Does Electronic Medical Records make cost benefits to non-profit seeking health care institutes?

Amarasiri H.A.D.B.[*] **, Dorabawila S.S.K.B.M.**[**]

[*]Department of Pharmacy, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka.
[**]Department of Economics and Statistics, Faculty of Arts, University of Peradeniya, Sri Lanka.

Abstract- **Background**: Sri Lanka provides a free public health care service to its permanent residents. Currently Sri Lankan health care system is in the process of using EMR systems both public and private sector healthcare institutions. There are few published data available regarding cost-benefits of EMR in profit seeking institutes in some countries and no published data on non-profit seeking institutes. Therefore, main objective of the study is to perform a cost benefit analysis (CBA) of EMRs in the public health care system in Sri Lanka and secondary objectives are to evaluate the perception of EMRs among patients, health care professionals and supporting staff.

Methodology: Two Sri Lankan government hospitals' OPDs; hospitals belong to Type A divisional category, were selected for the study. Those two hospitals were named as Hospital D and Hospital AR. Hospital D has an EMR system and hospital AR has traditional paper-based recording. A modified cost- benefit analysis was done using achievable costs and benefits. Meanwhile, three different questionnaires were distributed among health care professionals, supporting staff and patients to determine their perception on EMRs.

Results: This study found that Benefits-to-Costs ratio of OPD of the hospital D for the year 2015 was 0.269 and for hospital AR was 0.0589. From CBA four basic cost reductions were found as costs for stationeries, patient queue waiting time, supporting staff number and indirect costs such as drug balancing. Health care professionals, supporting staff and patients had a positive perception on EMR systems.

Conclusion: Implementing EMRs to Sri Lankan health care system leads to **cost reductions**. If Sri Lankan government implements an EMR system only in OPDs of government hospitals, it will lead to save millions of rupees. There are thirty-five, Type A divisional hospitals in Sri Lanka. If this EMR system is implemented only in OPDs, Sri Lankan public health care system would have saved Rs192 million ($ 1.3 million) in 2015.Finally, it can be concluded that implementing EMRs in non-profit seeking health care institutes lead to cost reductions and save money.

Index Terms- Electronic Medical Records, EMR, Cost Benefits Analysis, CBA

I. INTRODUCTION

Medical Record is defined as "A single record of all data on an individual's health status from birth to death. It would include birth records, immunization records and records of all illnesses and treatments given in any health care facility."[1]

Medical records (MR) are known as health records in some countries and they are essential for patient's present and future health care. Usually these medical records are a written collection of information about a patient's health and treatments and used in management and planning of health care of the patient. Medical records of a particular health care providing institute begin with the patient's first admission as an in-patient or with attendance as an out-patient for the health care facility. Accurate, timely accessible health care data plays a vital role in the planning, developing and maintaining of a good health care service. Therefore, a quality, accurate medical record and its availability is essential to optimize the health care services provided to the patients.

With the development of Information Technology (IT), world is converting numerous manual applications and procedures into digital versions. As a result, MRs are also converted into its digital electronic version and it is known as Electronic Medical Record.US government health IT describes EMR as the digital version of traditional paper-based medical records.[2] Sometime EMRs are known as Electronic Health Records or Electronic Patient Records.

Sri Lanka is a developing country and it has a developed health care compared to other developing countries in the world. Sri Lanka has a free public health care service to all permanent residents. Sri Lankan health care system has been using paper based Medical Records.

Currently Sri Lankan health care system is on the point of using EMR systems and some institutes are using some forms of EMR systems including both public and private sectors[3]–[6]. Main purpose of implementing EMR in Sri Lanka is to enhance the efficiency of the health care system[3], [4]. But main obstacle is relatively high set up cost for implementing an EMR[7]–[9]. At the same time Sri Lankan Ministry of Health is in a position to introduce mechanisms to reduce health care expenditure due to imbalance

of Sri Lanka's total income and expenditures. Though, there are several studies done in other countries[7], [10]which have profit seeking health care institutes on cost-benefits of implementing EMRs, but no study in countries like Sri Lanka which have free health care providing system. Therefore, this study attempts to fill that gap.

General objective for the study is to perform a cost benefit analysis of EMR system in the public health care system in Sri Lanka and specific objectives are to determine health care professionals', patients' and supporting staff members' opinion on EMR system.

II.   METHODOLOGY

All the previous CBA of EMR systems studies were done in private or profit seeking institutes in other countries and basically they were the ratios of costs and profits. But this is the first and a unique study which was done for non-profit seeking government (public) hospitals.

