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Analyses of Budget Impact Considering the Use of the Picture Archiving and Communication System

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ABSTRACT

Objective: To analyze the budget impact of using the picture archiving and communication system (PACS) in comparison to the screen/film system. **Methods:** The budget impact analysis was conducted on the basis of registry data from the Clinics Hospital of the Faculty of Medicine, University of São Paulo, Ribeirão Preto, Brazil. The budget impacts were compared between the PACS, with high- and low-cost PACS architectures, and the screen/film system by considering reference and alternative scenarios over the course of 5 years. **Results:** The budget impact associated with the use of PACS was lower than that associated with the use of the screen/film system in all the evaluated scenarios. The low-cost PACS architecture (mini-PACS) had an even lower budget impact, especially in the scenario in which a simulation of lower numbers of medical examinations was performed. **Conclusions:** The screen/film system had a high budget impact in all the scenarios evaluated, wherein its costs were higher than the available budget. In contrast, the PACS (high- and low-cost architectures) showed a budget impact that allowed for savings in resources, especially the mini-PACS. Therefore, we recommend the implementation and use of the PACS in health services with any volume of examinations performed.

Keywords: Brazil, budget impact analysis, PACS, radiology, screen/film system.

Introduction

Among health technologies, medical imaging equipment and devices for diagnostic and therapeutic purposes represent a major impact in terms of costs and specialized human resources. The technological development in the last decade allowed the structuration and implementation of the picture archiving and communication system (PACS) [1–4]. The PACS is an image diagnostic tool that allows immediate access to medical images in digital format [3,4]. By definition, the PACS offers image visualization in remote diagnostic stations, data storage in magnetic or optic media for short- or long-time recovery, and data sharing by using local (local area network) or wide networks (wide area network), thereby establishing the basis for a filmless radiology service, which refers to a wide and integrated network environment in which the film has been completely or greatly replaced by electronic systems [3]. In digital radiology, the communication standard is the digital imaging and communications in medicine (DICOM) [2–5], which consists of a global standard for the transference of radiological images and other medical information across computers [6].

An important aspect in the process of transition to a digital environment with the implementation of the PACS refers to the study of viability on the basis of an evaluation of binomial cost-benefit or cost-efficiency. In general, when analyzing the impact of implementing information technology in the health area, the following three basic aspects are considered: benefits to the patients, benefits to the diagnostics, and benefits to the service [7,8]. Possible alternatives that require less short-term investments are based on the use of open-source software such as Conquest and K-PACS [9–11]. Regarding equipment, a possible low-cost approach is the implementation via modules according to a modular philosophy based on the concept of mini-PACS [9], with the use of robust but small storage servers such as those from the SuperMicro line.

In this context, each server receives and distributes images that originated from specific equipment, decreasing the demand for simultaneous access that occurs with the centralized

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standard architecture, making the equipment's performance less critical in terms of availability and resilience and enabling the use of lower-cost solutions.

Considering the previously discussed information and the importance of the subject for the health system, the present study aimed to analyze the budget impact (BI) of using the PACS (low- and high-cost [mini-PACS]) in comparison to the conventional screen/film system.

Methods

The study consisted of a BI analysis (BIA) of using the PACS (high-cost and low-cost) in comparison with the conventional film/screen system on the basis of recommendations described in the Methodological Guidelines for BIA [12], orientations from the International Society for Pharmacoeconomics and Outcomes Research [13], and methods described by Drummond et al. [14] under the perspective of the Brazilian Public Health Care System (PHCS).

Analysis Time Horizon

The analysis was conducted within a period of 5 consecutive years after the implementation of the PACS, using an annual inflation rate of 5% on costs, with the assumption of a constant budget.

Target Population

The target population was the one ensured by the Brazilian PHCS and served by the Clinics Hospital of the Faculty of Medicine, University of São Paulo, which includes four regional health departments of the state of São Paulo, Brazil, which has approximately 3,350,000 inhabitants, typically young and middle-aged adults with socioeconomic status compatible with that of what is called the Brazilian middle class.

