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Original Article

Life cycle costing as a decision making tool for technology acquisition in radio-diagnosis

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ABSTRACT

Background: Life cycle costing analysis is an emerging conceptual tool to validate capital investment in healthcare.
Methods: A preliminary study was done to analyze the long-term cost impact of acquiring a new 3 T MRI system when compared to technological upgradation of the existing 1.5 T MRI system with a view to evolve a decision matrix for correct investment planning and technology management. Operating costing method was utilized to estimate cost per unit MRI scan, costing inputs were considered for the existing 1.5 T and the proposed 3 T machine. Cost for each expected year in the life span of both 1.5 T and 3 T MRI scan options were then discounted to its Net Present Value. Net Present Value thus calculated for both the alternative options of 1.5 T and 3 T MRI machine was charted along with various intangible but critical Figures of Merit (FOM) to create a decision matrix for capital investment planning.
Result: Considering all fixed and variable costs contributing towards assumed operation, unit cost per MRI procedure was found to be Rs. 4244.58 for the 1.5 T upgrade and Rs. 6059.37 for the new 3 T MRI machine. Life Cycle Cost Analysis of the proposed 1.5 T upgrade and new 3 T machine showed a Net Present Value of Rs. 42,148,587.80 and Rs. 27,587,842.38 respectively.
Conclusion: The utility of life cycle costing as a strategic decision making tool towards evaluating alternative options for capital investment planning in health care environment is reiterated.

Introduction

Twentieth Century has witnessed exceptional advances in technology which has brought scientific marvels into hospitals with unprecedented demand on medical services, particularly in areas such as surgery, clinical laboratory and radiological services.[1] These advances are continuing at an accelerated pace in the twenty-first century too.

Health has remained priceless since time immemorial and technological advances have made modern medicine more desirable. In an era of limited resources and unlimited demand for health care, health economists tend to weigh benefit against cost when making informed choices. Those

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responsible for allocating resources will need to prioritize between competing claims so that maximum benefit can be obtained from a given budget.[2]

Most clinicians remain profoundly uninterested in medical economics as the perspective of the economist regarding medical necessity and other societal concerns is frequently at odds with the traditional role of the physicians. While the physicians have in recent years acknowledged the desirability of providing more cost-effective medical care, this theoretical goal is infrequently attained in practice due to absence of adequate financial data in respect of alternative diagnostic and therapeutic strategies.[3] Economics does not provide answers or make it easier to take better medicine, but it does clarify how to ask the questions to make decisions more rational and more consistent.

Capital investment decisions will always be difficult to make and medical decision rules for allocation of resource will remain a challenge in the face of competing claims for the "latest and greatest technology" at a time of dwindling resources and increasing competition. A need exists to analyze the down-stream cost impact of a system due to its utilization, maintenance and support across its planned life-cycle while deciding on acquisition of high-end technology. Unfortunately, not much work seems to have been done on the utilization of life cycle costing methodology for capital investment decisions in acquiring high-end healthcare technology, as manifested by a singular lack of publications on the subject.

The present study was conducted in a tertiary care and teaching institution to analyze the long-term cost impact of acquiring a new 3 T MRI scan system when compared to technological upgradation of the existing 1.5 T MRI scan with a view to evolve a decision matrix for correct investment planning and technology management.

Materials and methods

An observational study was carried out for a period of 1 month at the MRI Scan center of a tertiary care and teaching intuition, the center at present housing one 1.5 T MRI Scanner. The center is in the process of finalizing a procurement plan for one new 3 T MRI scanner to replace the existing 1.5 T machine. As an alternative plan, the original manufacturer of the equipment has agreed for a complete up-gradation plan of the existing 1.5 T machine, changing its entire software for an improved version and extending its operational life by eight more years.

Operating costing method was utilized to estimate cost per unit MRI scan, the method being found to be particularly suitable for costing studies in service organizations.[4] While calculating the unit scanning cost, the costing inputs were considered for the existing 1.5 T and the proposed 3 T machine, necessary inputs being obtained by direct observation, perusal of documents, quotations received from the manufacturer and interview with staff. Cost inputs were initially divided into two broad categories, namely fixed and variable cost based on the variability of the cost factor with variation in the level of activity of the center. Total cost for functioning of the MRI scan center for both the options (1.5 T and 3 T) was calculated and then divided by the total number of expected procedures to be performed to arrive at the cost per unit procedure in respect of 1.5 T and 3 T MRI scan machines.

Volume of MRI scan to be performed by the 1.5 T machine was assumed to be the volume performed by the existing machine, whereas the number of procedures to be performed by the 3 T machine was assumed to be 10% more than the existing machine due to faster throughput of the machine.[5]

All the cost categories that have been identified during cost estimation of MRI procedures were included in the cost breakdown structure of the life cycle of both the options. For ease of calculation, 60% of all scans to be performed were assumed to be without contrast and 40% of all scans with contrast. Cost for each year of the life span of both the equipment options (8 years for 1.5 T upgrade and 10 years for the proposed 3 T machine) was then estimated by multiplying the expected number of procedures in each year with the cost of performing unit procedure for both options. All procedures per year were also multiplied by the expected revenue per scan to derive the expected benefit to be gained by the centre for both options, revenue being calculated by applying the standard rates laid down by the Regulations for the Medical Services-2010 for MRI scans with or without contrast.

Cost for each expected year in the life span of both 1.5 T and 3 T MRI scan options were then discounted to its Net Present Value (NPV), so as to be able to compare the costs associated with alternative options on an equivalent basis. A discounting value of 10% was assumed for annual compounding (10% being the assumed target rate of return) and the expected cash flow in respect of cost and benefit stream for each year of the life cycle of both options multiplied by the discounting factor (worked out from a standardized table of interest factor for annual compounding) to arrive at the present value of the cost streams concerned. Yearly inflation was not incorporated in calculating NPV as demand for healthcare has been traditionally price-inelastic.

Net Present Value thus calculated for both the alternative options of 1.5 T and 3 T MRI machine was charted along with various intangible but critical Figures of Merit (FOM) to create a decision matrix for capital investment planning.

Results

Capital Investment cost apportioned to unit MRI scans was calculated to be Rs. 1032.68 for the 1.5 T upgrade and Rs. 3310.94 for the new 3 T machine (Table 1). When all the fixed and variable costs contributing towards assumed operation of the MRI Scan centre is considered, unit cost per MRI procedure was found to be Rs. 4244.58 for the 1.5 T upgrade and Rs. 6059.37 for the new 3 T MRI machine (Table 2). Revenue for unit MRI scan by 1.5 T machine was calculated as Rs. 6200, whereas the same for the 3 T worked out to be Rs. 7077 due to higher throughput.

Life Cycle Cost Analysis (LCC) of the proposed 1.5 T upgrade showed a Net Present Value of Rs. 42148587.80 (Table 3) while similar analysis performed in respect of the 3 T new MRI scan machine showed an NPV of Rs. 27,587,842.38 (Table 4).