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Budget Variance Analysis of a Departmentwide Implementation of a PACS at a Major Academic Medical Center

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In this study, the costs and cost savings associated with departmentwide implementation of a picture archiving and communication system (PACS) as compared to the projected budget at the time of inception were evaluated. An average of $214,460 was saved each year with a total savings of $1,072,300 from 1999 to 2003, which is significantly less than the $2,943,750 projected savings. This discrepancy can be attributed to four different factors: (1) overexpenditures, (2) insufficient cost savings, (3) unanticipated costs, and (4) project management issues. Although the implementation of PACS leads to cost savings, actual savings will be much lower than expected unless extraordinary care is taken when devising the budget.

KEY WORDS: Cost-effectiveness, PACS, budget

INTRODUCTION

Radiological services have historically played a major role in the delivery of modern medicine and have experienced a dramatic rise in utilization in the twentieth century.[1] With all the financial implications at stake, it is surprising that so little research has been performed within the radiology community to evaluate the trends and patterns of utilization and the effect of the introduction of new technology on the utilization of imaging services. Picture archiving and communication system (PACS) is a technological advancement in the field of Radiology, with imaging studies being interpreted directly on the computer work station and stored electronically instead of the previous practice of interpreting on printed films and storing in film libraries and warehouses.

The decision to implement PACS is a difficult one, with many advantages and disadvantages to consider. From the physicians' viewpoint, PACS increases productivity, allowing physicians the ability to see more imaging studies, thus increasing throughput and the profitability of the hospital.[2] PACS also allows physicians the ability to access prior radiological studies with relative ease, compared with having to physically retrieve the images from the file room and also allows them the freedom to access radiological images anywhere work stations are installed.

However, there are several disadvantages associated with implementing PACS. There is a learning curve associated with using this new technology and all physicians who use the equipment will have to be trained. This may alienate physicians who are used to hard-copy methods of viewing films. PACS is also subject to downtime, as is true with most computer-based technologies. Institutions need to have around-the-clock dedicated support in the case of an emergency, in addition to a downtime contingency plan so that images can be continually interpreted in the event a system malfunctions. PACS is also quite costly and will require a huge commitment from the institution. In fact, it is possible that the proposed savings may not even be achieved. There are so many variables with a project of this size that it is difficult to predict what the final outcome will be.

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From an administrator's viewpoint, PACS is an enormous capital expenditure with a break-even point several years down the road.[3] Considering the long payback time, from a purely financial planning point of view, administrators often have to consider other projects that will have similar, if not better, returns on investments (ROIs). The issue is further complicated by the fact that teaching facilities need to have the latest technology to recruit the best physicians and residents. Although there has been much discussion about the cost of radiological services,[4,5] there has been little talk about the true costs of a PACS once it is finally implemented.

METHODS

The costs and cost savings associated with departmentwide implementation of PACS as compared to the projected budget at the time of inception were evaluated. PACS-related costs were clearly labeled on the radiological information systems (RIS) and were obtained by the business manager for the dates of this study. It is unlikely that there are other sources of PACS-related costs not captured through this method. All related savings due to PACS were calculated by subtracting all PACS-related annual costs from our pre-PACS expected budget. The budget variances from 1999 to 2003, as well as any trends in spending over this period of time were also identified. The cost-effectiveness of PACS and its impact on supply, processing, salary, storage, and maintenance costs was also calculated. We also identified hidden costs, which are defined as any "surprise" costs that we did not anticipate on our budget. No IRB or ethics committee approval was necessary by our institution for this type of study.