Scenarios

We used statistical data on the cost, budget, and production of the image service in the year 2011, when approximately 200,000 imaging medical examinations were performed, including flat-plane radiography, ultrasonography, computed tomography, and magnetic resonance imaging, with a PHCS budget of $10,212,440.62, which was selected as the reference budget for the comparative analysis using different scenarios. This budget relates to the reimbursement for the production of the hospital's radiology department. With the purpose of exemplifying the possibilities and limitations inherent in the evaluated technologies (the screen/film system and the PACS), the following scenarios (and subscenarios), based on 200,000 examinations per year in the reference scenario (RS) where the study was conducted, were elected scenarios that represented 50%, 25%, and 12.5% of the RS, respectively: 1) RS: screen/film + printing of digital images from 200,000 medical examinations per year; 1.1) reference subscenario 1: 12,000 medical examinations per year using the screen/film system; 1.2) reference subscenario 2: 50,000 medical examinations per year using the screen/film system; 1.3) reference subscenario 3: 100,000 medical examinations per year using the screen/film system; 2) alternative scenario 1: high-cost PACS + residual printing (5%) of digital images from 200,000 medical examinations per year; 2.1) alternative subscenario 1.1: 12,000 medical examinations per year with 5% duplicated residual printing; 2.2) alternative subscenario 1.2: 50,000 medical examinations per year with 5% duplicated residual printing; 2.3) alternative subscenario 1.3: 100,000 medical examinations per year with 5% duplicated residual printing; 3) alternative scenario 2: low-cost PACS + residual printing (5%) of digital images from 200,000 medical examinations per year and 5% duplicated residual printing; 3.1) alternative subscenario 2.1: 12,000 medical examinations per year with 5% duplicated residual printing; 3.2) alternative subscenario 2.2: 50,000 medical examinations per year with 5% duplicated residual printing; and 3.3) alternative subscenario 2.3: 100,000 medical examinations per year with 5% duplicated residual printing. For financial calculations, the performance of 200,000 radiological medical examinations per year (reference) was considered, where 70% of the medical examinations (140,000) consisted of flat-plane radiography and the remaining 30% (60,000) consisted of other types of medical examinations. When necessary, we also ensured that each medical examination was documented on two 35- × 43-cm films (residual impression).

Screen/Film System + Digital Image Printing

This scenario (and subscenarios) assumes that all flat-plane radiographies are documented on radiographic films using the technology screen/film, that is, 140,000 medical examinations per year, which are documented on 280,000 films (35 × 43 cm). The remaining medical examination modalities, which have already incorporated digital technology, must also be documented on films, because this scenario does not involve the basic infrastructure required for the transmission and visualization of images on monitors. Therefore, the 60,000 medical examinations per year generated in digital format were documented on 120,000 films (35 × 43 cm) made for DICOM printers.

High-Cost PACS + Residual Printing of Digital Images

Even in a completely digital clinical scenario, the impression of a residual amount of films should be considered to meet the requirements of individual health insurance providers and certain clinical areas other than radiology. Considering this situation, we assumed that 5% of the total number of medical examinations could be documented on film, that is, 10,000 medical examinations documented on 20,000 films (35 × 43 cm) specifically designed for DICOM printers. Considering that 70% of the medical examinations are flat-plane radiographs, it is necessary to acquire the technology for the conversion of radiographic images into digital format. In the scenario presented here, we considered the acquisition of a computed radiography system that uses a specific set of capture plates and a laser reader; it can be installed in conventional radiological environments in place of the screen/film system. The remaining modalities already offer images in digital format. Costs relative to the scenario presented here are presented in Table 1.