This study did not follow conventional CBA method which performs net present value calculations. A shadow pricing method was used due to the difficulties in obtaining financial records for past five years of the particular government institute with the EMR system. For the purpose of comparison another institute of similar capacity was taken based on government classifications.
Since Sri Lankan government health care institutes are not profit making organizations, cost reductions generated through the EMR system is considered as benefits for the analysis.

The study was included a CBA of EMR system and an opinion study on EMR System.

Importance of the study

Currently Sri Lankan health care system is going to use EMR systems and some institutes are using some forms of EMR systems including both public and private sector. Main purpose of implementing EMR in Sri Lanka is to enhance efficiency of the health care system. Set up cost is relatively high for implementing an EMR. But Sri Lankan Ministry of Health has to introduce mechanisms to reduce health expenditure while maintaining a good service to the public. Though, there are several studies done in other countries on cost-benefits of implementing EMRs, but no study in Sri Lanka.

Objectives of the study

General objective
Perform a cost benefit analysis of EMR in the public health care system in Sri Lanka and to determine whether it is worth to implement EMR.

Specific objectives
1. Determine Health care professionals' opinion on EMR system
2. Determine patients' opinion on EMR system
3. Determine supporting staff members' opinion on EMR system

2.1 Population and setting

All the Type A divisional government hospitals in Sri Lanka were taken as the population for the study.

2.2 Sample Selection

After 2005, EMR systems were introduced to a few government hospitals in Sri Lanka[3]–[6]. From the hospitals with EMR system, one hospital was selected randomly and named as hospital D. The selected hospital was a Type "A" divisional hospital (Sri Lankan Heath Ministry has categorized hospitals based on the bed strength of the hospital and based on the governing institute; Health Ministry or Provincial Council. Type A Divisional hospitals have 100 to 200 bed strength and govern by a Provincial Council.). Therefore, for the purpose of comparison another Type "A" divisional hospital("SL Hosp List Beds.pdf," 2010) was selected which uses traditional paper based recording and named as hospital AR. Out-Patient Departments (OPDs) of both hospitals were selected as the study setting.

Only OPD of hospital D implements relatively a 100% EMR system and has relatively zero paper charts when the study conducted. This study analyzed economic effects of an EMR system using a Cost-Benefits Analysis (CBA)[12].

2.3 Quantitative study

This study analyzed economic effects of an EMR system using a Cost-Benefits Analysis(CBA), based on different costs. Any qualitative factor such as quality of therapy and safe use of medication were excluded. These are key factors in health care services, but are not easily converted into monetary values and they consume more time. At the same time costs for drugs, devices and laboratory chemicals were excluded because the flow of drug and other supplies are not equal for both hospitals due to difference in their governing provisional councils. Therefore, the study focused on tangible items' cost and important key services' costs which can easily measure. In conclusion, this study discussed cost shifting after adoption into the EMR system.

Study setting of CBA

OPDs of both hospitals were selected as the study setting. Because only in OPD of hospital Dis relatively 100% implements EMR system and it has relatively zero paper charts. In wards and clinics, paper charts are used and paper documentation is done along with EMR system. Therefore this study only considered costs and benefits for the OPD.

CBA

Cost benefit analysis is a systemic approach for estimating the strengths and weaknesses of alternatives that satisfy activities or function of an organization. It is a technique to select the best approach with labor, time and cost benefits for the adoption and practice. Cost benefit analysis is used for two purposes. First purpose is to justification of an investment and the second one is to compare two or more projects.

This study was not a conservative CBA and the purpose of the CBA was to compare two OPDs; with an EMR system and without an EMR system. The financial costs were obtained through each hospital's accounting reports, though questionnaire, observations and opinions of experts. Net Present Value (NPV) calculation for the studied costs for the two hospitals was not done because the CBA was done through comparison of costs of two OPDs. Decline balance depreciation method was used to calculate computer hardware costs for the relevant year for the OPD of the hospital D.

Costs

EMR system incurred initial cost that used to implement the system, to purchase computer hardware, to develop the software. This cost was calculated for the year 2015 by using decline balance depreciation method (Depreciation is a method of allocating the cost of a tangible asset over its useful life). Other regular costs were the costs that the hospital usually bare such as salaries and wages and cost for stationeries.

Benefits

Basically benefits were cost reductions originated from cost savings due to elimination of stationeries. There were basically four types of cost reductions: 1)Cost reduction of stationeries, 2)Cost reduction of patient queue waiting time, 3) Cost reduction in supporting staff number, 4) Cost reduction in indirect costs such as drug balancing, recording.

