Uganda Health Information Network (UHIN)

COST EFFECTIVENESS OF PERSONAL DIGITAL ASSISTANTS IN HEALTH INFORMATION SYSTEM IN RAKAI AND LYANTONDE DISTRICTS, UGANDA

Nazarius Mbona Tumwesigye, PhD

SUBMITTED TO:

Uganda Chartered HealthNet (UCH)
And
AEDSATELLIFE, Inc.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I am very grateful for the Inputs from Dr. Leela McCullough, Mr. Berhane Gebru, Ms Trudy Masembe, Ms Holly Ladd, Mr. Fred Kakaire, Dr. Mworozi Edson, Patrick Kibaya and Mr. Ernest Mwebaze. All their comments have been very useful.

LIST OF ACRONOMS

Functional	**In good working condition**
HMIS	Health management Information Systsem
MOH	Ministry of Health
UCH	Uganda Chartered Healthnet
UHIN	Uganda Health Information Network
PDA	Personal Digital Assistants

ABSTRACT

Personal Digital Assistants (PDAs) were introduced in 2003 in a pilot scheme to facilitate Health Management Information System (HMIS) data capture and processing in some parts of former Mbale and Rakai districts of Uganda. The handheld computers or PDAs which were given to health workers relay information to devices called Jacks located at places central to a number of health facilities. From the Jacks the information is relayed to a central server at the Uganda Chartered Healthnet (UCH) office in Kampala. Besides facilitating HMIS data flow, the PDAs are increasingly being used for other services such as storage and dissemination of health materials. A study was carried out in April 2007 in former Rakai to establish the cost effectiveness and economic benefits of the PDAs.

The study was cross-sectional and the study units were health workers using PDAs and PDAs. The data collected can be classified into activities in which PDAs are used, costs of alternatives to PDAs, perceived benefits of PDAs, and costs of inputs into use and non-use of PDAs. All health workers who used PDAs were interviewed using a semi-structured questionnaire. Other sources of data were district PDA focal persons and shops for prices of services and materials.

When PDAs were introduced timeliness of submission of HMIS reports improved but changed little since 2004. PDAs are cost effective and have high cost benefit index when over head costs of operating them are already covered by external funding. In one approach of computation of cost benefit index results showed that for every unit of spending one reaps 91.1% of perceived benefits. In another approach that uses allocation factors of the first cost-effectiveness study of PDAs in the districts it was found that for every unit spent, there are 15% more benefits. The hindrances to more use of PDAs include heavy workload, minimal motivation for PDA contact persons, lack of efficient repair and maintenance services. All efforts should be made to address the hindrances to maximum use of the PDAs

1.0 INTRODUCTION

Cost-effectiveness analysis refers to economic analysis of an intervention (UCSF,2002). It compares the cost and effectiveness of two or more alternatives and involves assignment of values to the outcomes (US Dept. of veterans Affairs, 2006). It is also defined as the comparison of the relative expenditure (costs) and outcomes (effects) associated with two or more courses of action. It is typically expressed as an Incremental Cost-Effectiveness Ratio (ICER), the ratio of change in costs to change in effects (Wikipedia, 2006). During the analysis costs and consequences of decision alternatives are both taken into account in a systematic way (Levin, 1995).

In strict sense, cost effectiveness is slightly different from cost-benefit and cost utility all of which are commonly used to relate costs and outcomes. While cost effectiveness of a health project assesses outcomes in health terms cost-benefit assesses outcomes in monetary value and cost utility evaluates the outcomes in terms of subjective value to the decision maker (Levin, 1988) such as cost per Quality Adjusted Life Years (QALY). Cost-effectiveness analysis can be useful for assessing the relative costs and effectiveness of different programmes, but all relevant factors for policy-making and resource allocation can rarely be incorporated in a single analysis (Hurley, 1990). Cost-effectiveness analysis was developed in the 1950s by the US department of Defence as a device for making a decision over demands from different branches of the armed services for costly weapons systems with different levels of performance (Levin, 1995).

In 2003 hand held computers or Personal Digital Assistants (PDAs) were introduced in a pilot scheme to facilitate Health Management Information System (HMIS) data capture and processing in some parts of former Mbale and Rakai districts of Uganda (Manafa and Bududa districts were curved out of Mbale district while Lyantonde district was created from Rakai district). The PDAs, which were initially of Palm M130 models had also other functions ranging from acting as a media for sending vital medical literature and protocol for diagnosis and prescription to being a game board and calculator.

The handheld computers or PDAs which were given to health workers relay information to devices called Jacks located at places central to a number of health facilities. From the Jacks the information is relayed to a central server at the Uganda Chartered Healthnet (UCH) office in Kampala. The link between the PDAs and the Jacks is made possible by infrared beam while the connection between the Jacks and the central server is made via the GSM cellular telephone network and Internet Service Providers.

The project run for 8 months and in 2004 an evaluation study found that the project was viable and cost effective. A cost effectiveness analysis of the project found that it offered 24.2 percent more benefits per unit of spending. It was proposed that the network built expands to all health centers from level III category and above. The expansion would enable a better analysis of the cost-effectiveness since both period and coverage of the extension would be more than those of the initial pilot scheme.

In 2006 more PDAs were bought and supplied to the rest of health centers in former Rakai and Mbale districts. This time the PDAs supplied were of Tungsten models which had more capacity and functions. More staff in different fields of health service were trained and provided with the machines.

The PDAs were supplied under the Uganda Health Information Network (UHIN) project which is being implemented by SATELLIFE, Inc., USA, Uganda Chartered HealthNet (UCH), and the Faculty of Medicine, Makerere University. UCH coordinates the UHIN project from its office in the Makerere University Medical school in the capital city Kampala but has district PDA focal persons in each district. The focal persons, who are facilitated by UCH, are in charge of training and reporting problems with use of the PDAs.

The UHIN project is engaged in equipping health workers with handheld computers (PDAs) to collect data and access health information over the available Cellular networks. The project addresses several of the problems associated with information and

data flow within an under-resourced health system. The network integrates handheld computers also known as Personal Digital Assistants (PDAs), the local GSM cellular telephone network and relay devices, known as "Jacks".

With over three years of implementation of the UHIN project there have been more coverage and more users and therefore the cost effectiveness of the PDAs was due for assessment. At the same time UCH and its sister partners on the UHIN project were looking into a possibility of up-scaling the PDA use to other parts of the country. Therefore this study comes in handy to provide vital information to map out a way forward for the UHIN project.

This cost effectiveness study focused on Rakai and Lyantonde districts because they had minimal disruption in PDA use compared to Mbale, Manafwa and Bududa districts which experienced several Jack failures. At the time of the previsit in October 2006 in preparation for this study health workers in Mbale district were filling the HMIS forms manually because of failure of the Jacks. The analysis is not segregated by district because Lyantonde district health information system was effectively separated from that of Rakai recently in July 2006 (DDHS, 2007).

1.1 Objectives

According to the terms of reference provided by the Uganda Chartered Health Net, objectives of this study were to:

a. To develop a cost effectiveness study methodology of the PDA use
b. To collect data in accordance with the cost effectiveness methodology developed
c. To evaluate the cost effectiveness of use of the PDA network by comparing traditional paper based approaches of HMIS data collection and with the PDAs
d. Assess the economic benefits of using the PDA network

2.0 METHODS

This section outlines the methods that were used to achieve the above objectives. It includes the design, source of data, data collection procedures, data management and data analysis techniques. Unlike other evaluation indices cost effectiveness does not have many established analysis procedures. Measuring cost-effectiveness is a tough area with no easy answers (Mango's guide, 2006). Levin (1995) advises to derive methods from previous evaluations or from tailored evaluations for a current purpose.