We must point out that even though the investment in equipment and infrastructure is for a limited period, this scenario takes into account computational solutions provided by specialized companies, implying a continuous investment. Another important aspect is that because of the centralized and redundant model of image storage and distribution used in this scenario, the equipment involved must have high availability and performance, with a tendency to increase the costs of the used technology.

Low-Cost PACS + Residual Printing of Digital Images

As mentioned before, even in a completely digital clinical scenario, the possibility (and necessity) to print a residual volume of films must be taken into account. Therefore, we considered that 5% of the total number of medical examinations could be documented on films, that is, 10,000 medical examinations are documented on 35- × 43-cm films specifically made for DICOM printers. In the scenario presented here, we assumed the

Table 1 – Composition of costs in real (Brazilian currency R$) for the implementation of the high-cost PACS and the low-cost PACS (reference year 2011).

Acquisition	Quantity	Unitary cost (R$)	Total value (R$)
Low-cost PACS			
Image storage environment	1	263,500.00	263,500.00
CR for image digitalization and accessories	2	179,111.13	358,222.26
Visualization stations	38	2,958.66	112,429.00
Investments: Subtotal			734,151.26
Cassettes			57,600.00
Network infrastructure (switch)	1	81,600.00	81,600.00
Rental of visualization and management software	12	8,570.00	102,840.00
Software rental			110,317.40
Acquisition of storage discs (2011)			72,000.00
Investments: Subtotal			424,357.40
Informatics experts	03	3,700.00	144,300.00
Grand total			1,302,808.66
High-cost PACS			
Image storage environment	1	263,500.00	263,500.00
CR for image digitalization and accessories	2	179,111.13	358,222.26
Visualization stations	38	2,958.66	112,429.00
Investments: Subtotal			734,151.26
Cassettes			57,600.00
Network infrastructure (switch)	1	81,600.00	81,600.00
Investments: Subtotal			139,200.00
Bioinformatics experts	03	3,700.00	144,300.00
Grand total			873,351.26

Source. Center of Images and Medical Physics (Clinics Hospital, Faculty of Medicine, University of São Paulo).
CR, computed radiography; PACS, picture archiving and communication system.

acquisition of a computed radiography system [15]. In the scenario with high-cost PACS, two main factors stand out in comparison with the scenario with low-cost PACS. The use of a model of decentralized data flow according to the modality is based on a model known as mini-PACS, with the use of open-source software and/or free licenses for image storage, distribution, and visualization. Decentralized storage reduces the inherent performance requirements because it minimizes the simultaneous demand of access on each storage server and naturally creates a redundant environment, as once there is a failure, the data flow can be redirected to the equipment while the problem is being solved. Meanwhile, the use of free-license software has a tendency to decrease the direct costs with material. However, because this scenario does not contemplate the implementation of a commercial solution, demands regarding the support and maintenance of the environment must be met by local information technology professionals, thereby increasing the costs with additional human resources.

Costs

The microcost method was used considering the direct disbursement and cost of human resources required for the adequate operation of the system. Expenses owing to radiologist physicians were not taken into account because these professionals are equally needed both for the screen/film system and for the PACS.

Once both the high-cost PACS and the low-cost PACS were implemented from the second year, the annual costs showed a new composition, as can be observed in Table 2.

In contrast to the high-cost PACS, the low-cost PACS requires only human resources for its adequate function and maintenance [2,10]. As previously mentioned, in both PACSs, it is necessary to consider that at least 5% of all medical examinations must be printed out, generating a cost of R$244.13/m^2, where each 0.35- × 0.43-cm film costs R$36.74. In contrast, in digital medical examinations, the printing is performed using the DICOM system, which costs R$488.27/m^2 and each film costs R$73.48.

Table 2 – Composition of the fixed annual cost in real (Brazilian currency R$) of the high-cost PACS and the low-cost PACS from year 2.