2.4Qualitative/Opinion study

The opinion study was carried out in the same government hospitals to gather information regarding perception of EMR of health care professionals, patients and supporting staff.OPD, clinics and wards were randomly selected from each hospital.

Three separate questionnaires were given to collect information from following parties, because they are the people who interact with medical records in Sri Lankan health care system.

1. Health care professionals (Physicians, Pharmacists, Medical Laboratory Technicians, Nurses)
2. Patients
3. Supporting Staff

Data collection tool

Three self-administered questionnaires for the patients, health care professionals and supporting staff were used as the data collection tool for the opinion study. Questionnaires had both open ended questions and close ended question. Written consents were obtained after explaining the objectives of the study from the participants.

The questionnaire for patients consist of six main areas,

1. Demographic information
2. Residential information
3. Patient income
4. Health care need
5. Medical Record
6. Electronic Medical Record

The questionnaire for Health care professionals and supporting staff consist six main areas,

1. Medical Records
2. Responsibility of Medical Records
3. Difficulties with paper based records
4. Information Technology knowledge
5. EMR
6. Costs

Data collection
Inclusion criteria

No age limit
 Patients and care givers who come to hospital to above units for medical purposes
All health care professional and helpers who work in above units
 All specified costs in Table 1

Exclusion criteria
 Any person who refused to participate

Statistical analysis

All the obtained data from the study was entered into the Statistical Package for Social Sciences (SPSS) version 16. Descriptive statistics were performed to evaluate the socio-demographic characteristics of the participants. Cross tables were used with some variables.

Frequencies and especially percentages were calculated for the opinion study. For continues variables (mostly for CBA) mean values and standard deviations were calculated using descriptive statistics.

2.5 Ethics

Qualitative study carried out in this study involved human subjects and hence informed written consent was obtained from each participant after explanation about the study and informing that there are no direct benefits to participants. This study involved minimal risks since it was a questionnaire based study. The ethical approval to conduct the study was obtained from ethical review committee, faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka. All the data were kept anonymously; confidentiality of the data was maintained according to ethics standards.

CBA Analysis

Step 1   Interventions were clearly identified as direct costs and indirect costs.

Step 2   All the costs for OPD were identified.

Table 1: Identified direct costs and indirect costs for the OPD

Direct Cost for one month
Cost for waiting time in the hospitals for patients
Physicians salaries
Nurses Salaries
Pharmacists salaries
Supporting staff salaries
Cost for papers for patient registration
Total cost for paper slips for patients * Paper slips are used to write prescription and to give numbers for patients
Total cost for pens for staff members
Indirect costs for one month
Cost for patients to re-correct prescriptions *If prescribed drugs are not available at drug stores, patients themselves have to go back to the physician to have another prescription to purchase drugs from the outside pharmacies. But in EMR system drug availability at stores is shown.
Cost of drug balancing *In Sri Lankan public health care practice drug stock balancing is done in daily basis and annually. Approximately it takes around 2 hours for manual balancing. But in EMR system drug balancing is done automatically.

Cost for papers for recording OPD drugs at Pharmacy department
Cost for patients to re-correct a laboratory investigation test order *If requesting test cannot be done with available facilities or available chemicals, patient has to visit back to the physician to have another laboratory investigation test order to purchase it from the outside.
Cost for print laboratory investigation tests
Cost for papers for recording OPD laboratory tests at Medical Laboratory
Total cost for energy use for computers
Cost for the EMR system for the year 2015; according to decline balance depreciation.
Cost of maintenance of EMR system for a year

Step 3   Benefits were calculated by comparing costs values. Cost reductions were accounted as benefits.

Step 4   Summation of all the cost values was taken.
             Summation of all the benefit values was taken.
             Total costs were subtracted from total benefits to determine net benefits.
                     Net benefits=Total benefits- Total costs
             Benefit-to-cost ratio was calculated.
                     Benefit-to-cost ratio=Total benefits/Total Costs

The financial costs for the year 2015 were obtained through each hospital's accounting reports, questionnaires, observations and opinions of experts. Net Present Value (NPV) calculation for the costs for the two hospitals was not done because the CBA was done through comparison of costs of two OPDs (Any cost reduction with respect to the other hospital was taken as a benefit for the considering hospital.). Decline balance depreciation method was used to calculate computer hardware costs for the relevant year for the OPD of the hospital D.[13] There were basically four types of cost reductions:

1) Cost reduction of stationeries
2) Cost reduction of patient queue waiting time
3) Cost reduction in supporting staff number
4) Cost reduction in indirect costs such as drug balancing and recording

The opinion study was carried out in the same government hospitals to gather information regarding perception of EMR. OPD, clinics and wards were randomly selected from each hospital. Three separate questionnaires were given to randomly select stake holders- health care professionals, supporting staff and patients of the two government hospitals. One hundred patients, fifty health care professionals and fifty supporting staff members were selected.