2.1 Design

The study was designed as a cross-sectional one. Most information collected depict usage of PDAs, activities engaged in, expenditures, incomes and value of assets and infrastructure as per the week of data collection or in a typical average week since the start of use of PDAs. All benefits and outputs were costed. Costs of all ingredients in the data and information flow within the HMIS with and without the PDAs were computed and compared.

The ingredients approach relies on the notion that every intervention uses ingredients that have costs (Murindwa et al. 2004). All inputs used to effect an intervention and its alternatives are systematically identified and their values determined. All inputs are assumed to have a cost including donated or volunteers resources. The value of an input is its market value. The costs are then analysed in an appropriate decision-oriented framework. Data from accounting and budgetary reports cannot be relied on because they don't include all ingredients (Levin, 1995). The approach was developed to provide a systematic way for evaluators to estimate the costs of social interventions (Levin, 1983).

The study units were HMIS records and HMIS data flow, health workers using PDAs and PDAs. The data that were collected can be classified into costs, effectiveness measures, benefit measures and utilities. The costs data include the cost of PDAs and cost of

ingredients in the HMIS system. The data on effectiveness include proportion or number of facilities that submitted complete returns in a given period or submitted the returns timely. Data on benefits include respondents' score of accuracy, timeliness and other perceived benefits of using PDAs. While cost effectiveness measures were limited to HMIS data flow the benefits measures covered all that respondents perceived as valuable, cost saving or beneficial. Examples of benefits outside HMIS that accrue from Use of PDAs are information dissemination and storage facilities.

2.2 Source of data

The sources of data were health workers who had been given PDAs in Rakai and Lyantonde districts, PDA focal persons in the two districts, companies and shops that sell assets such as computers and furniture in Kampala City and Rakai town. More information was sought through record/document review at district and Ministry of Health (MOH) headquarters and interviews with District Director of Health Services

2.3 Survey preparation and data collection procedures

The first preparatory activity before data collection was a previsit. This was carried out in October 2006. It helped identify key ingredients in use of PDAs. Data collection tools were later constructed and pre-tested during training of Research Assistants (RA) who numbered 10. A one day pilot survey was conducted in Mbale district using the tools. A number of questions were restructured after the pilot survey. The tools used were HMIS record review forms and structured questionnaires. Copies of the tools are in the appendix I.

2.4 Data management

Data from health workers were entered in a computer using EPIDATA 3.1 and later exported to Ms Excell for analysis. Ms Excell was chosen because analysis of cost effectiveness involves a lot of aggregate data summarization and tabulation. Another reason is the interlink between different tabulations. A change in one table changes

several related tables. An example is change in foreign exchange rate which changes tables on personnel costs and costs for physical infrastructure and equipment. In common statistical softwares such as SPSS and STATA such a change requires one to tabulate again. In spreadsheets such as MS Excell changes in related tables occur automatically.

2.5 Data analysis

This sub-section describes approaches used to measure costs, effects, benefits and cost-effectiveness indices.

2.5.1 Measuring costs

The total cost of ingredients can, in short, be expressed as the sum of the product of the unit cost of each asset/ingredient, the share of asset value used over the period of analysis, number of assets of the same kind and the estimated proportion of time the asset was used for each subsystem (PDA and Non PDA-Manual). In algebra, this is expressed as:

$$C_k = \sum_{i=1}^{I} n_i P_i a_i Q_{jk} \qquad (3.1)$$

Where;

C_k = The total cost associated to subsystem k where k=1 or 2 (1=Manual 2=PDA)

n_i = The number of assets of category i

P_i = Unit cost of the ingredient/asset

a_i = Proportion share of asset value used over the period of use. This was obtained by dividing the length of time of use by the life expectancy of the asset

Q_{jk} = Estimated proportion of time the ingredient/asset j was used for subsystem k (PDA or non-PDA). For the PDA use time, the estimate was obtained by dividing the number of hours spent using a PDA in a week divided by 40 hours, the maximum length of official working time in a week. It is assumed here that the proportion of time you spend using a PDA in a week is an estimate of the fraction of the value of the asset/ingredient you are

using while using the PDA as well. To obtain the proportion of time the ingredient/asset would be used for the same activity if PDAs were not used the proportion obtained for PDA use is multiplied by a Time Factor (TF) which is a ratio of time it takes to accomplish without a PDA to the time it takes when using a PDA. That is,

$$Q_{jPDA} = \frac{T}{40hrs} \tag{2.2}$$

$$Q_{jNON\_PDA} = \frac{T}{40hrs} \times TF \tag{2.3}$$

Where $TF = \frac{AT_{Non-PDA}}{AT_{PDA}}$

T = Length of time spent in a week using PDA in hours

TF = Time Factor

$AT_{Non-PDA}$ =Average Time taken to accomplish an activity without using a PDA

AT_{PDA} = Average Time taken to accomplish an activity when using a PDA

In this study the Time Factor (TF) used is computed by considering HMIS activities because the most frequently mentioned activities in which PDAs were used were HMIS related.

It can argued that individual time factors should be used instead of overall average Time Factors. There are problems in this. All the figures used are estimates which are subjective and have highly extremely values. For example the maximum time taken to use a PDA for HMIS information processing was 480 minutes while the minimum was 1.

The costs of personnel were computed by multiplying the monthly salary with the length of time of use of PDAs in months. The cost was apportioned to PDA and non-PDA use in the same way as assets.

The analysis in this paper excludes start up costs and costs of running the UHIN project. Data on start up costs were difficult to get. The focus of this study is mainly on operational costs.

The physical infrastructure and assets considered in this study are those that were being used by a respondent when using a PDA.

2.5.2 Effects and effectiveness

The effects of major interest in this study are the reporting and timeliness of HMIS submissions at district and Health unit level. Health units are supposed to submit HMIS returns by 14th of the following month while districts are supposed to submit returns by 28th of the following month.

Effectiveness is measured by the reporting rate and Timeliness of HMIS data at district and national level. The reporting rate is defined as the proportion of monthly returns in a year that a district sent to the MOH headquarters while timeliness refers to the proportion of the monthly returns that a district sent within 28 days of the following months. Changes in the rates is regarded as a useful effect in this analysis.

2.5.3 Measuring Benefits

Benefits from use of PDAs were quantified to be able to carry out a cost benefit analysis. Two ways were used to quantify benefits. In one way health workers were asked to rank or score the benefits. In the second method benefits are measured in terms of money saved.

In using the benefits score method, the maximum average score was 10 while the minimum was 1. This is the same method used in the previous evaluation (Murindwa et al. 2004) where 8 kinds of benefits were identified. The benefits were timeliness,

accuracy, querying mechanism (ease of identifying a query, error, inconsistency and inaccuracy), completeness, prestige, supervision, motivation and miscellaneous (other benefits not in our list).

An average of rankings for each benefit was computed by category of health worker. The average score from n health workers of category i for the jth attribute was A_{ij}. An overall average score was also computed from the sum of the averages from each category of health workers. An analysis tool for the benefits is shown in Appendix II.

The resultant figure is the benefits index B. The algebra for computation of B is as follows:

$$B = \frac{\sum_{j=1}^{8} A_{j.}}{8} \qquad (2.4)$$

Where;

$$A_{j}. = \frac{\sum_{i=1}^{5} A_{ij}}{5}$$

n_i = Number of health workers in category i where i=1, 2,…,5

$A_{j}.$ = Average score given for attribute j where j=1,2,…,8

A_{ij} = Average score for attribute j given by health workers of category i

Similar rankings of benefits are used by other authors of cost benefit theories and practice including Dasgupta and Pearce, (1987).