Items	Quantity	Unitary cost (R$)	Total value (R$)
High-cost PACS			
Software rental	–		110,317.40
Storage discs	–		72,000.00
Human resources	3	3,700.00	144,300.00
Total			326,617.40
Low-cost PACS			
Human resources	3	3,700.00	144,300.00
Total			144,300.00

Source. Center of Images and Medical Physics (Clinics Hospital, Faculty of Medicine, University of São Paulo).
PACS, picture archiving and communication system.

Table 3 – Comparison of the BI in the course of 5 y between RS, AS1, and AS2.

Year	BI (%)		
	RS	AS1	AS2
2011	+87.08	17.60	15.80
2012	+96.40	18.47	16.60
2013	+106.25	19.40	17.42
2014	+116.57	20.36	18.30
2015	+127.40	21.38	19.21
Total	+106.75	19.44	17.46

AS1, alternative scenario 1; AS2, alternative scenario 2; BI, budget impact; RS, reference scenario.

Results

Considering the implementation of the high-cost PACS, the BI, with the RS as the basis (i.e., the performance of 200,000 medical examinations per year and a budget of R$10,212,440.62), would be 12.75% (R$1,302,808.66/R$10,212,440.62), whereas with the implementation of the low-cost PACS, the BI would be 8.55% (R$873,351.26/R$10,212,440.63). A summary of results from each evaluated scenario is presented in Table 3, starting from the RS and assuming an annual budget of R$10,212,440.62 for the image service of the Clinics Hospital of the Faculty of Medicine, University of São Paulo, in 2011.

As observed in Table 3, the use of the screen/film system presents a high cost, exceeding 87% of the PHCS budget for image services, where at the end of the 5-year period, the costs were 106% higher than the budget. With the use of the high-cost PACS, from the first year after the implementation of the system and assuming that 200,000 medical examinations are performed per year, of which 5% are predicted to be printed out in duplicate using the DICOM system, and adding the maintenance costs, the BI is approximately 20%. In alternative scenario 2, the BI varies between 15.8% and 19.2% during the 5-year period.

In the comparison between the first scenarios, it can be noted that the screen/film system presents a great BI, causing a budget overload that, if not complemented, leads to a large deficit. On the contrary, with the high-cost PACS, the BI stayed at approximately 20%, and with the low-cost PACS, the BI was slightly lower at 1% to 2% relative to alternative scenario 1.

In Table 4, the costs and BI are summarized, assuming that 12,000 medical examinations are performed per year using the high-cost PACS (alternative subscenario 1.1), with 5% duplicate printing with the DICOM system, and taking into account an annual budget of R$ 612,746.44 relative to the RS.

In the present scenario, the BI represents approximately 67.7% to 82.3% and at the end of 5 years, 75% of the total budget, considering the cost of 5% duplicate printing of the examinations using the DICOM system added to the fixed maintenance cost for the high-cost PACS. Using the low-cost PACS and with 12,000 medical examinations performed per year, the BI is approximately 40% per year. Even in a scenario with an annual prescription of only a few medical examinations (i.e., 1000 per month), the BI is too large with the screen/film system, exceeding the available budget by at least 87%. In contrast, for the high-cost PACS, the BI represents a significant percentage (range 67%–82%); for the low-cost PACS, the BI represents less than 50% of the budget, thus being advantageous than the screen/film system and the high-cost PACS.

To analyze the scenarios and subscenarios with 50,000 medical examinations per year, it is necessary to assume a budget of R $10,212,440.62 for the RS, with a generation of 200,000 medical examinations per year. Considering the proportionality, with 50,000 medical examinations performed per year, or 25% of the RS, the annual budget would be R$2,553,110.16. Table 5 presents a summary of the costs and BI inherent in the use of the high-cost PACS (alternative subscenario 1.2), with 50,000 medical examinations performed per year, and thus the BI for reference subscenario 2.

