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Development of an activity based costing model for a government hospital

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ABSTRACT

Activity based costing (ABC) is a new age accounting system developed to overcome the limitations of traditional costing system, which in today's technologically advanced world has lost its ability to provide accurate and useful cost information often required in taking various managerial decisions, like setting of selling price, ascertaining profitability of products as well as customers, taking a make or buy decision, eliminating the non-beneficial activities, and rewarding the employees. In this paper, an ABC model is developed for a government hospital in the state of Bihar in India to quantify its various public health related services. Although, there are limited published research papers related to application of ABC model in a specific department or method of a healthcare system, none of them has investigated its scope for organization-wide implementation. The results obtained from the developed ABC model in the public hospital would provide more comprehensive and accurate cost information, and radically contribute to the hospital administration in effective planning, controlling and decision making. This paper also elucidates about various obstructions and difficulties encountered during the implementation phase of ABC model in an Indian healthcare setting.

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1. Introduction

It is imperative for a country, like India facing high fiscal deficit to think about the ways to counter it. One of the many possible ways to reduce fiscal deficit is to trim down the government expenditure wherever possible. A significant portion of the GDP (approximately 1.36%) in India for the financial year 2012-13, has been spent on healthcare sector which makes the study of cost dynamics of the public sector hospitals more important. In today's context, cost of healthcare delivery is rising gradually because of cost escalation of medical equipments, medicines, skilled manpower etc. This increased cost stretches the healthcare budget allotted to an individual unit or hospital, and throws a challenge to the hospital administration to provide high quality services with constrained resources. Therefore, it becomes crucial to understand the cost at different activity levels of a hospital in order to control the same and make a hospital more cost efficient. Traditional costing system practiced in

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majority of the government hospitals in India does not provide such information due to the reason that the product/service cost in the system is calculated using a single cost driver.

Use of a single cost driver in the traditional costing system not only thwarts calculation of the cost at various activity levels but also more often results in over-costing or under-costing of the product/service. This limitation of traditional costing system stimulates the need of application of a new accounting system, like activity based costing (ABC) which uses multiple cost drivers at different resource levels and activity levels to estimate the product/service cost. Effective implementation of ABC model in a healthcare organization provides its management more accurate and precise cost information on its different activities, which helps the administration to institute a realistic budget, recognize the inefficiencies, set the unit price of each service delivered, silhouette the customer profitability and enhance the organization's competitiveness.

In this paper, an Indian government hospital of a status of primary health center (PHC) is selected for development and subsequent implementation of an ABC model because the conventional costing system practiced in that PHC is inept or imprecise to provide accurate cost information on different indoor services and outdoor patient care amenities. Additionally, the traditional costing system also flounders to provide an insight on various cost elements related to healthcare service delivery that will facilitate efficient management decision and administrative policy making. Besides this, in present economic scenario, Government of India is under tremendous pressure to control its fiscal deficit in order to enhance the economic growth and save the nation from losing investment grade credit rating, which makes control and management of government expenditures on various priority sectors, like health, education, transport, agriculture etc. immensely critical. Therefore, the need of deployment of an ABC model in a public sector hospital is ardently felt which can help in providing high standard and cost effective healthcare support to the people of this country.

2. Literature review

Cooper and Kaplan (1988,1991,1992) elucidated the implementation of ABC model in diverse fields of manufacturing as well as service sectors, for providing more precise cost data for making suitable strategic decisions. Chan (1993) demonstrated the applicability of ABC model to estimate laboratory tests, and concluded that the application of ABC system would provide better and reliable cost information than the traditional costing system. Ramsey (1994) discussed about the implementation issues of an ABC model in a radiology department and nursing station of a hospital. Canby (1995) examined the applicability of ABC model in a hospital's X-ray department.

Udpa (1996) applied ABC model to a hospital's inpatient services, and compared the results derived from the application of ABC model with those of traditional costing system to exemplify its superiority. Edbrooke et al. (1997) analyzed the patient-related and non-patient-related costs of intensive care units using ABC methodology. Devine et al. (2000) developed a framework integrating ABC model, life cycle costing and value chain analysis in assisting healthcare providers as a mechanism for cost reduction to sustain competitiveness. Ridderstolpe et al. (2002) proposed the implementation of a model for process analysis and ABC method at a Heart Center in Sweden as a tool for administrative cost information, strategic decision-making, quality improvement and cost reduction. Lievens et al. (2003) proposed an ABC model to calculate radiotherapy costs. Cardinaels et al. (2004) highlighted that ABC system development in hospitals would largely be explained by various hospital specific factors. González et al. (2005) proposed the application of quality function deployment/benchmarking for developing an optimal ABC model using baseline information from five different Spanish hospitals. Cao et al. (2006) developed a simplified ABC model to determine the associated costs of laboratory tests while reducing the number of cost drivers used in the proposed model. Lin et al. (2007) explained the adoption of ABC methodology to profile the cost structure of inpatients with surgical procedures and identified the missing or inappropriate clinical procedures. Rajabi (2008) applied ABC model for computing the cost of different services in government

hospitals in southern Iran. Demeere et al. (2009) developed a time-driven ABC model for application in an outpatient clinic of Belgium. Cinquini et al. (2009) explored the application potentiality of process analysis and ABC model in a healthcare setting to provide usable, useful and correct information on resource consumption and processes. Shander et al. (2010) proposed an ABC model to accurately determine the cost of blood in a surgical population from a health system perspective. Gujral et al. (2010) applied ABC model to calculate the indirect cost and thus total cost per sample of various tests at a hematopathology laboratory of a government hospital. Jerico and Castilho (2010) applied ABC model to identify disinfection and sterilization processing costs for medical-hospital equipments and supplies with the help of a real time case study. Goldberg and Kosinski (2011) proposed the application of an ABC model to gastro-intestinal unit of a hospital. Dugel and Tong (2011) presented a model, which would perform ABC analysis for a retina physician practice, exclusive of its ambulatory service center and research facilities, to evaluate productivity and efficiencies of various clinical procedures and services delivered to the patients. Popesko and Novák (2011) evaluated the worldwide applicability of ABC model in healthcare sector and predicted the possibilities of application of hospital-wide ABC system. Rajabi and Dabiri (2012) examined the use of ABC methodology to calculate cost of various remedial services in hospitals. Popesko (2013) analyzed the specifics of application of ABC method in hospital management and discussed the differences in the application procedures between the manufacturing and hospital organizations .