In costing benefits in terms of money saved each worker was asked to estimate how much it would cost to engage in an activity similar to the one with which a PDA was used and with the same output. As mentioned in 2.1 all activities in which PDAs were used

were considered in the computation of value of benefits. The total cost from different activities was taken to be the cost of benefits that accrue from use of the PDAs.

2.5.4 Cost effectiveness indices

Cost effectiveness is assessed by differences in costs between different systems, cost per additional benefit score, cost per increment in reporting and timeliness of reporting Another index that was computed is the Incremental Cost-Effectiveness Ratio (ICER), the ratio of change in costs to the change in effects (Wikipedia 2006).

3.0 RESULTS

This section presents results of the survey which are arranged in sub-sections of use of PDAs, costs of ingredients, benefits of use of PDAs.

3.1 Distribution of PDAs

Table 3.1 shows, by district, the health units with functioning PDAs, the number of PDAs that were functioning (good working condition) and the number of PDAs given since 2003. By 2006 one hundred and fifty five PDAs had been given to staff in 80 out of 92 health units in Rakai and 15 out of 18 health units in Lyantonde district. However, at the time of the survey, the PDAs were functional in only 45% of the health units. Of the 115 PDAs given to Rakai only 48% were functioning while of the 40 given to Lyantonde only 70% were functioning. 86 staff were interviewed but 3 of them had just received the PDAs and hence most of the questions were not applicable. 68% of the PDAs in Lyantonde district were used in Lyantonde hospital while 35% of the PDAs in Rakai were used in Rakai and Kalisizo hospitals. The proportions of health workers in hospitals is nearly similar to the distribution of the PDAs in each of the districts.

Table 3. 1 Distribution of health units and PDAs in Rakai and Lyantonde districts

District	Health Units			Personal Digital Assistants (PDAs)		
	Health Units	HUs given PDAs	HUs with functioning PDAs	PDAs given since 2003 (v)	PDAs in use at survey time	% Used in large health units (hospitals)
(i)	(ii)	(iii)	(iv)		(vi)	(vii)
Rakai	92	80	34 (42.5%)	115	55 (47.8%)	19 (34.5%)
Lyantonde	18	15	9 (60.0%)	40	28 (70.0%)	19 (67.8%)
All	**110**	**95**	**41 (45.3%)**	**155**	**83 (53.5%)**	**38 (45.8%)**

Several reasons were raised for low proportion of PDAs being used. On discussion with respondents and PDA contact persons, it was found that staff who were not HMIS or records officers had little time for PDAs and some did not use them at all because of high workload. There was minimal motivation for PDA contact persons to go around health units training staff on how to use them. A problem was raised on lack of efficient repair and maintenance services. An example was given of a PDA in Ndolo Health unit in Lyantonde which was taken 2 years ago to Kampala by UCH staff but had never been brought back. Another limitation was lack of electricity to charge the jacks in places that are far away from the main grid especially when the solar power fails.

3.2 Use of PDAs

A question was asked on how many hours each respondent spent using a PDA on average and the distribution of the time by activity. The same question asked the number of hours the respondent spent or would spend on the same activity without PDA but achieve the same output. Table 3.2 shows the commonest use of PDAs, time saved and a ratio of time spent on activity without using PDA to that spent on same activity but using a PDA. For the purpose of this analysis the ratio is termed as Time Factor (TF). The activity that engaged most health workers (57%) in use of PDAs was preparing HMIS returns. The next common usage of PDAs was reading health messages (48%) reading current news (42%) and games and music (41%). Other activities mentioned that are not in the table below were use of information from PDAs to prescribe, use as calendar, collect data,

write memos, record inventory, carry on administration and supervision, monitor health services, monitor drugs in the store and learn about drugs.

Table 3. 2 Commonest use of PDA, time saved and efficiency

Use (i)	No. Of respondents (ii)	% of 83 (iii)	Median time (min) taken using PDA (iv)	Median time taken without PDA (v)	Time saved using a PDA (vi)	Time Factor (TF) (vii)=(v)/(iv)
a. Preparing HMIS	47	56.6	30	180	150	6.0
b. Read Health message	40	48.2	60	135	75	2.3
c. Read current news	35	42.2	45	120	75	2.7
d. Store Relevant Information	14	16.9	30	90	60	3.0
e. Games and music	34	41.0	120	180	60	1.5
f. Use as a calculator	28	33.7	27.5	90	62.5	3.3

Table 3.2 further shows that when preparing HMIS returns with PDAs it takes a sixth of the time one takes when not using PDAs. Reading health messages on PDAs takes a half of the time one takes when without PDAs. Large differences between time taken when using PDAs and when not using them can be explained by long distances to the library, town, slow internet cafes in towns and transport delays. In subsequent computation of costs of ingredients into PDA use the Time Factor (TF) for use of PDA in preparing HMIS (6 times) is used to allocate time and hence costs incurred when PDAs are not used. The choice of TF for HMIS preparation is due to the largest number of respondents that engage in the activity. The computations that follow greatly change when the efficiency in accessing health messages (2.3) is used instead of the TF for preparation of HMIS (6.0).

3.3 Cost effectiveness assessment

The section below is divided into sub-subsections of costs all key ingredients in HMIS manual and PDA systems, costs of personnel, effects of introduction of PDAs and cost effectiveness indices.

3.3.1 Costing Ingredients in HMIS manual and PDA system data flow

One of the major elements of the evaluation is to obtain an estimate of the cost of running a PDA and a non-PDA system. This involves identifying all ingredients into the systems, how long each ingredient has been contributing to systems and the cost of the contribution. The ingredients were categorized into personnel, physical structures, equipment and other inputs. The costs shown have been converted from Uganda Shillings to US dollars at a rate of Shs 1635 per US$ as per interbank exchange rate of 24th July 2007 (Oanda Corporation, 2007). Appendix III shows a list of identified ingredients and details that include how long each had been used and the cost incurred.

Table 3.3 shows the costs of equipment and physical infrastructure, costs apportioned to PDA use and non-PDA use considering the prevailing Time Factor (TF) of 6 (Ratio of time it takes to accomplish a task when not using a PDA to the time it takes when using a PDA). The results show that when PDAs are functional and are used in the activities mentioned in subsection 3.1 it costs only US$ 12,270 compared to US$ 66,965 for the total cost when PDAs are not used. When physical infrastructure (office space) is excluded the total costs are much lower (US$ 3,406 for PDA system and US$13,771 for non-PDA system).

Table 3.4 shows the imputed costs of personnel since they started using PDAs. For the time the personnel used the PDAs the imputed cost to the employer was US$ 141,551 compared to US$ 850,015 if they did not use the PDAs. The total imputed cost of labour, equipment and physical infrastructure during the time of use of PDAs is US$ 153,940 compared to US$ 916,970 (850,015+66,955) if the activities carried out with PDAs were carried out without them.