RESULTS

The institution did achieve significant cost savings over the life of the project. From 1999 to 2003, an average of $214,460 was saved each year, with nearly $460,000 saved during the first year of implementation. Figure 1 shows significant cost

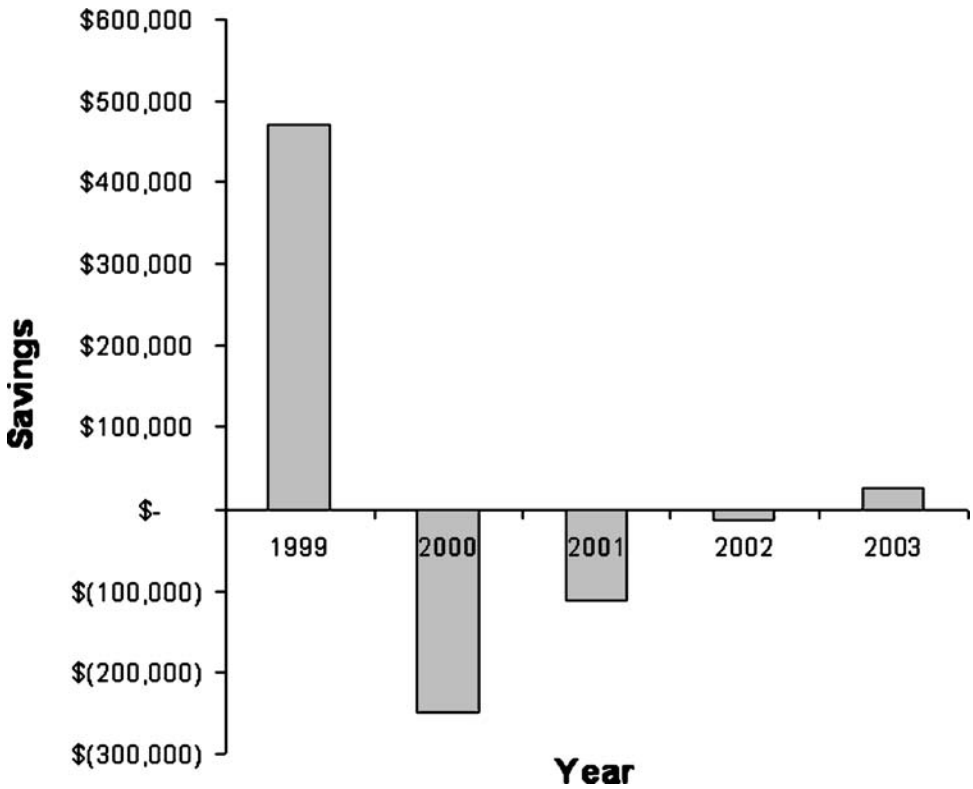

Fig 1. PACS cost savings from 1999 to 2003. The cost savings were maximized in 1999 at close to $480,000. This was followed by three successive years of overexpenditures followed by some small savings in 2003. The initial savings represented an immediate halt in spending on budgeted items. The period from 2000 to 2003 represented increasing savings being offset by greater than expected expenditures.

Table 1. PACS average annual cost savings/(*overexpenditures*) from 1998 to 2003

	Budgeted ($)	Average Cost ($)	Difference ($)
Supplies	987,000	440,583	546,417
Salary	732,000	425,757	306,243
Storage	51,300	69,515	(18,215)
Temp	-	40,684	(40,684)
IS	-	44,310	(44,310)
Others	-	77,691	(77,691)
Service (PACS and Film)	242,700	700,000	(457,300)
Total			214,460

savings during the first year of implementation followed by 3 years of overexpenditures and finally a return to cost savings in 2003. Examining the cost savings more closely, we see that they were achieved from line items in the budget such as supplies and salaries, with an average savings of $546,417 and $306,243, respectively. Costs for the project were considered both capital as well as operational costs. Table 1 summarizes the annual cost savings as a result of our PACS implementation.

Supplies and salary represent the only areas of cost savings, whereas spending in storage and PACS and film service costs exceeded the budget. We did not anticipate having to spend money on temporary workers, IS, and "others." These unanticipated costs impeded us from achieving even more savings. Figure 2 shows in greater detail the supplies and salary cost savings achieved by PACS as a percentage of the budget. Despite these savings, the institution exceeded its budget on service agreements and storage. In fact, on service agreements alone, expenditures exceeded the budget by an average of $457,300 each year.