It is observed that till date, no attempt has been made for the implementation ABC model to estimate cost of the entire range of services or activities in a hospital, including both inpatient services and outpatient care. This paper for the first time proposes the development of an ABC model to cost each and every service provided by a government hospital in India. The detailed implementation procedure of ABC model in that hospital is also presented. The derived results from the application of ABC model in a healthcare organization will help its administration to analyze its various activities for better budget allocation and resource requirement planning, initiate the cost control process while utilizing more precise and accurate cost information, take pricing decisions on various services delivered, optimize the profitable patient mix, and improve its overall efficiency while exploiting the information about unused capacity cost of the hospital. This paper also explicates the benefits of adopting an ABC model in hospitals over the traditional costing system. Further, the information extracted from the adopted ABC model is effectively utilized to benchmark the performance of doctors based on some identified cost parameters.

3. ABC model development

The accounting system of the PHC, Kahalgaon (previously known as Colgong) is selected here for the development and subsequent implementation of an ABC model. The PHC, Kahalgaon is a state government hospital, established in 1869, catering to the medical needs of approximately 2,91,823 persons belonging to sub-district of Kahalgaon in state of Bihar in India. Its journey started as a charitable society in the 18th century providing healthcare services to the ailing patients, later the state government took this hospital under its control. Today, apart from its 30 bedded hospital in heart of the town, the PHC, Kahalgaon has nine additional primary health centers (APHC), and another 37 health sub-centers (HSC) under its control through which healthcare services are provided to the people of the surrounding region .

With recent advancement in technologies and innovation in process deliveries, significance of the traditional costing system to provide precise and reliable information on product/service cost has immensely been declined. Traditional accounting system was developed during the industrial era, when cost associated with labor hour or machine hour was used to form a considerable proportion of product/service cost. Due to this reason, more often than not, traditional costing system uses labor hour or machine hour as a single allocation base to assign overhead cost arbitrarily, which results in distortion in product/service cost estimation. So, a modern costing system, like ABC model has been

developed during the late 1980s to provide an alternative paradigm to traditional accounting system, which can provide more accurate and dependable information on product/service cost, and help the management in taking various operational, tactical and strategic decisions. The first step in developing an ABC model is identification and determination of the cost object, which is the cost of a product/service. The next phase is to recognize all activities consumed by the product/service, whereas, the third stage of ABC model is to identify the resources required for each activity. Subsequently, resources' cost is allocated to various activities using an assortment of resource cost driver, which is a gauge for the quantity of resources consumed by an activity. The final stage of ABC model is allocation of activities' cost to cost objects using multiple activity cost drivers, where activity cost driver is a measure of the frequency and intensity of demand, placed on the activities by the cost objects .

The PHC, Kahalgaon mainly provides six broad categories of health services, i.e. outdoor patient care, emergency department service, routine immunization (RI), family planning (FP) operation, institutional delivery and pulse polio (PP) vaccination. The last four services are being provided through four different national level programs run under the PHC, like RI program for RI, PP campaign for PP vaccination, FP program for FP operation, and Janani Evam Baal SurakshaYojana (JBSY) for institutional delivery. Therefore, six corresponding cost objects related to the above-mentioned health services are identified as outdoor patient care cost, RI cost, FP operation cost, institutional delivery cost, emergency patient treatment cost and PP vaccination cost. The cost object of RI consists of the total cost associated with execution of the complete RI schedule in the PHC, Kahalgaon, which includes vaccination for Tetanus Toxoid (TT), Bacillus Calmette Guerin (BCG), Hepatitis B, Diphtheria, Pertussis and Tetanus Toxoid (DPT), measles, Vitamin-A etc. On the other hand, cost object of outdoor patient care cost and emergency patient treatment cost consist of the total cost incurred in treating patients in outdoor patient department (OPD) and emergency department of the PHC respectively. Similarly, FP operation cost, institutional delivery cost and PP cost provide information on total expenditure incurred in running these national level programs in the PHC. The activities required by these cost objects are classified into seven activity pools, i.e. RI, FP, delivery department, administration, OPD, emergency department and PP. The activity pool of RI consists of all those activities needed for successful implementation of the complete RI schedule in the area covered by the PHC. The activity pool of FP includes those activities required to successfully accomplish FP operations.

The activity pool of OPD comprises of all the activities directly associated with the treatment of OPD patients, while emergency department activity pool consists of activities related to the medical treatment of patients in the emergency department. Furthermore, it is noticed that gynecology department (often also known as delivery department) is responsible for institutional deliveries, and therefore, all activities related to institutional delivery is accumulated into the activity pool of delivery department. Moreover, each and every activity required for successful accomplishment of PP vaccination campaign is put into the activity pool of PP. In addition, it is also observed that various administrative works are required to successfully implement multiple national level programs apart from delivery of regular indoor and outdoor services in the PHC. Hence, all those activities connected to administrative work are attached to the activity pool of administration. Those activity pools are further critically analyzed as the next step of ABC model development to determine different resource centers. Doctor resource cost, staff resource cost, vaccine courier, vaccine lifting, repairing of cold boxes, accredited social health activists (ASHA) under Muskaan, measles, special RI, FP resource cost, female sterilization camp, JBSY rural, JBSY urban, JBSY incentive paid to ASHA, outsourcing of pathology, vaccinator, supervisor, sub-depot holder, vehicle, ice pack, mobility, information, education and communication (IEC), contingency, cold chain handler, PP vaccine lifting, flood/extra expenses, BikramshilaMela, and Chath Puja special are identified as various resource centers required for the above-mentioned activity pools. The developed ABC model in the PHC, Kahalgaon is shown in Fig. 1.