Table 3. 3 Imputed Costs in US$ for Physical infrastructure and equipment since PDAs were introduced

Ingredient (i)	Total cost since start of use of PDA (ii)	Part of total cost apportioned to PDA use (iii)	Cost apportioned to non-PDA use* (iv)	Difference in cost between PDA &non-PDA (v)=(iv)-(iii)
Office space	18,104	8,864	53,184	44,320
Chairs	293	155	928	773
Desks	263	126	758	632
File Cabinets /Shelves	166	74	444	370
Computers	742	645	3,872	3,226
Printers	118	125	751	626
UPS	26	30	182	152
PDA	1,111	1,111	-	(1,111)
Solar panel	2,016	1,099	6,595	5,496
Normal charger	74	40	241	201
Overall Total	22,912	12,270	66,955	54,684
Minus office space	4,808	3,406	13,771	10,364

*The figures in the column shows how much it would cost if PDAs were not used in the same activities PDAs were used for considering the prevailing Time Factor (Ratio of time it takes to accomplish a task when not using a PDA to the time it takes when using the PDA for the same task)

Table 3. 4 Imputed Personnel costs in US$ since PDAs were introduced

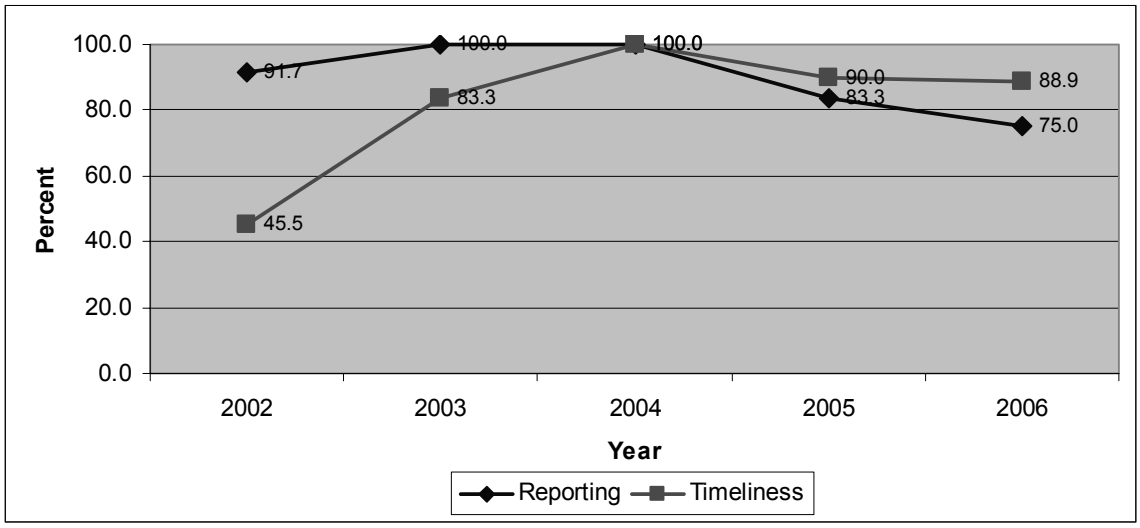
Personnel (i)	Amount paid since start of PDA (ii)	Amount paid apportioned for PDA work (iii)	Amount paid apportioned for non-PDA work* (iv)	Difference in costs between PDA and non-PDA use (v)
a. HMIS officers	19,382	19,933	119,598	99,665
b. Records Assistants	36,423	18,267	109,603	91,335
c. In-Charges	129,266	43,308	259,849	216,541
d. Administrators	16,911	4,336	26,018	21,682
e. Members of Management committee	807	606	3,633	3,028
f. Other	110,024	55,219	331,313	276,094
Total	312,813	141,669	850,015	708,345

3.3.2 Effects

The major effects of interest are reporting and timeliness rates of HMIS reports. Reporting at district level refers to percent of HMIS monthly returns from the district that reach the Ministry of Health (MOH) headquarters. Timeliness at district level refers to percent of HMIS monthly returns that reach the MOH by 28th of next month. At the facility level reporting refers to percent of health units that presented their monthly returns while timeliness refers to percent of health that submit their monthly returns by 14th of next month. It is difficult to attribute the changes in reporting rate and timeliness on introduction of PDAs in a situation that wasn't fully controlled. However since there is no known clear intervention in HMIS data flow we can to some reasonable extent attribute the changes to PDAs.

Figures 3.1 show the changes in reporting and timeliness rates of Rakai district at the national level. PDAs were introduced in 2003 and the reporting rate at national level rose from 92% in 2002 to 100% in 2004 while the timeliness rate increased from 46% in 2002 to 100% in 2004. This is a change of absolute value of 8% on reporting and 54% on timeliness. However, the reporting rate declined to 75% in 2006 and the timeliness level reduced to 90% in 2006. This is an absolute reduction of 25% in reporting and 10% in timeliness.

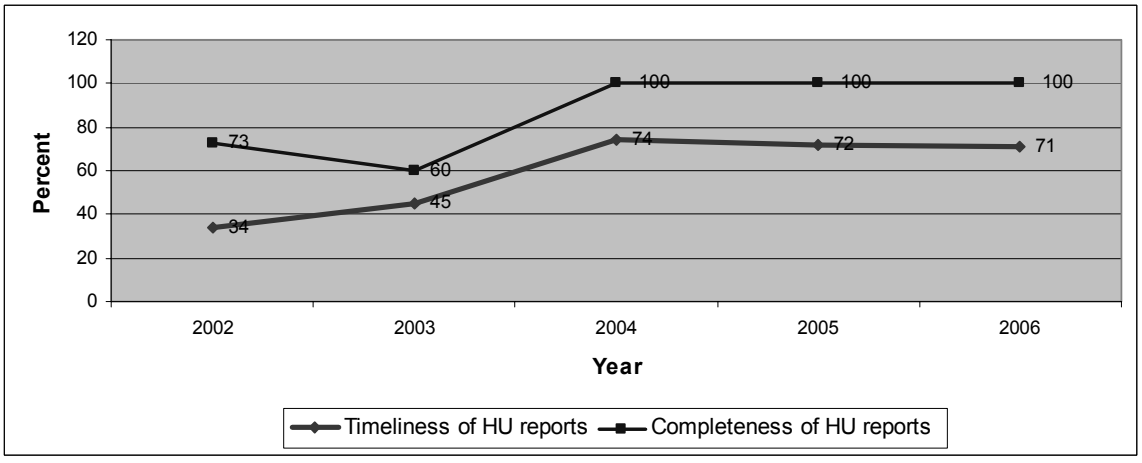
Figure 3. 1: Reporting and timeliness rates of HMIS at district level: Percent of HMIS monthly returns received by the MOH from Rakai district byfrom 2002 to 2006



Source of data: MOH, 2007

Figure 3.2 shows the timelines of Health unit reports at district level. The timeliness rate increased from 34% in 2002 to 74% in 2004 and then 71% in 2006.

Figure 3. 2 Timeliness and completeness of submission of HMIS data from Health Units to district: Percent of HMIS monthly returns from health units submitted by 14th of next month to Rakai district from 2002 to 2006



Source of data: Rakai District HMIS

Changes in effects

Figures 3.1 and 3.2 show a slump in timeliness and reporting because of a number of reasons mentioned by the staff interviewed.

Firstly, there has been a declining trend in funding for activities related to HMIS. This has reduced the morale of the health workers.

Secondly, a number of jacks were not functional at certain times. This forced the health workers to fill the HMIS manually. Some of the staff said they are not able to make timely delivery of the reports because they reside far away form either their Health Sub-District (HSD) or district offices involving transport costs and yet money may not be readily available. Another avenue for sending reports is waiting for visitors from either the district or HSD to help deliver the reports. However at times these supervisors also may not come in time. At Health Sub-District level, health workers find that some reports of lower level health units are late which forces them to wait a little longer before submitting the entire HSD report to the district.

Secondly, some facilities are getting busier with few staffs leaving very little time for compiling the HMIS information leading to delays in delivery of the forms. There are many projects going on in the districts and the volume of work cannot allow them time to work on the HMIS.