In addition to spending that exceeded the budget, an audit revealed many "hidden costs" that were not accounted for by the budget. Such items included temporary help, information systems support, and "others"—which includes office supplies, training and conferences, printing and forms, optical disks, CD-ROMS, other purchased services, cellular phone charges, overnight couriers, and equipment rental. These items

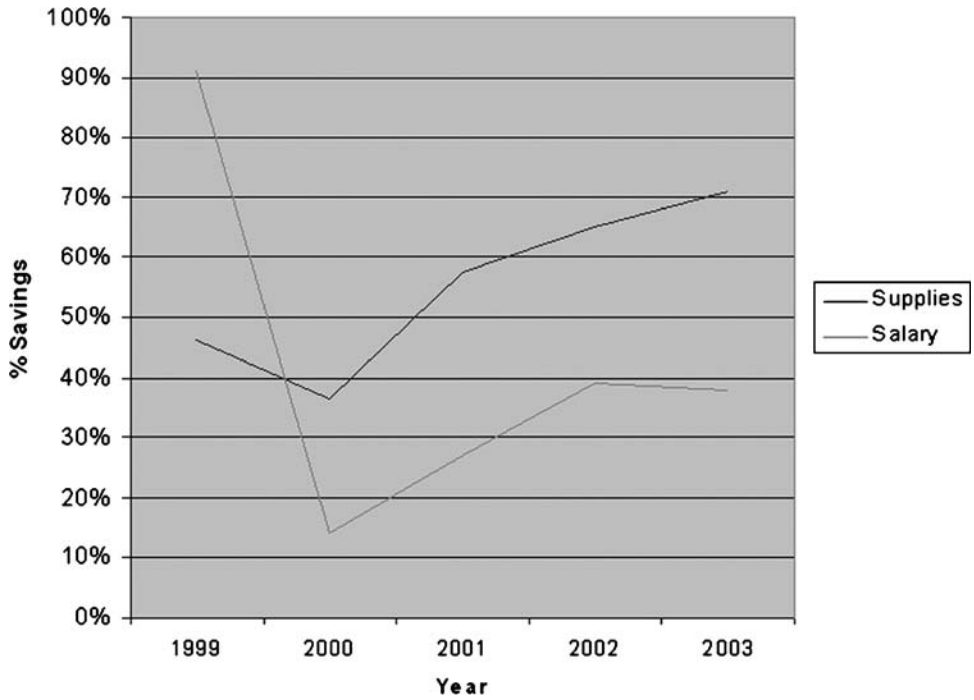

Fig 2. Supplies and salary savings from 1999 to 2003. Salary savings were highly volatile as they reached their maximum in 1999, dropped over 70 percentage points the following year, and hovered close to 40% in 2002 and 2003. Supply savings fell only slightly from 1999 to 2000, but rose steadily from 2000 to 2003. PACS facilitated cost savings on supplies; however, savings on salaries were less pronounced because of the additional staffing requirements of PACS.