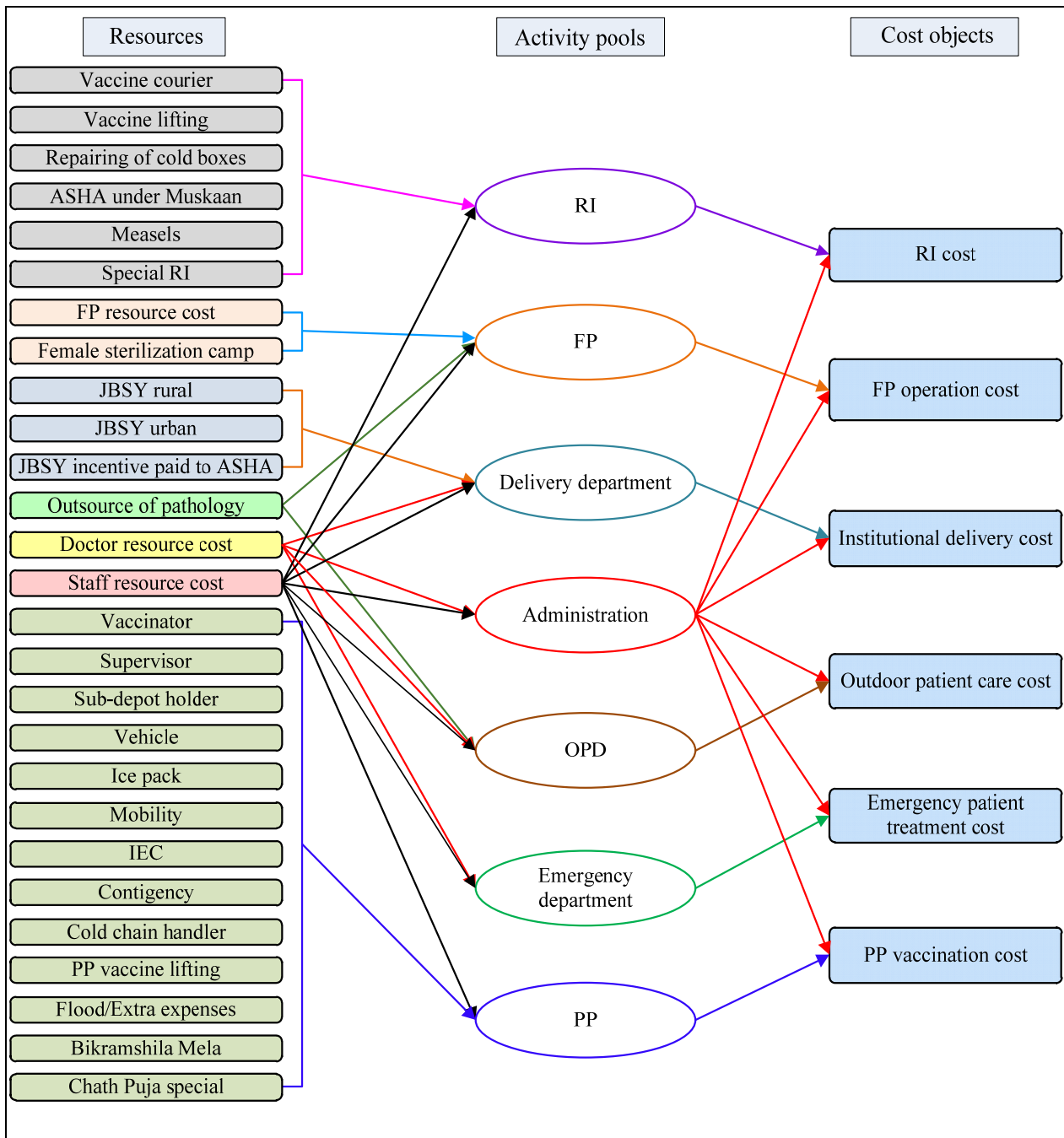


Fig. 1. Developed ABC model for a public hospital

4. ABC model implementation in a public hospital

4.1 Allocation of resource cost

As discussed earlier, initially, the resource centers' costs are assigned to various activity pools using the considered resource drivers, which are the factors chosen to approximate the utilization of resources by those activities. Then, each activity pool's cost is distributed to the cost objects through multiple activity drivers. All the relevant data required for implementation of the ABC model in this public hospital are accumulated for the financial year of 2012-13. Based on the ABC model, cost related to doctor's resource is assigned to four activity pools according to the time devoted by the individual doctor to the concerned department/activity. It is noticed that altogether 21 doctors are

working in the PHC, Kahalgaon; ten among them are placed at different APHCs, and the remaining 11 doctors are stationed at the PHC, Kahalgaon itself. Those doctors posted at the APHCs can only check and advise the OPD patients, and their salary cost allocation is made accordingly. While, the doctors serving the PHC, Kahalgaon consist of three distinct groups, i.e. male doctors, female doctors and medical officer-in-charge (MOIC). Male doctors are assigned with the duties of OPD and emergency department, whereas, female doctors are entrusted with the responsibilities of OPD and gynecology department (delivery department). The doctor at the position of MOIC has the responsibility of administrative functionalities besides his/her normal assigned duties. It is estimated that the total time devoted by all the doctors in OPD in the year 2012-2013 is 1818 hours. The total working hours per year devoted to three other departments vary for each individual doctor, and is traced down from their respective scheduled duty charts. These time allocations to various departments are then transmuted into monetary units by changing the individual doctor's time dedicated to each department into time equivalent cost. It is calculated that the total doctor's resource costs assigned to four activity pools are Rs.67,16,825 in OPD, Rs. 23,63,779 in emergency department, Rs.12,22,213 in delivery department and Rs.1,00,895 in administration respectively for the considered year. A detailed allocation of doctor's resource cost to various activity pools is shown in Table 1.

Table 1
Allocation of doctor's resource cost to different activity pools

Doctor	Doctor cost/hr = Annual salary/total scheduled duty hrs in a year (Rs./hr)	Doctor's resource cost in OPD/yr (Rs.)	Doctor's resource cost in emergency department/ yr (Rs.)	Doctor's resource cost in delivery dept./yr (Rs.)	Doctor's resource cost in administration /yr (Rs.)
A	162	193059	201790	-	100895
B	382	693978	476394	-	-
C	226	410740	281960	-	-
D	393	714663	490593	-	-
E	255	463246	-	742010	-
F	117	213464	146536	-	-
G	117	213464	146536	-	-
H	137	249041	170959	-	-
I	76	138368	-	221632	-
J	89	161429	-	258571	-
K	248	451284	-	-	-
L	132	240000	-	-	-
M	132	240000	-	-	-
N	132	240000	-	-	-
O	132	240000	-	-	-
P	132	240000	-	-	-
Q	132	240000	-	-	-
R	132	240000	-	-	-
S	132	240000	-	-	-
T	360	654089	449011	-	-
U	132	240000	-	-	-

Apart from doctors, various medical and non-medical staffs are having different designations and responsibilities in the PHC, Kahalgaon. Those staffs are categorized into 12 groups according to their duties (activities) performed. Among all these staffs, 13 are administrative staffs, performing their duties related to successful execution of various national level health programs. Besides this, they are also responsible for regular administrative works related to compilation of relevant information, preparation of book of accounts, reimbursement of bills etc. Therefore, the added annual salaries of all these administrative staffs of the PHC are allocated to the activity pool of administration, which approximately equals to Rs.39,23,340. Auxiliary nurse midwife (ANM) and A grade nurse form the second category of staffs in the PHC. The ANMs have again two groups, i.e. the first group is on permanent service and the other group is constituted of those ANMs, recruited on contractual basis.