3.3.3 Cost effectiveness indices

Table 3.5 shows cost effectiveness indices that summarise major findings in the study. They show that on average a unit change in timeliness of HMIS reports to MOH costs US$ 17,342 while the corresponding figure for timeliness of Health Unit reports at District headquarters is US$44,884. The assumptions are that the changes in effects were due to introduction of PDAs and that the time factor of 6 applies on all activities that use PDAs.

Table 3. 5 Cost effectiveness indices

No	Indices	Using PDA	Not using PDA	Difference	Assumptions or comment
1	Costs of ingredients in US$	153,940	916,970	763,030	Assumption: Time factor =6 as in HMIS compilation activities.
2	Effects-Reporting-District (%)	75 (2006)	92 (2002)	-17	Decline
3	Effects-Timeliness –District (%)	90 (2006)	46 (2002)	44	Improvement
4	Effects-Timeliness-Health Unit (%)	71 (2006)	34 (2002)	17	Improvement
5	Incremental Cost-Effectiveness Ratio (ICER)-Reporting to MOH	-44,844.			
6	Incremental Cost-Effectiveness Ratio (ICER)-Timeliness-Reporting to MOH	17,342 Assumption: Changes in the effects were due to the PDAs			
7	Incremental Cost-Effectiveness Ratio (ICER)-reporting from Health Unit to District	44,884 Assumption: Changes in the effects were due to the PDAs			

3.4 Economic Benefits of PDAs

This section presents assessment of economic benefits of using PDAs. The section starts with scoring a selection of benefits then costing a list of perceived benefits and later a computation of the cost-benefit indices.

The benefits in use and non-use of PDAs were presented in form of scores and imputed costs of benefits

3.5.1 Score of benefits

Table 3.6 shows average rankings for each kind of benefit that accrued from use and non-use of PDA by the respondents. The table shows that using PDAs increases the benefits rankings from 5.08 to 8.38, a difference of 3.30. This is a 65% increase in perceived

benefits. PDAs score highly on accuracy, timeliness and prestige. It is clear that motivation and prestige score lowest on the manual/non-PDA system.

3.5.2 Costing the benefits

Table 3.7 shows the benefits from use of PDAs which were costed at US$ 161,294. The benefits include reading health messages and protocols, ease of preparing HMIS, enjoying games and music. Games and Music were valued highly because of the costs in traveling to urban areas to play in casinos and game centres.

Table 3. 6 Benefits rankings for PDA and Non-PDA Use

No (I)	Benefits (ii)	HMIS Officer (iii)	Records Assistant (iv)	In-Charge or MO (v)	Administrator (vi)	Other (vii)	Average
	PDA use						
1	Data Accuracy	8.75	8.90	9.08	10.00	8.97	**9.14**
2	Timeliness	9.25	8.40	8.84	9.67	8.74	**8.98**
3	Querying	5.25	6.80	6.52	8.67	6.85	**6.82**
4	Completeness	9.25	9.10	8.54	8.33	8.62	**8.77**
5	Prestige	8.50	8.70	8.65	9.33	9.15	**8.87**
6	Supervision	7.50	6.80	8.23	8.67	8.18	**7.87**
7	Motivation	8.75	8.40	8.38	9.33	8.42	**8.66**
8	Miscellaneous	9.33	7.60	7.88	6.67	8.29	**7.95**
	Average	**8.32**	**8.09**	**8.27**	**8.83**	**8.40**	**8.38**
	Non-PDA use						
1	Data Accuracy	4.50	6.00	6.20	6.13	5.59	**5.68**
2	Timeliness	5.50	5.10	5.20	4.33	5.97	**5.22**
3	Querying	6.25	5.73	5.88	3.67	4.94	**5.29**
4	Completeness	4.75	6.40	6.04	5.33	6.00	**5.70**
5	Prestige	3.50	4.90	5.00	1.00	4.79	**3.84**
6	Supervision	4.25	5.50	5.32	4.67	5.79	**5.11**
7	Motivation	4.25	5.00	4.62	4.67	4.30	**4.57**
8	Miscellaneous	4.00	3.90	3.32	11.00	3.85	**5.21**
	Average	**4.63**	**5.32**	**5.20**	**5.10**	**5.16**	**5.08**

Table 3. 7 Cost of benefits from use of PDAs

Benefits of PDA	Unit of measure	Cost of achieving the same without PDA in one week (Use local rates)-1 in Ug Shs	Total cost since PDAs were introduced Ug Shs.	Costs in US dollars at a rate of Shs US$ 1635 per US$
a) Helps in preparing HMIS report	Photocoping, transport	638,700	56,293,714	34,430
b) Read Health messages and guidelines	Cost of Manual guide, internet, journals	1,000,500	70,236,429	42,958
c) Read current news	Cost of 1 daily local new papers	147,800	13,851,429	8,472
d) Store relevant information including personal	Cost of cheapest notebook or media	348,000	18,613,286	11,384
e) Provides Games and music	Cost of going to Masaka or Kampala, play and return	354,000	34,448,571	21,069
f) Use as a calculator	Cost of a calculator	265,500	265,500	162
g) Use as a tool for prescribing patterns	Transport to nearest place with the manuals	9,000	492,857	301
h) Recording number of admissions and discharges	Cost of Extra load	26,000	1,688,571	1,033
i) Calendar use	Cost of a calendar (one per year)	24,000	38,000	23
j) Tools for Collecting data	Cost of delivery from district	178,000	15,595,714	9,539
k) Generate reports	Typing costs, papers	5,015	364,607	223
l) Used for enter ing information on HIV patients	Cost of going to hospital to enter data	45,000	5,978,571	3,657
m) Writing memos	Cost of paper/notebook	7,000	840,000	514
n) Provides knowledge on health management	Cost of travel to library	216,000	15,702,857	9,604
o) Sending and retrieving information to and from the district	Transport	101,000	10,560,000	6,459
p) Use it as a clock	Cost of a clock (once)	14,500	14,500	9
q) Inventory recording	Exercise books	77,000	2,014,286	1,232
r) Administrative assistance	Writing letter, vouchers, use of stock cards for drugs, chemicals	30,000	4,500,000	2,752
s) Supervision tool		50,000	10,928,571	6,684
t) Can be used as a weekly duty roaster	Imputed cost of time spent	20,000	1,285,714	786
u) Teaches how to use the PDA well	Paper brochure	4,000	3,086	2
		3,561,015	**263,716,263**	**161,294**
Without Music and games		**3,207,015**	**229,267,693**	**140,225**

NB: In subsequent computations costs for games and Music are not included

3.6 Cost benefit Indices

Table 3.8 shows the computation of the cost-benefit ratio using the costs of ingredients and value of benefits. The cost benefit ratio was 0.911 or 91.1%. This implies that for every shilling spent on PDA, you reap shs 0.91 in benefits in a period of 18 months (median time duration since respondents started using PDAs). Comparison of the index with the first cost-effectiveness study is difficult since the computation method is not the same.