As in other examples from the previous scenarios, the screen/film system has a strong impact on the budget, exceeding it by far (from +87% to +127% of the budget available for the evaluated scenario). In this subscenario, the BI of the high-cost PACS is close to 30% in the 5-year study period. As observed, with the use of the mini-PACS, the BI represents, in the referred scenario, a percentage slightly or moderately higher than 20% a year. In the comparison between the BI in the three subscenarios comprising the performance of 50,000 medical examinations per year, similar to the previous systems, the screen/film system greatly affects the budget, exceeding the maximum by far, whereas the high-cost PACS requires approximately 30% and the low-cost PACS requires between 20% and 24%.

Table 6 presents data for scenarios and subscenarios assuming the execution of 100,000 medical examinations per year, with the expenses proportionally corresponding to 50% of the value for the RS (R$10,212,440.62; i.e., R$5,106,220.31).

Again, it can be observed that the screen/film system generates a BI (87%–127% or higher) higher than the available budget, considering the scenario of 100,000 medical examinations per year. In the analyzed subscenario, the high-cost PACS represented 21% to 25% of the budget. The BI of the low-cost PACS in alternative subscenario 2.3 does not exceed 20% a year. In comparison, the screen/film system is the technology that generates the highest BI, exceeding more than 87% the budget available for a service that

Table 4 – Comparison of the BI in the course of 5 y between RSS1, ASS1.1, and ASS2.1.

Year	BI (%)		
	RSS1	ASS1.1	ASS2.1
2011	+87.00	67.70	37.94
2012	+96.40	71.07	39.84
2013	+106.25	74.63	41.83
2014	+116.56	78.36	43.92
2015	+127.39	82.30	45.12
Total	+106.74	74.81	41.93

ASS1.1, alternative subscenario 1.1; ASS2.1, alternative subscenario 2.1; BI, budget impact; RSS1, reference subscenario 1.

Table 5 – Comparison of the BI in the course of 5 y between RSS2, ASS1.2, and ASS 2.2.

Year	BI (%)		
	RSS2	ASS1.2	ASS2.2
2011	+87.07	27.18	20.04
2012	+96.43	28.54	21.04
2013	+106.20	29.97	22.10
2014	+116.56	31.47	23.20
2015	+127.40	33.04	24.36
Total	+88.75	30.04	22.15

ASS1.2, alternative subscenario 1.2; ASS2.2, alternative subscenario 2.2; BI, budget impact; RSS2, reference subscenario 2.

Table 6 – Comparison of the BI in the course of 5 y between RSS3, ASS1.3, and ASS2.3.

Year	BI (%)		
	RSS3	ASS1.3	ASS2.3
2011	+87.70	20.79	17.22
2012	+96.43	21.83	18.08
2013	+106.25	22.92	18.98
2014	+116.56	24.06	19.93
2015	+127.39	25.27	20.93
Total	+106.74	22.97	19.03

ASS1.3, alternative subscenario 1.3; ASS2.3, alternative subscenario 2.3; BI, budget impact; RSS3, reference subscenario 3.

performs 100,000 medical examinations per year, whereas the high-cost PACS generates a BI of approximately 20% to 25% and the mini-PACS generates a BI of 17% to 21%.

In Table 7, all the BI percentages are shown for all the previously described scenarios and subscenarios.

Regarding the BI values, it can be clearly observed that the screen/film system in all the scenarios exceeds by far the budget available for the service, as measured by the generation of medical examinations per year, with consistent patterns among the years. As for the high-cost PACS and the low-cost PACS, they generated highly variable BIs, which were, however, always lower than the BI of the screen/films system.

Table 7 – Summary of BI (%) of the screen/film system, HC-PACS, and LC-PACS considering the performance of 200,000, 12,000, 50,000, and 100,000 medical examinations per year during a 5-y period.