The permanent ANMs and A grade nurses are delegated with the duties of delivery department, whereas, contractual ANMs offer their service to PP and RI programs. Therefore, the total of the annual remuneration to all the permanent ANMs and A grade nurses of the PHC is completely assigned to the activity pool of delivery department, which is estimated as Rs.1,82,75,988. On the other hand, the total cost incurred to the annual compensation of all the contractual ANMs adds up to Rs.49,68,000, and is allocated to the activity pools of PP and RI programs according to the proportionate number of persons vaccinated in those two programs during 2012-13 in the PHC, Kahalgaon. So, it is estimated that total ANM and A grade nurse costs allocated to the activity pools of PP and RI are Rs.39,89,304 and Rs.9,78,696 respectively.

Four persons are posted as health trainers in the PHC, and their main responsibilities include organizing programs to train the ANMs, ASHAs and other staffs engaged in various national level programs. Those health trainers also make the staffs aware of various functional changes in the national level programs from time to time. Besides it, they also shoulder the responsibilities of administrative works as needed to successfully carry out the national level programs. Therefore, the total cost related to annual salaries of the health trainers is apportioned to the activity pools of PP, RI, FP and delivery department on pro rata basis of number of persons treated/vaccinated in each of the programs/departments during the year 2012-13 in the PHC, Kahalgaon. It is calculated that the total cost related to annual salaries of all the four health trainers equals to Rs.17,83,404, from which Rs.14,16,084 is allocated to PP, Rs.3,46,004 is assigned to RI, Rs. 2,894 is allocated to FP and Rs.18,422 is assigned to delivery department. Helpers are those staffs, whose services are utilized for multi-dimensional purposes, including shifting of indoor patients from one ward to another, managing the queue of patients in OPD, assisting in distribution of medicines, performing registration of patients, and helping the patients in guiding them to different departments or assisting the patients during their stay at the PHC. The total cost associated with their annual salaries adds up to Rs.32,93,280, and it is apportioned among the activity pools of OPD, emergency department, delivery department and FP according to the proportionate number of patients treated at those departments/programs in the PHC, Kahalgaon during the considered financial year. Thus, it is observed that the total helper costs apportioned to four activity pools are Rs.1,37,829 in delivery department, Rs.54,612 in emergency department, Rs.30,79,189 in OPD and Rs.21,650 in FP respectively.

The next category of staffs in the PHC is the sweepers who are solely responsible for cleanliness of the entire hospital, and the total expenses incurred in their annual compensation are allocated to the activity pools of OPD, emergency department, delivery department and administration in accordance with the proportion of total area covered by each of them in the PHC. Therefore, it is estimated that the total sweeper costs allocated to the activity pools of OPD, emergency department, delivery department and administration are Rs. 1,23,972, Rs.35,420, Rs.1,06,261 and Rs.88,551 respectively. Employees designated as advertising and development staffs are mainly responsible for generating awareness among the people in the region of the PHC, Kahalgaon about the benefits of different national level programs, like RI, JBSY, FP and PP. Those staffs are also entrusted with the responsibilities of arranging and announcing the dates on which the national programs would be scheduled by the PHC. Various ways of communication, like distribution of pamphlets, sticking posters and banners extensively, holding road shows, and making announcements through loudspeakers are usually availed by them for this purpose. The total cost incurred on annual salaries of the advertising and development staff members is Rs.4,50,156, and it is apportioned among the activity pools of RI, delivery department, FP and PP depending on the number of patients treated/vaccinated in those departments/ programs of the PHC, Kahalgaon during the financial year of 2012-13. It is computed that the total advertising and development staff costs assigned to the four activity pools are Rs.87,336 in RI, Rs.4,650 in delivery department, Rs.731 in FP and Rs.3,57,439 in PP respectively. One staff posted as the family planning counselor in the PHC, Kahalgaon has the responsibility of motivating the local people for bilateral tubectomy and vasectomy operations for

birth control. He performs his duties in the villages and blocks nearby the PHC, and educating people regarding the benefits of family planning and advantages of small family. Therefore, the reimbursement made towards his annual salary is entirely allocated to the activity pool of FP, which equals to Rs.1,80,000. The service of a lone staff designated as the distributor of medicines is utilized by the patients of OPD, emergency department, delivery department and FP. Therefore, the cost related with his annual salary is proportionately assigned among the activity pools of OPD, emergency department, delivery department and FP based on the number of patients attended in those departments/programs of the PHC during the financial year 2012-13, and equals to Rs.3,10,028, Rs.5,499, Rs.13,877 and Rs.2,180 respectively. The workload of the operation theater (OT) assistants mainly comprises of assisting the doctors and anesthetists during the family planning operations. They are also held responsible for arranging and maintaining the operation theaters and associated medical equipments/instruments. Besides this, they are also entrusted with the responsibility of first hand treatments (like, stitching of a wound, dressing of an injury) of the patients in emergency department. The total expenditure incurred on annual salaries of the two OT assistants is estimated as Rs.5,43,036, which is further allocated to the activity pools of FP and emergency department according to the proportion of total scheduled time spent by them attending the patients admitted in the departments/programs of the PHC, Kahalgaon. It is estimated that the total OT assistant costs assigned to the activity pools of FP and emergency department are Rs.1,54,161 and Rs.3,88,875 respectively. An ophthalmic assistant helps the doctors in various eye-related clinical check-ups and tests. It is observed that it takes approximately 15 minutes per patient to perform those clinical check-ups. A total of 3900 patients have been checked up by the ophthalmic assistants during the considered financial year. The patients who need the service of ophthalmic assistants first come to OPD, where the concerned doctors used to send them to the ophthalmic assistants for various eye-related tests after completing the initial check-ups. So, the total cost incurred on annual remuneration of the two ophthalmic assistants is allotted to the activity pool of OPD commensurate with the time devoted by each of them in checking up the patients. Additionally, it is noticed that even after performing the assigned duties, some portion of the ophthalmic assistants' duty time remains unutilized. Therefore, the salary cost equivalent to the unused time of each ophthalmic assistant is allocated to unused capacity cost. Thus, it is computed that the total ophthalmic assistant cost assigned to the activity pool of OPD is Rs.1,49,408. While, the unused capacity cost which can also be labeled as opportunity cost due to underutilization of ophthalmic assistant resource adds up to almost Rs.4,06,192. A detailed analysis of the ophthalmic assistant cost is shown in Table 2.