Table 3. 8 Cost benefit indices

No	Indices	Using PDA	Not using PDA	Difference	Assumptions or comment
1	Costs of ingredients in US$	153,940	916,970	763,030	Assumption: Time factor =6 as in HMIS compilation activities.
2	Value of benefits of PDA in US$	140,225			
3	Cost benefit Ratio	0.911 or 91.1			

3.6.1 Comparison of cost-benefit indices with first study

In the first cost effectiveness study by Murindwa et al. (2004), a Cost effectiveness Index was computed by

$$\frac{I_b}{(Cost_{PDA} - Cost_{Non-PDA})/\text{Cost}_{\text{Non-PDA}}}$$

Where
I_b =Index of additional benefits which is the average score of benefits as in table 3.6 first section
$Cost_{PDA} - Cost_{Non-PDA}$ =Difference of subsystems between PDA and Non-PDA use
$Cost_{Non-PDA}$ =Cost when not using PDAs

Table 3.9 shows the total cost of ingredients and parts of the total costs apportioned to PDA and non-PDA use using allocation factors as those used in first study. The difference in the subsystems is US$ 25,389. The index of additional benefits from table 3.6 is 8.38 (max=10) which is 0.838 when the maximum is 1. These figures, together

with the cost apportioned to non-PDA use give a cost effectiveness index of 0.154 or 15.4%. This shows that there is an additional 15.4% benefit per unit of spending. This is lower than what was obtained in the initial study assuming the accuracy of allocation factors. However, there is a caution on the comparisons. The two studies are different in that while the first one concentrated on HMIS this one includes other uses of PDA. The decline can be attributed to lack of quick technical support for the PDA systems which resulted into non use and malfunctioning.

Table 3. 9 Total cost of ingredients apportioned to PDA and non-PDA use using allocation in first cost-effectiveness study

Ingredient (i)	Total cost since start of use of PDA (ii)	Part of total cost apportioned to PDA use (iii)		Cost apportioned to non-PDA use* (iv)		Difference in cost between PDA &non-PDA (v)=(iv)-(iii)
		Allocation Factor	Amount	Allocation Factor	Amount	
Office space	18,104	0.10	1810.4	0.30	5431.2	3620.8
Chairs	293	0.10	29.3	0.30	87.9	58.6
Desks	263	0.10	26.3	0.30	78.9	52.6
File Cabinets /Shelves	166	0.05	8.3	0.90	149.4	141.1
Computers	742	0.80	593.6	0.40	296.8	-296.8
Printers	118	0.40	47.2	0.30	35.4	-11.8
UPS	26	0.50	13	0.50	13	0
PDA	1,111	1.00	1111	0.00	0	-1111
Solar panel	2,016	1.00	2016	0.00	0	-2016
Normal charger	74	1.00	74	0.00	0	-74
TOTAL	22,913		5729.1		6092.6	363.5
Personnel costs	312,813	0.05	15,641	0.13	40,666	25,025
GRAND TOTAL			21,370		46,758	25,389

3.7 Decision tool: Fishman's table

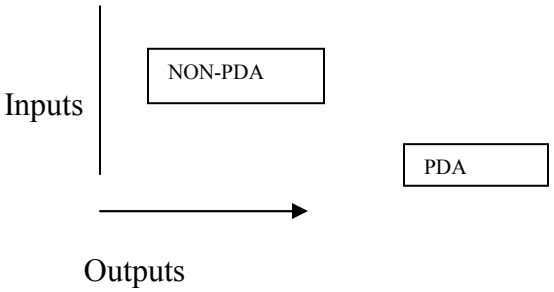
The results from the cost effective and cost-benefit analyses above can be used to make a choice between costs and outcome of use of PDAs. The Fishman's table which consists of rows of inputs and columns of outputs is one of the decision tools commonly used to make a choice of systems (NIDA, 2006). Table 3.10 shows Fishman's table featuring comparison of costs of running PDA and non-PDA systems in the rows and outcomes in the columns. The shaded cell indicates that PDAs have better outcomes than having no PDAs and the costs are lower when using the PDAs. Therefore, if people are to enjoy the same facilities PDAs provide then having PDA is much cheaper than not having any and the outcomes are also better when one uses PDAs.

Table 3. 10 Fishman's table: Cost-Outcome decision between PDA and non-PDA system

Cost	**Outcomes**		
	PDA has better outcomes than Non-PDA	**PDA and non-PDA have similar outcomes**	**PDA has worse outcomes than non-PDA**
PDA has lower costs than Non-PDA	Choose PDA	Choose PDA	Uncertain
A and B have similar costs	Choose PDA	Choose either	Choose non PDA
A has higher costs than B	Uncertain	Choose non-PDA	Choose non PDA

Results in table 3.8 are mirrored in figure 3.3 below. The figure shows that PDA use requires few inputs but the outputs are many. This can also be viewed in terms of monetary values. That is PDA use requires low value of inputs but results into high value outputs.

Figure 3. 3 Comparison inputs and outputs in HMIS data flow



3.8 Limitations in this study

This study has a number of limitations which any reader needs to consider. Some of the limitations were beyond the control of the researchers.

Firstly, comparison groups were lacking yet this is an important part of cost effectiveness studies. The study did not have a control district or other interventions for comparison because of financial constraints. To get comparative figures like costs incurred when PDAs are not used a time factor of 6 was multiplied by corresponding costs when PDAs are used. This is over assumption. Not all activities took 6 times longer when carried out without PDAs compared with when PDAs are used. In addition not all people worked HMIS where the factor applied.

Secondly, start up capital and expenditures at Uganda Health Information Network (UHIN) are not included in the ingredients. This underestimates the costs of ingredients.

Thirdly, the effects in timeliness and reporting could have been due to PDAs that worked for sometime and got faulty or abandoned. The information on these PDAs was not captured in the survey.

Fourthly, some computations are based on perceptions. An example is scores for PDA and non-PDA systems. Giving a score on accuracy of a PDA or manual system is highly subjective. If one recently had a problem with adding up figures manually he will score PDAs highly after use of a PDA.

Fifthly, seasonality effects do have a role to play in estimation of time spent using a PDA. The answer to a question on average number of hours in a week that one uses a PDA is largely influenced by events around the time of survey. If in the weeks prior to survey time a respondent had ample time using a PDA that is the time he will provide. The time would be different in other months when the respondent is busy and cannot use the PDAs.

Lastly, the intervention of PDAs is not controlled. Though, no known intervention on HMIS has been established since introduction of the PDAs one is not sure whether the improvement in timeliness and reporting was not due to Ministry of Health (MOH) or other stakeholders.

Comparison cost effective and cost-benefit rates with the previous study is difficult since some computations depend on perceptions and guess work of the respondents. This more evident on time apportioned to PDA and non-PDA work. The difference in times of the study can change the kind of responses especially when characteristics of the respondents change.

4.0 DISCUSSION, CONCLUSIONS AND RECOMMENDATION

This chapter discusses the key findings and presents the conclusions and recommendations based on the findings.

4.1 Discussion

From this study new information has been established on usage, costs, effects and benefits of use of PDAs in Rakai and Lyantonde districts. The study has found out that there has been a problem with functioning of the PDAs and that most of the PDAs are used in hospitals. The few that were operational at the time of the survey were being used in many aspects of health service delivery. The study further shows that PDAs save a lot of time in all activities in which they were engaged. Since introduction of PDAs timeliness of submission of HMIS reports has improved greatly though there has been minimal or no change since 2004. PDAs are highly rated in terms of benefits and can save much money when the costs of several benefits are imputed. PDAs have also been shown to be highly cost effective.

The non-functionality of PDAs is an issue that should raise concern with the project implementers and stake holders. This study did not conclusively establish reasons why the other PDAs where not in use because those who were not using the PDAs were not interviewed. The study relied on PDA focal persons to get information on non use of the PDAs. However, the issue is characteristic of sustainability problems with new projects and new technologies.