Year	Medical examinations			
	200,000	12,000	50,000	100,000
Year 1				
SF	+87.08	+87.00	+87.07	+87.07
HC-PACS	17.60	67.70	27.18	20.79
LC-PACS	15.80	37.94	20.04	17.22
Year 2				
SF	+96.40	+96.40	+96.43	+96.43
HC-PACS	18.47	71.07	28.54	21.83
LC-PACS	16.60	39.84	21.04	18.08
Year 3				
SF	+106.25	+106.25	+106.20	+106.25
HC-PACS	19.40	74.63	29.97	22.92
LC-PACS	17.42	41.83	22.10	18.98
Year 4				
SF	+116.57	+116.56	116.56	116.56
HC-PACS	20.36	78.63	31.47	24.06
LC-PACS	18.30	43.92	23.20	19.93
Year 5				
SF	+127.40	+127.39	+127.40	+127.39
HC-PACS	21.38	82.30	33.04	22.27
LC-PACS	19.46	45.12	24.36	20.93
In 5 y				
SF	+106.75	+106.74	+88.75	+106.74
HC-PACS	19.44	74.81	30.04	22.97
LC-PACS	17.46	41.93	22.15	19.03

BI, budget impact; HC-PACS, high-cost PACS; LC-PACS, low-cost PACS; PACS, picture archiving and communication system; SF, screen/film.

With the visible advantage of the high-cost PACS and the low-cost PACS in terms of BI in all the scenarios, Table 8 presents a comparison between the two architectures.

As observed, the low-cost PACS generates the lowest BI in all the situations; however, the advantage was higher for services that require fewer medical examinations. It is noticeable that in the scenario in which 12,000 medical examinations are performed per year, the difference between the low-cost PACS and the high-cost PACS was 30% for the first years, whereas for the execution of 50,000 medical examinations per year, the difference was between 7% and 8%. With the performance of 100,000 and 200,000 medical examinations per year, the differences were approximately 3% and between 1.8% and 2%, respectively.

Discussion

In the present BIA, the PACS system was evaluated for its impact on the budget of an image service from the PHCS perspective. The analyzed technology can currently be implemented with two architectures as follows: 1) the centralized or high-cost PACS, which uses software and other commercial technologic solutions, and 2) the low-cost (or decentralized) PACS, also known as the mini-PACS, whose installation and maintenance present a few characteristics that make it an attractive option because it considerably reduces costs when compared with the high-cost PACS by using open software and requiring only biomedical informatics technicians to function. This fact was plainly confirmed in this BIA in which results reveal that the mini-PACS presents a low BI than does the high-cost PACS and a much lower BI than that of the screen/film system, which was shown to be highly disadvantageous in comparison with the two computerized architectures. However, the mini-PACS could be clearly observed to be an excellent option for services with a low demand for medical examinations, as demonstrated in the scenario with a production of 12,000 medical examinations per year. In such situation, the mini-PACS had a BI that was 30% lower than that of the high-cost PACS and had a total BI of approximately 40%.

During this study, literature search in reliable databanks provided only a few publications that evaluate costs and conduct economic analyses on the subject. Thus, the present study may be the first one to conduct an analysis according to the recommended methodology. The study of MacDonald and Neville [16], however, should be mentioned, wherein an evaluation of the costs and benefits of the implementation of PACS was conducted in two Canadian provinces, in which they concluded that the cost of each medical examination in the PACS environment is approximately 20% lower than that in the screen/film system. Nevertheless, during the following years, the benefits of using PACS were less obvious. In the present BIA, however, we observed that the low-cost PACS is advantageous for small-scale services because it has a low impact on the budget by avoiding costs with hardware and software and having low maintenance costs. Another recent study [17] concluded that PACS, when compared with the screen/film system, has much lower costs, offering a higher effectiveness for the health system and the patients. A study from the 1990 s [18] showed a reduction in hospitalization costs associated with faster and more precise diagnostics owing to the use of PACS. There is a report that US $32,000.00 can be annually spared as a result of a 1% reduction in the hospitalization associated with the use of PACS, assuming that 4000 ambulatory procedures are performed per year, suggesting that there would be a cost reduction of approximately US $800,000.00 for a hospital that performs 100,000 ambulatory procedures. Cost-benefit analyses considering the use of the PACS in general contexts are rare, and available studies are dedicated to the evaluation of a specific applicability and more commonly compare the screen/film system

Table 8 – Summary of BI (%) of HC-PACS and LC-PACS considering the performance of 200,000, 12,000, 50,000, and 100,000 medical examinations per year during a 5-y period.