Table 2

Analysis of ophthalmic assistant cost

Employee	Annual salary (Rs.)	Total scheduled working hs/yr (D)	Salary/hr (S) = Annual salary/total scheduled time (Rs./hr)	Number of patients (N)	Hours spent on checking patients/yr (P) (N×0.25)	Unutilized hs/yr (U) = D-P	Cost allocated to OPD = P×S (Rs.)	Unused capacity cost = U×S (Rs.)
A	285672	1818	157	2145	536.25	1281.75	84264	201408
B	269928	1818	148	1755	438.75	1379.25	65144	204784

Health workers in the PHC are bestowed with the duties of emergency department and hence, the total cost related to annual salary of the solitary staff placed in this position is allotted to the activity pool of emergency department, which amounts to Rs.3,68,700. It is also noticed that one person appointed as a driver in the PHC, Kahalgaon is now not having any assigned duty as no vehicle is allotted to him. Therefore, the total cost associated with his annual salary, which equals to Rs.3,33,348, remains unutilized and hence, is treated as unused capacity cost. So, it is estimated that the total staff resource costs assigned to seven activity pools are Rs.36,62,597 in OPD, Rs.8,53,106 in emergency department, Rs.36,16,16 in FP, Rs.40,11,891 in administration, Rs.1,85,57,027 in delivery

department, Rs.57,62,827 in PP and Rs.14,12,036 in RI respectively. It is also calculated that Rs.7,39,540 of the total staff resource cost remains unutilized under unused capacity cost.

The resource centers of FP cost and female sterilization camp are linked with family planning operation as they include compensations given to the acceptor (who gives his/her consent for vasectomy/bilateral tubectomyoperation), motivator (who motivates the person for the operation), surgeon, anesthetist, staff/nurse, OT technician, and expenditure incurred on refreshment and camp management. It is calculated that the total cost related to these two resource centers equals to Rs. 11,00,319 and it is entirely allocated to the activity pool of FP. Further, it is observed that JBSY rural, JBSY urban and JBSY incentives paid to the ASHA resource centers are associated with the delivery department. The primary objective of JBSY in the state of Bihar is to increase the percentage of institutional delivery which is abysmally low (23.2%) in comparison to the national average (41%) as reported by State Health Society, Bihar. JBSY rural and JBSY urban comprise of the enticements paid to the delivery patients from the rural and urban areas respectively, whereas, JBSY incentive paid to ASHA is the monetary inducement given to ASHA for motivating patients for institutional delivery. These three resource costs add up to Rs.60,87,200 for the considered financial year, which is subsequently allotted to the activity pool of delivery department.

Outsource of pathology cost is associated with the disbursements made to third party for their pathological tests in the PHC, Kahalgaon. It is noticed that services of pathology department are mostly utilized by the patients of OPD and FP program. Therefore, the total payout given to third party for pathological tests is proportionately allocated to the activity pools of OPD and FP according to the pathology service utilization by the patients of these two departments during the financial year. Thus, it is estimated that the total outsource of pathology costs assigned to the activity pools of OPD and FP are Rs.3,38,370 and Rs.2,379, respectively. Vaccine courier cost comprises of the total cost of transportation of RI vaccines from the PHC to different HSCs, vaccine lifting (cost of transportation of RI vaccines from the district hospital to the PHC), repair of cold boxes (in cold boxes, RI vaccines are kept), ASHA under Muskaan program consisting of total compensation paid to ASHA for conducting RI program, measles that includes the total cost of special measles immunization campaign on its sudden outbreak, and special RI for conducting special RI schedules, as traced down from the expenditure report of the PHC, Kahalgaon for the concerned year, and is explicitly attached to RI process. Hence, the total cost related to these cost heads is allocated to the activity pool of RI, which measures as Rs.8,02,073.

Similarly, the cost heads directly linked to PP campaign are also traced down from the expenditure report of the PHC for the financial year 2012-13 as vaccinator, supervisor, sub-depot holder, vehicle, ice pack, mobility, IEC, contingency, cold chain handler, PP vaccine lifting, flood/extra expenses, BikramshilaMela and Chath Puja special. The cost head of vaccinator comprises of remittances paid to PP vaccinators for their service, while supervisor cost head encompasses indemnity paid to those persons for supervising PP immunization programs. The resource center of sub-depot holder is the total cost associated with the reimbursement made to them, whereas, vehicle resource cost is the transportation cost linked with the movement of PP vaccines from the PHC to different HSCs. Additionally, it is observed that the total purchase cost of ice blocks for storing PP vaccines is embraced in the cost head of ice pack, while the resource center of mobility includes payments made to the vaccinators for traveling from one place to another to cover each and every possible household/children in their respective allotted areas.

The cold chain handler cost head is recognized as the total cost incurred on the person responsible for transporting and storing PP vaccines at the recommended temperature. The IEC resource cost consists of advertisement and communication cost related to PP campaign. In addition, the total cost associated with transportation of PP vaccines from district hospitals to the PHC is taken care of in resource centre of PP vaccine lifting. On the other hand, cost heads of BikramshilaMela and Chath Puja specially epitomize the expenditure made on special PP immunization campaigns on the

occasion of famous BikramshilaMela and Chath Puja festivals in Bihar. Although, the PP vaccinators are compensated for their service and transit from the cost head of vaccinator and mobility, but occasionally, they are required to visit flood affected areas on emergency basis in order to successfully execute PP campaigns and therefore, special allowances are provided to them from the flood/extra expenses cost head. It is also observed that there are some additional costs related to various activities under PP campaign that cannot be categorically defined under any of the cost heads as discussed above, and so they are combined together under the resource center of contingency. Therefore, it is computed that the total cost related to these resource centers linked to PP is Rs.25,31,809, which is entirely assigned to the activity pool of PP. Based on the above-developed ABC model, it is estimated that the total resource costs allocated to seven activity pools of OPD, emergency department, delivery department, FP, RI, PP and administration are Rs.1,07,17,792, Rs.32,16,885, Rs.2,58,66,440, Rs.14,64,314, Rs.22,14,109, Rs.82,94,636 and Rs. Rs. 41,12,786 respectively.