It is gratifying to note that PDAs were being used in many aspects of health service delivery. This is a manifestation of the ability and interest to adopt new technology in Uganda as in other parts of the world. Many studies have shown how health workers in developed countries have adopted PDA use for on-spot information necessary for anesthesia (Fu, 2003), surgery (McCaffrey 2003), Peadiatrics (Weigle, 2001) general practice (Greiver, 2001) and obstetrics (Joy, 2004). PDAs have also been used to collect

patient information, improvement of records for administrative functions such as electronic prescribing (Grasso, 2002), coding (Luo, 2004), tracking in research projects and continuing medical education (Abubakar et al. 2004).

PDAs save a quite a lot of time on many activities and this is one of the reasons why they should be promoted and made accessible to everybody. This echoes what several authors including Levin (1999) have written about PDAs.

High rating of PDAs shows perceived benefits of the users. This builds on earlier cost effectiveness study (Murindwa et al 2004). Users still find a lot of benefits in PDA use.

Imputed value of benefits from PDA use are quite high. One of the reasons why the value is high is the high cost of travel. To take HMIS forms to the district or to the Ministry of Health (MOH) headquarters is quite high. To play computer games that come on PDAs requires one to go to the nearest big town that have computer centres. This involves the transport cost to the town and hire of a computer or game machine.

4.2 Conclusions

From the above results it can be deduced that if over head costs of administration are covered PDAs can reduce costs of running HMIS and many other activities beneficial to health service delivery. Investing in PDAs is highly cost beneficial as there is more than 100% return of costs. Once the systems has been established, low value inputs are required for high value outputs. Assuming that the time taken in running health services that PDAs can be engaged in (used as tools) is a perfect factor of the costs incurred then using PDAs are higly cost effective tools.

4.3 Recommendation

From the study findings a number of recommendations can be made in regard to benefits and cost effectiveness of the PDAs.

There is a need to keep a log of all PDAs given, their functioning status, who is using other necessary information. This way it will be easy to know what is happening to the PDAs.

Continuous training of health workers is essential if more benefits are to be realized from use of PDA. Some health workers did not use the PDAs because they did not know how to use them.

Record keeping of all costs incurred, benefits and effects of intervention are important in monitoring and evaluation of the project. It was difficult to get information on administration issues of the project and information of reporting rate of the district HMIS was obtained from the Ministry of health quarters.

Constant technical support of PDA users in the district is crucial. Some users complained that when the machines go faulty they take long to get support.

The PDA data collection mechanism should be well integrated into the district programme, making follow up and supervision easier. This will also help health workers appreciate and make use of the benefits of the programme after confirming it is part and parcel of the district programme.

More jacks should provided to reduce distances travelled when sending the information otherwise the health staff would resort to their old method of data compilation

REFERENCES

Abubakar, I., Williams, C.J. and McEvoy, M. 2005. Development and evaluation of hand held computer based on-call pack for health protection out of hours duty: A pilot study. *Biomed Central Public Health,* 5:35.

Dasgupta, A.K. and Pearce, D.W. 1978. *Cost-benefit analysis: Theory and practice.* Allen and Unwin. London.

DDHS-District Director of Health Services, 2007. Personal communication with Dr. Katumba, the DDHS of Lyantonde on 27th July 2007 9:30 pm.

Fu Q, Xue Z, Klein G: Using mobile information technology to build a database for anesthesia quality control and to provide clinical guidelines. *Stud Health Technol Inform* 2003, **95:**629-634.

Greiver M: Evidence-based medicine in the palm of your hand. *CMAJ* 2001, 164:250.

Grasso BC, Genest R, Yung K, Arnold C: Reducing errors in discharge medication lists by using personal digital assistants. *Psychiatr Serv* 2002, 53:1325-1326.

Hurley,S, 1990. A review of cost-effectiveness analyses. *Medical journal of Australia.* Number 153. Suppl:S20-3

Joy S, Benrubi G: Personal digital assistant use in Florida obstetrics and gynecology residency programs. *South Med J* 2004, 97:430-433.

Levin, H.M. 1983. Cost-Effectiveness: A primer. Sage Beverly Hills. Calfornia

Levin, H.M. 1988. Cost-effectiveness and Educational Policy. *Educational Evaluation and Policy Analysis*. Spring Vol. 10. No.1, pp51-59. Website: http://www.jstor.org/view/01623737/ap040043/04a00050/0?frame=noframe&userID=51c71113@mak.ac.ug/01cce4405b00501b46d56&dpi=3&config=jstor

Levin, H.M. 1995. Cost-effectiveness analysis: In International encyclopedia of economics of education, 2: Ed, Carnoy,M. Pp 381-386. Oxford: Pergamon.

Levine R. Avoid the paper chase. real-time, wireless patient documentation helps therapists save both time and money. Health Inform. 1999. Jan; 16:(1):73–4.

Luo J: Portable computing in psychiatry. *Can J Psychiatry* 2004, 49:24-30.

Mango, 2006. Mango's guide to financial management for NGOs, **http://www.mango.org.uk/guide/advanced/accountability/cost.aspx**. 01/12/2006.

McCaffrey TV: Using hand-held computing devices in the practice of otolaryngology-head and neck surgery. *Curr Opin. Otolaryngol Head Neck Surg* 2003, **11:**156-159.

Murindwa,G., Muhumuza, F.K.,Mworozi, E., Asimwe, S.,Kakaire, F., Shinyenkwa,I.,Nzabanita,A. and Dongo,D.W., (2004). Cost effectiveness study report of Uganda Health Information Network. *A consultancy report available at Uganda Chartered HealthNet*. Kampala.

NIDA-National Institute on Drug Abuse, 2006. Compare program and program components http://www.nida.nih.gov/IMPCOST/IMPCOST11.html. 20/10/2006

Ouanda corporation, 2007. Currency exchange converter for 164 countries. Website: http://www.oanda.com/convert/classic Date: 24th July 2007.

UCSF, 2002. Good investment fact sheet. Can cost-effectiveness analysis help in HIV prevention? Website : **http://caps.ucsf.edu/pubs/FS/pdf/costeffectiveFS.pdf**, 01/12/2006

US dept of Veterans Affairs, 2006. General cost effectiveness Analysis Issues. Website **http://www.herc.research.va.gov/resources/faq_a01.asp**. 01/12/2006

http://www.ncbi.nlm.nih.gov/books/bookres.fcgi/pih/ch3.pdf

Weigle CG, Markovitz BP, Pon S: The Internet, the electronic medical record, the pediatric intensive care unit, and everything. *Crit Care Med* 2001, 29:N166-N176.

Wikipedia, 2006. Cost effectiveness. Wikipedia, the free encycropeadia. Website http://en.wikipedia.org/wiki/Cost-effective. On 01/01/2007

APPENDIX IA: CONSENT FORM AND USER QUESTIONNAIRE

THE EVALUATION OF THE UGANDA HEALTH INFORMATION NETWORK PROJECT

Dear Sir/Madam,

My names are _____ I am part of the team from Makerere University Institute of Public Health that is evaluating the use of Personal Digital Assistants (PDAs). The hand held computers have been in use for some time and we are trying to study their effectiveness, benefits, sustainability and acceptability by the users. I am therefore requesting you to kindly answer some few questions concerning the small computers. The information you provide will be a great input in deciding and planning their future use in the country.

You are free to express your opinions and provide any information you think is important. The information provided will be kept very confidential. The time for the interview will be only 40 minutes.

Should I go ahead and ask you the questions?
□ Yes □ No *(SAY THANKS AND LEAVE)*
Thanks you so much for your cooperation.