III.   RESULTS

Benefits-to-costs ratio of OPD of the hospital D for the year 2015 was 0.269 and for hospital AR was 0.0589. Average Benefits for the hospital D relative to the hospital AR for a month for the year 2015 were shown in Table No 2.

Table 2: CBA Calculation Summary

Item	Hospital D		Hospital AR	
	Costs/Rs	Benefit relative to Hospital AR(Rs)	Costs/Rs	Benefit relative to Hospital D(Rs)
Direct Cost for one month				
Cost for waiting time in the hospitals for patients	888250.52	192553.83	1080804.34	0
Physicians salaries	435462.52	0	435462.52	0
Nurses salaries	253561.72	0	126780.86	126780.86

Pharmacists salaries	113267.34	0	113267.34	0
Supporting staff salaries	Rs183779.75	183779.75	367559.50	0
Stationeries				
Cost for total pages for patient registration	0.00	600	600	0
Total cost for paper slips for patients	277.44	43738.56	44016	0
Total cost for pens for staff members	143.20	482.80	626	0

Total cost for a month	1692820.54	457372.38	2205409.51	128562.16
Total cost for the year 2015	20313846.44	5488468.58	26464914.11	1542745.92
Cost of maintenance of EMR system for a year	10000	0	0	10000
Cost of EMR system hardware for the year 2015	8296.54	0	0	8296.54
Total for the year 2015	20332142.98	5488468.58	26464914.11	1561042.46
Net benefit for hospital D	Rs(-14843674.40)	Benefits-to-cost ratio for hospital D	0.26994048	
Net benefit for hospital AR	Rs (-24903871.64)	Benefits-to-cost ratio for hospital AR	0.058985359	

Table 3: Benefits of hospital D relative to hospital AR for a month

Cost Reduction	Rs/Month
1) Stationeries	61201.36
2) Patient queue waiting time	192553.82
3) Supporting staff number	183779.75
4) Indirect costs (for an example drug balancing and recording)	19851.45
Total	457386.38

Only the OPD of the hospital D was able to save Rs 5488636.58 for the year 2015 because of the EMR system.

According to the study results, 54% of the patients visit more than one physician in government and private sector to fulfill their health care needs in last three months, October to December in 2015. 90% of the patients do not have a thorough knowledge on their previous disease conditions and given drug regimens. 89% of the patients think MRs are important in their current and future health care plans. 55% of the patients did not have any kind of a medical record at the time when the survey was conducted. 71% of the above 55% of the patients did not have any idea about their past MR. 59% of the sample was aware about EMR systems and 86% of them had experienced EMR inside the country, while 4% had seen through internet and 10% just heard EMR. 73% of the patients think that EMR systems can increase the efficiency of Sri Lankan health care system and it can save their time by reducing waiting time at health care institute. Study found that average time spent in hospital D was 50.30 ±24.57 minutes and in hospital AR was 63.54±27.42 minutes.

95% of the health care professionals stated that Medical Records are very important in caring patients. 41% of the health care professionals think the responsibility regarding MRs should go to all health care professionals and at the same time, another 41% of

health care professionals think it is the responsibility of all parties including patients and supporting staff. The other 18% of health care professionals feel that it is the responsibility of the supporting staff. 98% of the health care professionals think it is good to have a policy for Medical Records in Sri Lanka to ensure proper maintain. 82% of health care professionals stated that poor legibility and misplacing of the paper based Medical Records as two major issues. When consider the Information Technology (IT) knowledge, 41% of health care professionals did not have a proper IT education, but they can work with computers with experience. 86% of the health care professionals are aware about EMR systems and 73% of them had working experience with EMRs. 95% of the health care professionals think that health IT system can increase the efficiency of health care system in Sri Lanka. 98% thinks EMR make their service more easy and convenient. 91% thinks EMR is the best solution for the previously mentioned difficulties with paper basedMRs. 50% thinks that implementing EMR systems in Sri Lanka is difficult and 64% of the total sample has accounted maintaining as a major problem.

59% of sample thinks that EMR systems can reduce health care expenditures in Sri Lankan health care system.