4.2 Assignment of activity costs to cost objects

As discussed earlier, the total cost associated with the activity pools of OPD, emergency department and delivery department are directly allotted to outdoor patient care cost, emergency patient treatment cost and institutional delivery cost respectively. It is so because services of OPD, emergency department and delivery department are required for providing outdoor patient care, emergency treatment and institutional delivery correspondingly. Similarly, it is acknowledged that the activity pools of RI, PP and FP constitute of those activity costs needed for successful implementation of the respective national level health care programs, and hence, the total cost related to RI, PP and FP activity pools are directly allocated to the cost objects of RI cost, PP vaccination cost and FP operation cost in that order. While, the total cost allocated to the activity pool of administration is assigned to various cost objects, i.e. PP vaccination cost, RI cost, FP operation cost, institutional delivery cost, emergency patient treatment cost and outdoor patient care cost according to the proportionate service utilization of the administrative department by those departments/programs. Therefore, it is identified that the total cost allocated to PP vaccination is Rs.10,28,197, RI is Rs. 8,22,557, FP operation is Rs.4,93,534, institutional delivery is Rs.14,39,475, emergency patient treatment is Rs.1,23,384 and outdoor patients care is Rs.2,05,639.

4.3 Benchmarking of performance of doctors using ABC model

The concept of benchmarking is employed here to standardize the performance of doctors on three different identified parameters utilizing the information extracted from implementation of the proposed ABC model in the hospital. It is an internal benchmarking process as only performances of the in-house doctors are compared here to identify the best performing doctor based on each identified parameter. Cost/patient associated with treatment of OPD patients, emergency department patients and delivery department patients are shortlisted as the three special performance criteria for the doctors. The results obtained from this benchmarking process will provide a roadmap and guidance for improvement of performance of those doctors who are lagging behind on one or more parameters. This benchmarking process can also be adopted as a compliment to the existing performance appraisal system being exercised in the hospital.

Benchmarking based on cost/patient in OPD

The necessary data for estimation of the cost/patient associated with treatment in OPD by each doctor in the PHC, Kahalgaon involves in the total cost allocated to the activity pool of OPD for the individual doctor and the respective number of patients medically checked by them. The first set of data is obtained from the developed ABC model, while the remaining information is traced down from the hospital records. A detailed calculation of cost/patient associated with treatment in OPD by each doctor is given in Table 3, while Fig. 2 exhibits the results of the Pareto analysis for performance appraisal of doctors with respect to cost/OPD patient.

Table 3
Cost/patient associated with treatment in OPD

Doctor	Total cost assigned to OPD/yr (Rs.)	Number of OPD patients/yr	Cost/OPD patient (Rs.)
A	193059	2574	75
B	693978	11644	60
C	410740	13599	30
D	714663	11082	64
E	463246	7352	63
F	213464	18666	11
G	213464	7783	27
H	249041	6491	38
I	138368	7393	19
J	161429	4088	39
K	451284	4940	91
L	240000	4621	52
M	240000	4840	50
N	240000	5168	46
O	240000	4831	50
P	240000	6317	38
Q	240000	4960	48
R	240000	5326	45
S	240000	2300	104
T	654089	6132	107
U	240000	1979	121

It is observed from Fig. 2 that doctors F, I, G, C, P, H and J contribute most with respect to deliverance of OPD patient care with minimum cost. Among those seven doctors, doctor F is the best performer, and those seven efficient doctors form a cluster which can be further benchmarked for performance analysis. An in-depth study on various activities performed by those seven doctors can reveal the best ways to perform different tasks to reduce the cost of medical service delivery by the other doctors, who are comparatively underperformers based on the above criterion.

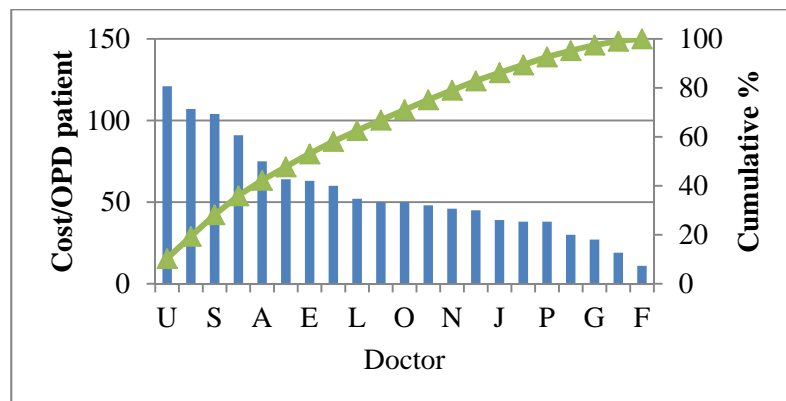


Fig. 2. Pareto analysis on the basis of cost/OPD patient

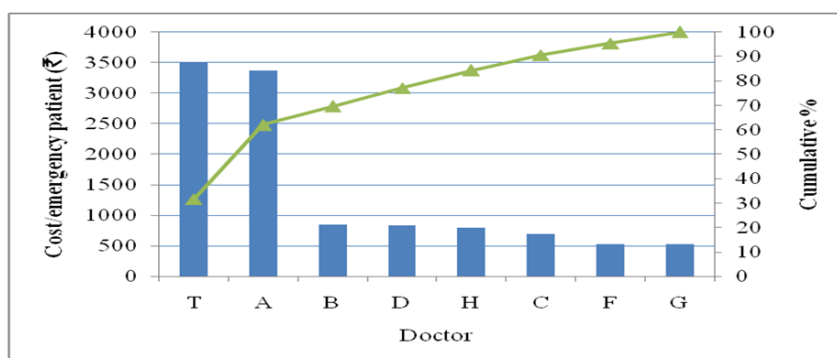
Benchmarking based on cost/patient in emergency department

In this case, cost/patient related to medical treatment in the emergency department is the performance criterion for benchmarking. In a similar manner as above, cost assigned to the activity pool of emergency department for the individual doctor is calculated from the ABC model, whereas, the emergency patient registers of the PHC, Kahalgaon provide the information on the total number of patients treated by each doctor. Table 4 shows the calculated cost/patient in the emergency department for each doctor of the hospital, while, the Pareto analysis on the performance of doctors based on cost/emergency patient is exhibited in Fig. 3.

Table 4

Cost/patient in emergency department

Doctor	Cost assigned to emergency dept./yr (Rs.)	Number of emergency patients/yr	Cost/emergency patient (Rs.)
A	201790	60	3363
B	476394	564	845
C	281960	408	691
D	490593	588	834
F	146536	276	531
G	146536	280	523
H	170959	216	791
T	449011	128	3508

**Fig. 3.** Pareto analysis on cost/emergency patient

It is observed from Figure 3 that performance of two doctors (T and A) with respect to cost/emergency patient needs to be monitored with the intention of realigning it with the government's vision of providing high standard health service to all at the least possible cost. It is further noticed that doctor G is the best performer, followed by doctors F and C with respect to the considered criterion, and therefore, their performance can be benchmarked.