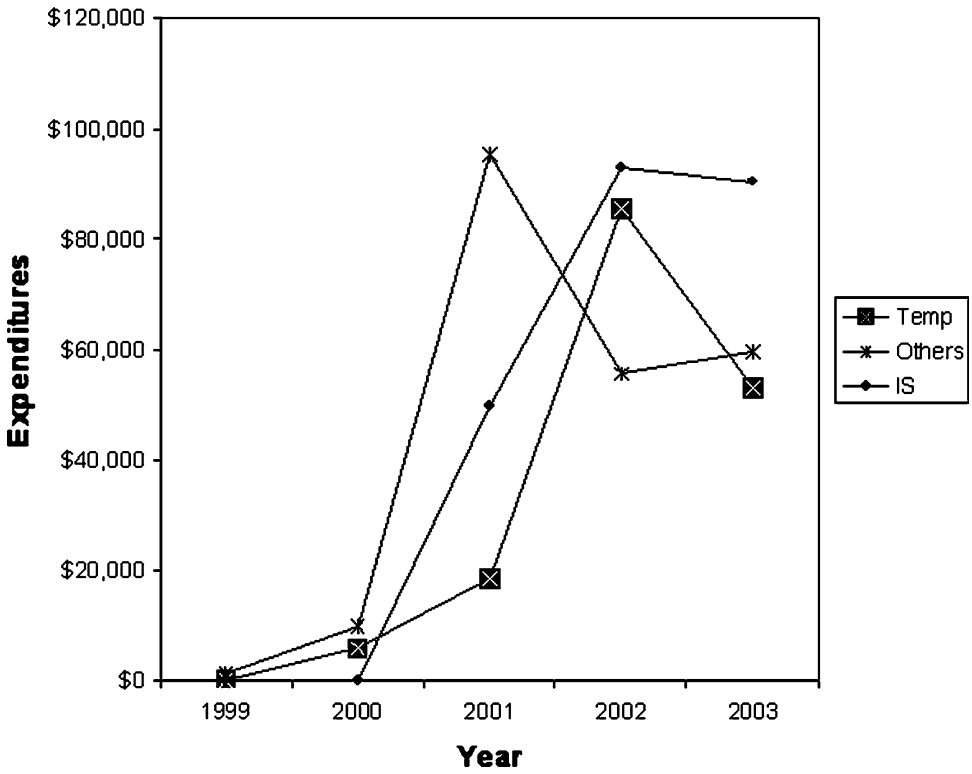

Fig 3. Annual expenditures on unanticipated costs. There is a general upward trend in unexpected expenditures from 1999 to 2003. In the earlier years, unexpected costs were minimal and, as they were unexpected, never appeared on our radar. In 2001, they became more apparent and after some time, we were successful in stabilizing the expenditures. However, spending in 2002 and 2003 on these items was still fairly significant and had a negative effect on our cost savings.

totaled $162,685 in unanticipated costs. Figure 3 tracks the expenditures on these items over time and reveals an overall upward trend in the spending on these unanticipated costs with a stabilization in expenditures on others and IS, and a decrease in temporary services from 2002 to 2003.

DISCUSSION

PACS has emerged as an important part of digital imaging technology. Full PACS implementation should theoretically provide cost savings for a large, subspecialized department. Institutions that are able to archive images by using image compression will also experience cost savings from PACS. However, smaller institutions that are committed to PACS implementation may take longer to recoup their initial investments. We suspect that larger institutions will have proportionally higher expenditures in film-related costs, supplies, and salaries, and by changing to a PACS, will be able to reduce if not eliminate these line items from the budget.

We were fortunate enough to be able to achieve $214,460 in cost savings per year mainly as a result of savings in supplies and salaries. Over the 5-year period since implementation, savings totaled $1,072,300, which is significantly less than the $2,943,750 projected savings that was expected at the start of the project. This large discrepancy between the two numbers can be attributed to a number of different factors that fall into one of four different categories: (1) overexpenditures, (2) insufficient cost savings, (3) unanticipated costs, and (4) market conditions.

Overexpenditures played a significant role in limiting the cost-effectiveness of PACS here at our facility. Table 1 shows that five out of seven items of the budget limited the effectiveness of the project by offsetting the cost savings. Of

these five items, only service and storage costs can be considered overexpenditures because they are the only two areas of the budget where costs were anticipated but expenditures exceeded the budgeted amounts. Had spending on these two items remained in line with what was budgeted, we would have achieved an additional $475,515 in annual savings or nearly $2.4 million over 5 years.