83% of SS thinks MRs are very important in treating patients.50% of the SS stated that physicians are responsible for MRs and 42% stated that as a responsibility of all parties.100% of the SS stated that it is good to have a policy for MRs in Sri Lanka. Poor legibility (67%) and inability to use in emergency situations (75%) are two major issues with paper based MRs for the SS. 58% of the SS did not have a proper IT knowledge. 67% of SS was aware of EMR systems and 94% of that had EMR working experience.96% of the sample believes that health IT can increase the efficiency of the health care service.100% of SS sample thinks that EMR make their service easier and the best solution for difficulties with paper based MRs is the EMR.88% of the SS stated maintaining as a major problem with EMR systems. Only 21% of SS thinks that EMR system can reduce the health care cost in Sri Lankan health care system.

IV.   DISCUSSION

The study found that Benefits-to-Costs ratio of OPD in hospital D was 0.269 and for hospital AR 0.0589 for the year 2015.Theoretically, it is not a socially beneficial project. However Sri Lankan government provides a free health care service and it does not make any profit. Therefore, when comparing Benefits-to-Costs ratio of two hospitals it can be concluded that hospital D has a higher Benefits-to-Costs ratio relative to hospital A. This means that the hospital D obtains more benefits when compared to its costs than hospital A because of its EMR system. All benefits were the cost reduction due to elimination of papers.

Opinion study showed that, patients do not have a thorough knowledge on their previous disease conditions and the given drug regimens. Patients think Medical Records are very important in their current and future health care management. Majority of patients stated that, EMR systems can increase the efficiency of Sri Lankan health care system and it can save their time by reducing waiting time at health care institutions in both private and public sector.

Health care professionals and supporting staff stated that medical records crucial in caring patients. Health care professional and Supporting Staff agreed to have a policy for MRs for Sri Lanka to ensure proper maintaining of Medical Records. Opinion study showed that health care professional and supporting staffs do not have a clear idea regarding the responsibility of Medical Records. Poor legibility and misplacing of Medical Records were identified as major problems with traditional paper base MRs for health care professionals and poor legibility and poor access in emergencies for Supporting Staff. Health care professionals and Supporting Staff believe that EMR systems can increase the efficiency of Sri Lankan health care service. They suggested EMR as the best solution for the difficulties with paper based recording. They mentioned EMR system maintenance as a major issue with implementation EMRs in Sri Lanka.

As guided by the World Health Organization- Medical Records Mannual- A guide for developing countires (2006), the EMR system that the hospital D has, is able to

1. Collect clinical, adminstrative data at the point of care
2. Exchange data more easily between health professionals to facilitate continuing care within the hospital D
3. Provide valuable statistical data in a timely and efficient manner to public health and health ministry
4. Support management in administrative and financial reporting and other processes

However, the collected data is not directly used for measuring clinical improvement and health outcomes, comparing the outcomes against benchmarks and facilitating research and clinical trials.

Limitation for the study

The study has several limitations. Opinion study was done only in two government hospitals due to issues in time duration. Number of staff members at the selected hospitals was not large enough. Some data used for CBA was not available at hospitals and not easily obtainable from authorities such as prices. Therefore usual market prices had to use. Qualitative factors such as quality of therapy and safe use of medication were omitted because they are time consuming steps. Cost for drugs and laboratory tests had to omit due to different in hospital supply and prescribing patterns.

V. CONCLUSION

Implementation EMRs to Sri Lankan health care system leads to remarkable cost reductions. These cost reductions are originated due to elimination of paper base recordings. If Sri Lankan government implements an EMR system only in OPDs of government hospitals, it leads to save millions of rupees. There are thirty five Type A divisional hospitals in Sri Lanka. If this EMR system is implemented only in OPDs of them, Sri Lankan public health care system would have been able to save Rs192102280.30 in 2015. If the EMR system is expanded to all units of hospitals with an interconnection, it may lead to save billions of rupees annually and Sri Lankan public can have an efficient health care service due to reduction in hospital waiting time. Health care professionals, patients and supporting staff have a positive view on EMRs. But for implementation of the EMR systems, MR policy needs to be introduced to the health care system to ensure proper maintenance.

Finally it can be concluded that implementation of EMR in non profit seeking healthcare institutes, leads to cost reductions.

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AUTHORS

First Author – Amarasiri H.A.D.B., Bachelor of Pharmacy, Department of Pharmacy, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka. dbadanu@gmail.com

Second Author – Dorabawila S.S.K.B.M., PhD, Department of Economics and Statistics, Faculty of Arts, University of Peradeniya,Sri Lanka, samanmald@yahoo.com

Correspondence Author – Amarasiri H.A.D.B., dbadanu@gmail.com , 0094 775 920 302/ 0094 710 871 882