Benchmarking based on cost/patient in institutional delivery

As already discussed that the female doctors are mainly entrusted with the duty in the delivery department, therefore, their performances are only compared to set the benchmark. So, the delivery registers of the PHC, Kahalgaon are reviewed to extract the information on number of deliveries made under each female doctor, while the total cost assigned from each female doctor's salary to the activity pool of delivery department is obtained from the developed ABC model. The cost/patient related to institutional delivery by each doctor is estimated, as given in Table 5.

Table 5

Cost/patient in institutional delivery

Doctor	Total cost assigned to delivery department/yr (Rs.)	Number of delivery patients/yr	Cost/delivery patient (Rs.)
E	742010	2196	338
I	221632	3096	72
J	258571	1068	242

Additionally, a Pareto analysis on the performance of female doctors on the basis of cost/delivery patient, as shown in Figure 4, reveals that the performance of doctor I is exceptionally better than the other two doctors. Therefore, the performance of doctor I can be benchmarked, and subsequently, it can contribute in the efficiency enhancement of the other two doctors, highlighting the thrust area to be addressed.

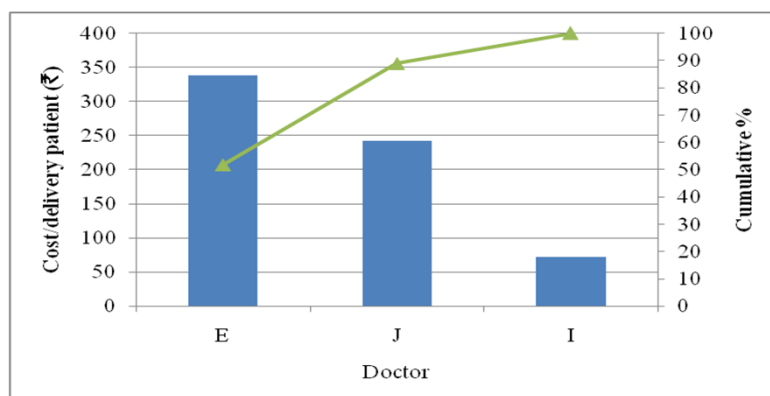


Fig. 4. Pareto analysis on cost/delivery patient

5. Results and discussions

The results elicited from the application of the proposed ABC model estimate the annual cost data of the hospital, as shown in Table 6.

Table 6

ABC-based results of annual cost in PHC, Kahalgaon for financial year 2012-2013

Cost object	Amount (Rs.)
Outdoor patient care cost	1,09,23,431
Emergency patient treatment cost	33,40,269
Institutional delivery cost	2,73,05,915
RI cost	30,36,666
PP vaccination cost	93,22,833
FP operation cost	19,57,848
Unused capacity cost (opportunity cost)	7,39,540

According to the proposed ABC model, cost/patient expended on medical treatment/vaccination in OPD, emergency department, FP, delivery department, RI and PP are calculated while dividing the total cost allocated to the corresponding cost objects of outdoor patient care cost, emergency patient treatment cost, FP operation cost, institutional delivery cost, RI cost and PP vaccination cost by the number of patients treated/immunized in the respective department/program during the considered financial year.

Table 7

Cost/patient for medical treatment/vaccination

Activity	Cost/patient (Rs.)
Treatment of OPD patients	77
PP immunization	19
Institutional delivery	4293
FP operation	1960
RI vaccination	25
Treatment of emergency patients	1326

Table 7 provides the cost/patient for medical treatment/vaccination in various departments/programs of the PHC, Kahalgaon, as derived from the ABC-based analysis. Based on the traditional costing system, cost/patient for institutional delivery is estimated by adding up the incentives paid to ASHA and mothers through JBSY. Similarly, cost/patient for FP operation is computed by adding up the compensations given to the acceptor, motivator, surgeon, anesthetist, staff/nurse, OT technician, and expenditure incurred on refreshment and camp management.

