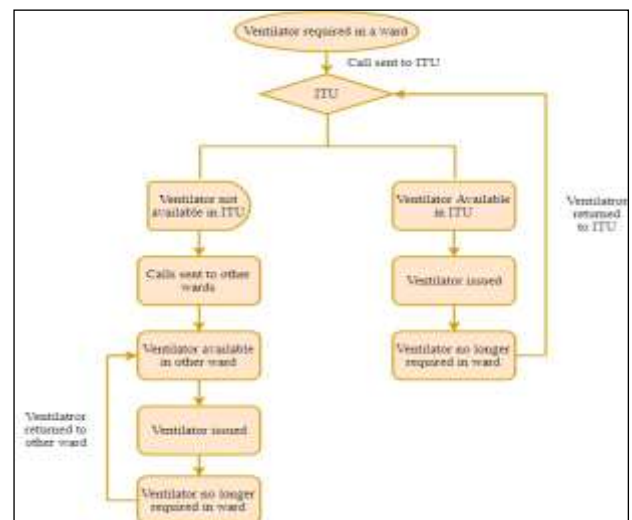


Figure 2: Process flow-ITU functional.

Intervention

After aforementioned analysis, two fundamental questions of process re-engineering were studied: “Why do we do what we do?” “And why do we do it the way we do?”⁶ Here, all activities were directed towards provision of ventilators in a hospital ward. Since ITU existed, all calls were first made to it. So, the old rule was, “If one needs a ventilator one must contact ITU”.⁷ New process was organized around the outcome, i.e. ‘provision of ventilator’. Fundamental rethinking was based around the outcome. Since nurses were using the output they were tasked with performing activities of arranging portable ventilators, these were handed over to nurses. Radical redesign provided an option wherein all the ventilators available with ITU could be distributed to various wards where these are needed under the custody of nurses. The allotment to various wards was based on utilizations on actual basis. Thus, the requirements were

expected to decrease drastically as wards having maximum demand were handed over those ventilators. Information of the distribution was made available to all wards through nurse administrators. In case of any requirement from other wards having lower requirement, the nurses could arrange the ventilators from the areas where ventilators were distributed just as they arranged any other consumable required but not immediately available in their ward.

The various principles of re-engineering were implemented by focusing on the outcome, user of the output, information production and putting decision point where the work is performed (Table 3). This eliminated the requirement of the ITU, and a lag incorporated due to checking availability with the ITU. As regards the demand for procuring 20 new ventilators, since newer high technology ventilators were available in the market, the same were provided to the wards later on.

Table 3: Modes of implementing principles of re-engineering.

Principles of re-engineering ⁷	Principles implementation modes
Organising around outcomes, not tasks	New process was organised around the outcome, i.e. ‘provision of ventilator’.
Having those who use the output of the process perform the process	Nurses were using the output and they were given the ventilators and were tasked with performing activities of arranging these.
Subsuming information processing work into the real work that produces the information	Nurses now did not maintain records as they had ventilators with them.
Treating geographically dispersed resources as though they were centralised	Various wards dispersed were considered as though ‘it’ was a centralised entity.
Linking parallel activities instead of integrating their results	ITU was unaware that a nurse may be arranging a ventilator parallel from another ward. New process made this redundant.
Putting the decision point where the work is performed, and building control into the process	The decision point was with the nurse of the ward where it was required, and control was in-built as ventilator was loaned.
Capturing information once and at the source	Information was captured in the ward that provided ventilator on loan.

Human resource and facility

After disbanding the ITU, the personnel were redistributed to other areas thereby vacating the facility for other use and thus optimizing resources involved.

Process flow

Process re-engineering reduced the steps involved and ITU no longer required (Figure 3). The calls will be sent to other ward directly in case a portable ventilator is not available in their inpatient ward. The numbers of such calls are expected to be lower as re-allocation of the portable ventilators was based on utilization.

DISCUSSION

The study demonstrates that process re-engineering eliminates delays in hospital service, facilitates resource optimization which includes medical equipment, space and human resource as well. Re-engineering can and has been applied to practically every domain of healthcare delivery. A multicenter study involving re-engineering of adult critical care by ICU telemedicine resulted in improving adherence to ICU best practices, reducing response times to alarms, and encouraging use of performance data, and was associated with lower mortality and length of stay.¹⁷ Similarly re-engineering of processes on preoperative verification, site marking and time-out in operating theatre have also been done.¹⁸ Re-

engineering of clinical operations in a medical practice have led to optimization of management of anaemia of chronic kidney disease.¹⁹ Re-engineering of outpatient billing process which replaced a traditional cash billing service with smartcard billing service demonstrated convenience for patients and reduction in waiting time by at least 8 minutes.²⁰ During process re-engineering of an outpatient pharmacy, it was found that pharmacists were hindered in filling prescriptions due to reasons such as the preparation of certain prescription units, menial sorting of medicines and storage issues related to medicines.

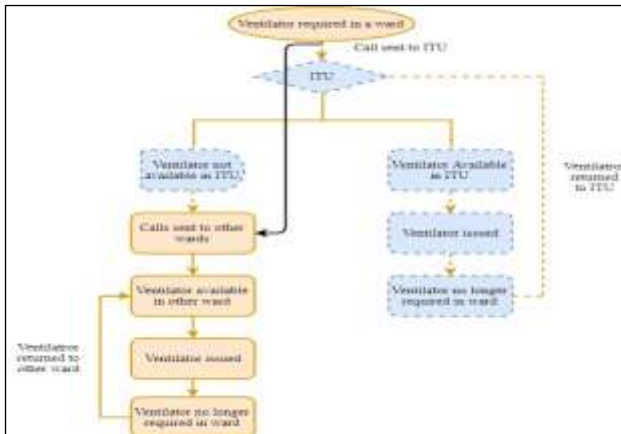


Figure 3: Process flow-ITU disbanded.

It suggested improving the process could decrease time wasted by 10.41% and enhance service by 8.95%. Shortening waiting times is the most obvious and effective method of increasing service quality.²¹

Managing hospital supplies using process re-engineering led to the design, development, and implementation of an IT-based re-engineered and integrated purchase and inventory management system. The new system led to saving of about 8% of annual costs of purchases and improved the availability of materials to the user departments.²²

In this study, although utilization coefficients are generally not calculated for life-saving medical equipment, it was done in our study as it involved cost containment by process redesign and not by reducing the absolute quantity of the equipment. A low overall average of 6.2% indicated that ITU contributed more towards logistical difficulties than positively affecting utilization. Another study revealed that utilization of high-technology medical equipment such as CT and MRI was 6.78% and 1.87% respectively.²³ In a study in India, utilization of dentistry equipment was above 50% (range 7.14% to 92.86%).²⁴ Utilization of diagnostic equipment in a study at a tertiary healthcare setup of Chandigarh was 60.2%.²⁵

The study concludes that process re-engineering leads to improved healthcare delivery, curtails delays in hospital

processes, optimizes or reduces costs involved in human resources and medical equipment. It will be of immense benefit in resource constrained secondary care hospital settings having limited availability of equipment. Such exercises carried out regularly can reduce waste and maximize value in higher centers. The study is limited by the fact that data on time wasted in arranging a ventilator, follow up utilizations and its impact on patient outcome were not studied and are areas opened for further research.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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