Year	Medical examinations			
	200,000	12,000	50,000	100,000
Year 1				
HC-PACS (1)	17.60	67.70	27.18	20.79
LC-PACS (2)	15.80	37.94	20.04	17.22
Difference (%), 2 - 1	-1.80	-29.76	-7.14	-3.57
Year 2				
HC-PACS (1)	18.47	71.07	28.54	21.83
LC-PACS (2)	16.60	39.84	21.04	18.08
Difference (%), 2 - 1	-1.87	-31.23	-7.50	-3.75
Year 3				
HC-PACS (1)	19.40	74.63	29.97	22.92
LC-PACS (2)	17.42	41.83	22.10	18.98
Difference (%), 2 - 1	-1.98	-32.80	-7.87	-3.94
Year 4				
HC-PACS (1)	20.36	78.63	31.47	24.06
LC-PACS (2)	18.30	43.92	23.20	19.93
Difference (%), 2 - 1	-2.06	-34.71	-8.27	-4.13
Year 5				
HC-PACS (1)	21.38	82.30	33.04	22.27
LC-PACS (2)	19.46	45.12	24.36	20.93
Difference (%), 2 - 1	-1.92	-37.18	-8.68	-1.34
In 5 y				
HC-PACS (1)	19.44	74.81	30.04	22.97
LC-PACS (2)	17.46	41.93	22.15	19.03
Difference (%), 2 - 1	-1.98	-32.88	-7.89	-3.94

BI, budget impact; HC-PACS, high-cost PACS; LC-PACS, low-cost PACS; PACS, picture archiving and communication system.

with digital radiography in mammography [19,20], with a focus on diagnostic accuracy, early diagnosis of suspicious lesions, and images with suspected malignancies.

Study Limitations

Considering that data on the cost of BI analysis were obtained from a hospital in which the PHCS budget is complemented by resources from the State Health Secretary, the generalization of our results may be influenced by measurement bias. The budget data we used, however, were entirely of those associated with the budget available from the Brazilian PHCS. Therefore, we believe that the bias was minimal. Another aspect to be considered was the noninclusion of costs related to wages and remuneration for radiologists because the logistic of the chosen subject of study (Clinics Hospital of the Faculty of Medicine, University of São Paulo) is different from that of standard hospitals, considering that we conducted our analyses in a university hospital in which docents participate in the radiology provided for the general public and are paid by the university, not by the hospital itself. Nevertheless, we believe that by excluding those costs, we did not compromise our results because the work performed by the radiologists was not very different among the systems (screen/film or the PACS); thus, the costs involved were the same [8,16].

Conclusions

According to the results from the present BIA, the screen/film system had a great impact on the budget in all the evaluated scenarios. In addition, in all the cases, its costs exceeded the budget, whereas both the high-cost PACS and the low-cost PACS showed a BI that resulted in saving resources, especially the mini-PACS. According to these findings, we recommend that health services that demand medical examinations work in PACS environments. It must be considered, however, that technologies that are currently associated with the PACS are under continuous development, which may require short-term changes in the cost composition, with either higher or lower costs. Therefore, frequent evaluations are required, always taking into account the characteristics of the health service, the user profiles, and the level of expertise of the medical staff.

It is important to point out that with the current situation, the implementation of the PACS apart from generating lower costs and BI in any scenario would also result in a productivity increase of up to 200% to 300% [16–18]. This would obviously require the preparation of the entire team in terms, for example, of greater agility in the generation of reports and an entire infrastructure for a demand higher than previously planned, considering the associated increase in demand.

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