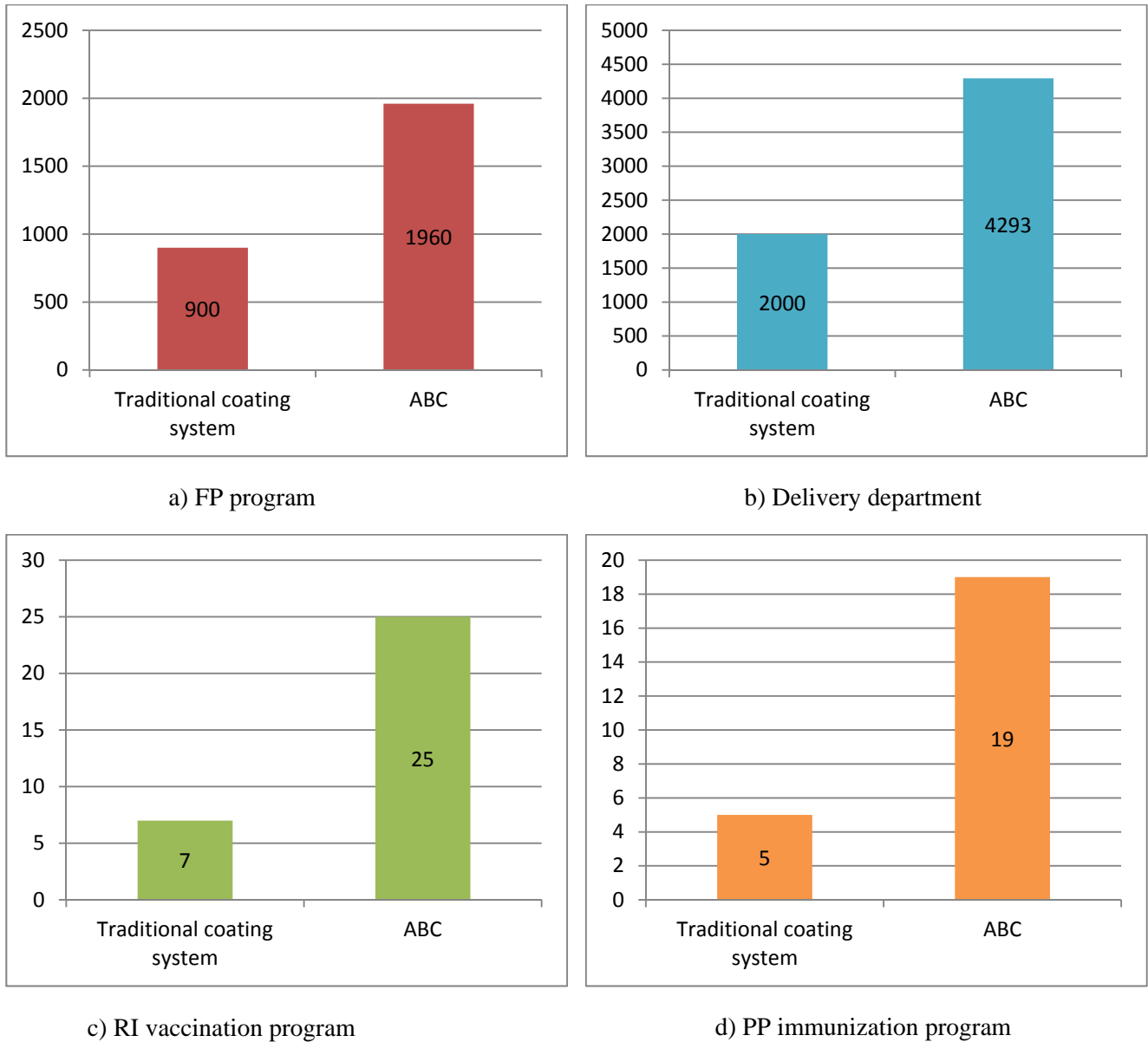


Fig. 5. Comparison of cost/patient in various departments/programs

While, the amounts related to all cost heads traced down from the expenditure report of the financial year 2012-13, linked to RI process, are added together, and then divided by the total number of persons vaccinated in that year under RI campaign of the PHC, Kahalgaon to determine the cost/patient for RI vaccination according to the conventional costing system. Applying the same procedure, the cost/patient expended on PP immunization during the financial year 2012-13 under PP campaign of the hospital is also calculated. It is further noticed that the present costing system in the PHC, Kahalgaon does not provide the information on cost/patient spent for treatment of patients in OPD and emergency department. Fig. 5 compares the cost/patient in various departments/programs of the hospital as reported by the two costing systems. It can now be concluded that the conventional costing system has underestimated the cost of each and every medical service provided in the hospital. So, application of the ABC model not only provides more accurate and reliable information on various cost elements for different activities undertaken in the hospital, but also throws a light on different perspectives of the hospital management which can help the administration to take appropriate decisions regarding workforce efficiency, capacity utilization, patient mix, capital budgeting, cost control etc. The annual expenditure profile as reported by the ABC model in the PHC, Kahalgaon is exhibited in Fig. 6. It is observed that the current management information system practiced in this hospital is inept to provide some information required for adoption of the ABC

model, and the same needs to be redesigned. Moreover, the tentative benefits supposed to be achieved from the adopted ABC model is required to be conveyed to all the stakeholders of the hospital, like doctors, nurses, administrative staffs etc., as initially, they may resist accepting a new costing methodology.

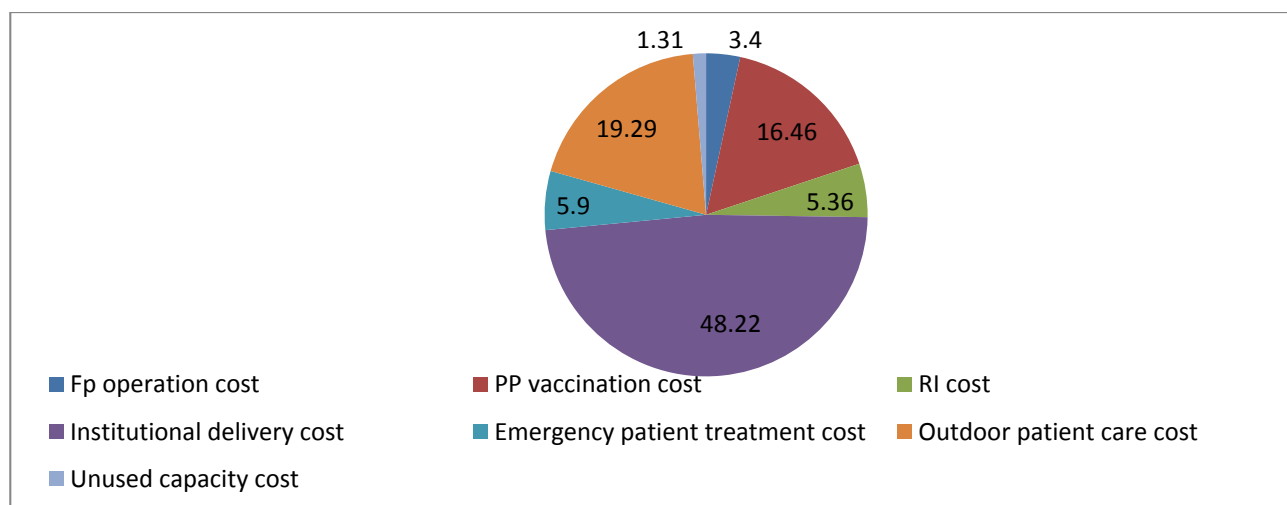


Fig. 6. Annual expenditure profile based on the ABC model

6. Conclusion

India has 269.7 million people of the total population below the poverty line as estimated by its Planning Commission report for the year 2011-12, and this fact makes the study of intricacies related to costing of the public healthcare service providers critical and relevant. Presently, most of the public hospitals in India use conventional costing systems which often provide inaccurate and unreliable cost information. The present costing system is also incompetent to establish a sound management control model in a hospital setup as it is inept to answer a few vital questions of management perspective that requires analysis of cost at micro level of the organization. Therefore, in this paper, an ABC model is proposed and developed in a public sector hospital of India to cost its entire range of services. Thus, the information obtained from adoption of the ABC model on cost of various activities in the hospital is more accurate, reliable and comprehensive which can aid the government to propose effective operational, tactical and strategic measures. A sincere effort can be put to allocate all the funds on the basis of cause and effect relationship. Further, a new performance appraisal system can be augmented to be used in conjunction with the present evaluation system of the hospital to enhance the effectiveness of its performance assessment process. Private sector hospitals can too employ this proposed model as a reference for organization-wide application of ABC system. The future work may include implementation of this model in various other government hospitals to compare their performance in order to identify the best performing hospitals and procedures along with the application of those identified best practices in relatively underperforming hospitals to improve the quality of public healthcare service.

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