Although it was difficult to tease out the exact PACS and film service costs, we feel that our straight-line estimate of $700,000 (Table 1) across the 5-year period is fairly accurate. At $700,000 in expenditures per year, we nearly tripled our $242,700 annual budget. There are a few reasons why cost savings were not achieved. Film costs could not be completely eliminated because a backup system needs to be in place if PACS ever goes down. Although we had envisioned a completely filmless environment, the possibility of PACS going offline required us to have a contingency plan. In particular, the film alternators and film processors had to be serviced as regularly as ever to ensure that PACS was properly "backed-up" in the case of an emergency. In addition, PACS service costs were significantly higher than expected as a result of inaccurate estimates. We created our budget based on these estimates given to us from our PACS vendor. Unfortunately, the PACS implementation did not occur as smoothly as envisioned. Our multiple sites were a complicating factor and we required an extraordinary amount of support from our vendor to get PACS up and running properly, which translated into higher costs.

Storage was another area where we overspent as compared with the budget. On average, we exceeded our annual budget by $18,215. This occurred because we began to maintain our film libraries and archives offsite to save valuable space in our facility. Although it was much cheaper to store films in the film room rather than outsource it, by making more efficient use of our space, we felt that the change would pay for itself. It is very possible that the inadequate savings in storage costs is due to an increase in volume of studies performed with the implementation of PACS.

Insufficient cost savings was a factor that limited the effectiveness of our project. We characterized insufficient cost savings as those costs that were anticipated and where savings were achieved, but further savings were still attainable. Supplies and salaries represented the two largest line items on the budget and thus it made sense to try to achieve cost savings there. To achieve the cost reductions in the salaries, spending in the film room related costs, including salaries were cut. Fewer FTEs were needed because our file room storage was outsourced. Although expenditures on film supplies decreased significantly, it did not drop as low as we had planned. Films were still being developed at a high rate, which suggests to us that many physicians were still producing hard copies when these same images could be viewed and interpreted on PACS. One possibility is that despite the implementation of PACS, some physicians are more comfortable having hard copy films in hand. Another possibility is that PACS provides such a fine level of detail that many more "interesting" cases are available than before and physicians are ordering hard copies for research and teaching purposes. Although this is "discouraged" according to department policy, stricter enforcement is required to ensure that only essential films are being developed. Another interesting finding is that according to Figure 2, it appears that the cost savings achieved have been fairly sustainable. In fact, the savings in supplies and salaries have steadily increased, except for a small drop from 2002 to 2003 in salaries.

Unanticipated or hidden costs proved to be a factor in our project. Our analysis has illustrated the importance of proper budgeting and how unexpected costs can negatively affect the profitability of a project. We feel that all institutions should pay close attention to the ancillary or hidden costs when deciding whether to implement PACS. These costs tend to be very large and could significantly offset the proposed savings. At our institution, we had $162,685 in annual unanticipated costs. This represented roughly 19% of our $852,660 in annual savings due to supply and salary savings. To have such a large amount of unanticipated costs means that both the initial estimates by the vendors and our forecasting model were extremely flawed.

In any large-scale project, unanticipated costs are to be expected, no matter how careful the planning may be. However, steps should be taken to limit the effect these variables have on the

success of the project. One suggestion is to compare spending versus the budget on a regular basis. Doing so would allow us to identify potential issues relatively early, so that timely corrective action can be taken. In addition, we should have held the vendors more accountable for their involvement in the project. The chairman of the department and the business manager worked closely with the vendor's VP of sales to create the budget and implementation plan for the project. In hindsight, we believe that the vendor had some influence on our budget planning and implementation. We believe that it is just as important for the vendors to be accurate with their estimates as it is for them to provide quality service. Although we did have a contract signed before the delivery of the system that held vendors' costs to a specified amount, unfortunately upgrades cost more than we anticipated. Penalizing vendors financially for underestimating true costs would help us receive more accurate quotes.

CONCLUSIONS

Our experiences with PACS and its financial implications has been an invaluable lesson illustrating the importance of budgeting and variance analysis. It has also reminded us how important planning is in any large-scale project. Furthermore, proper budgeting is only part of the equation: institutions need to regularly monitor expenditures to ensure that the budget is being adhered to. We also learned that it is also just as important to keep vendors accountable for their estimates. Planning, budgeting, and variance analyses are helpful steps in managing the costs of a large complex project such as PACS.

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