APPENDIX IB: QUESTIONNAIRE

Name of LC 1: _____

Name of health unit _____

Sub-county _____

Health sub-district _____

District _____ Contact telephone _____

PART I: BACKGROUND CHARACTERISTICS

Q1.01	Sex	1. MALE 2. FEMALE	
Q1.02	Age in completed years		
Q1.03	Education level	1.PRIMARY 2. SECONDARY (S1-S4) 3. SECONDARY (S5-S6) 4.TERTIALLY (UNIVERSITY, COLLEGE)	
Q1.04	Designation	1. HMIS OFFICER 2. RECORDS ASSISTANT 3. IN-CHARGE HEALTH CENTRE 4. ADMINISTRATOR 5. MEMBER OF THE MANAGEMENT COMMITTEE 6. OTHER (SPECIFY) _____	
Q1.05	How long have you been working here in years (approximate to full year)		
Q1.06	On which date did you start using PDAs	DAY MONTH YEAR	
Q1.07	What exactly do you do with the PDA? (WRITE ALL ACTIVITIES MENTIONED)	_____ _____	
Q1.08	When did you last handle HMIS data?	DAYS AGO **(WRITE 97 (NOT APPLICABLE) IF THE PERSON DOES NOT DEAL WITH HMIS DIRECTLY)** WEEKS AGO MONTHS AGO YEARS AGO	

PART II: BENEFITS

Q2.01	What are the benefits of using the PDAs vis-à-vis the HMIS forms HMIS system	_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	

PART III: COSTING OF INGREDIENTS

(Respondent is anyone using a PDA. write 'na' if not applicable)

Q3.0 ASSETS

No (I)	Ingredients (ii)	Quantity (iii)	Model (iv)	Manufacturer & date (v)	Unit cost in Ug Shs (vi)	Year & month it was brought here (vii)	Life expectancy (determined by investigator) (viii)	% of lifetime used* (ix)	Time allocation: PDA, HMIS forms & Others		
									# of hrs used for PDA(x)	# of hrs used on HMIS forms(xi)	%time used for others (xii)
1	Office Space (sq.m)										
2	Chairs										
3	Desks										
4	File Cabinets /Shelves										
5	Computers										
6	Printers										
7	UPS										
8	PDA										
9	Solar panel										
10	Normal Chargers										
11	Other Computer Accessories										
12	Paper										
13	Data Forms										

Notes: Leave columns 8(viii) and 9 (ix) ;
For rows 2 (Chairs), 3(desks) and 4 (cabinet) model you may fill wooden or modern

PART IV: REMUNERATION AND WORKING SCHEDULE OF PERSONNEL

Q4.1 What is your salary scale? _____

Q4.2 What is your monthly pay including allowances ? _____

Q4.3 On average, for how many hours in a week do you use a PDA? _____

Q4.4 Of the hours you spend using a PDA in a week, what is the distribution of the time by activity, what could have been done without the PDA

Use of PDA

Activity (E.g searching treatment information, filling HMIS information) and time it takes **(i)**		**Achievement (e.g obtained 2 treatment algolithm, filled 2 HMIS forms)** **(iii)**	**Details of what could have been done and time it would take to achieve the same without PDAs** **(iv)**		**Cost of achieving the same without PDA (Use local rates)** **(v)**
Activity	**Hrs/ Min** **(ii)**		**Detail**	**Hrs/ Min**	
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Q4.5 In a typical week when do you use a PDA?

1=Concurrently with day to day activities
2=Certain hours of the day
3=Certain days
4=Certain days and hours
5=Any time or any day

Q4.6 If 2 above (in Q4.5) state the hours _____

Q4.7 If 3 above (in Q4.5) state the days _____

Q4.8 If 4 above (in Q4.5) State the days ____ and time _____

PART V: BENEFITS RANKING

The respondent must be an HMIS officer/Records assistant/ In-charge of health unit/administrator/Member of management committee

Q5.1 Kindly rank the following on a scale of 1 to 10.

EVALUATION OF HMIS FLOW WITH AND WITHOUT PDAs: RANKINGS ON A SCALE OF 1 TO 10

No (I)	Attributes Benefits	With PDA	Without PDA
1	Data Accuracy		
2	Timeliness		
3	Querying		
4	Completeness		
5	Prestige		
6	Miscellaneous		
7	Supervision		
8	Motivation		
9	Other		
10	Other		

PART VI: HEALTH FACILITY BASED INFORMATION
(Respondent is an In-charge of the health facility or assistant)

Q6.1 Kindly provide us with the information below

UTILITIES

Utility	**Units**	**Cost per unit**	**Number of units spent**	**Share of time spent on**	
				HMIS forms System	**PDA system**
1. Electricity	Units				
2. Internet access	Minutes				
3. Water	Units				
4. Telephone	Minutes				
5. Others (List all other costs incurred at health facility level)					
6. Jacks					

6.2 May I please know your suggestions on how the cost effectiveness of PDAs (Deriving more benefits and efficiency) can be improved. What more needs to be done?

PART VII: INFRASTRUCTURAL AND OPERATIONAL COSTS AT DISTRICT LEVEL

Respondent is the District focal person for PDA in consultation with DDHS

Q7.1 Kindly provide us with the information below

		Without PDAs			**With PDAs**		
Id	**Ingredient**	**Units**	**Cost of each unit**	**Total cost**	**Units**	**Cost of each unit**	**Total cost**
1	Connectivity (connecting to PDA network)*						
2	Training						
3	Travel costs to district headquarters						
4	Travel costs from District to MOH headquarters						
5	Maintainance costs						
6	Meetings						
7	Data processing						
8	Report writing						
9	Posting/faxing/courier						
10	Photocoping						
11	Other costs						

NB: * Connectivitiy costs will be obtained from UCH (Uganda chartered Healthnet)

APPENDIX II: ANALYSIS TOOL FOR RANKINGS OF BENEFITS OF USING OR NOT USING PDA BY STAFF CATEGORY

j	**Attributes**	**HMIS Officer (*i* =1)**	**Records Assistant (*i* =2)**	**In-Charge or MO (*i* =3)**	**Administrator (*i* =4)**	**Management Committee (*i* =5)**	**Average score ($b_{j.}$)**
1	Data Accuracy						
2	Timeliness						
3	Querying						
4	Completeness						
5	Prestige						
6	Miscellaneous						
7	Supervision						
8	Motivation						
	Total obtained/ Possible total						

APPENDIX III: INGREDIENTS OF THE GENERAL HMIS AND PDA SYSTEMS

A. Personnel (i)	**Salary per month** (ii)	**Number of months PDA has been used** (iii)	**Total cost** (iv) = (ii)×(iii)	**Time spent on PDA in a week** (v)	**Allocation of cost**	
					PDA (vi) = (iv)×(v)/40	**Non-PDA** (vii) = (iv) ×(v)×6/40
1.						
2.						
…						
N						
Total			**SUM (col. Iv)**			

B. Physical Infrastructure				
Office space **(i)**	Area in Sq. meters. **(ii)**	Unit cost An average rentable room is 4 x 4 sq meters in Rakai and it costs 30,000 per month. **(iii)**	Number of Months since PDAs were introduced **(iv)**	Cost (v)=(ii)/16 Sq.m x Shs 30,000 x (iv) **(v)**
1.				
2.				
..				
N				
Total				**Sum (Col v)**

C. Equipment and materials **(i)**	**Number of items** **(ii)**	**Unit cost, source** **(iii)**	**Months PDA has been used** **(iv)**	**Life expectancy, source** **(v)**	**Cost** (vi) = (ii) ×(iii)×(iv /(v)	**Time spent on PDA in a week** (vii)	**Cost allocation**	
							PDA (viii) = (vi)× (vii)/40	**Non PDA** (ix) = (vi) ×(vii)×6/40
1. Computers	# Computers	The price of a brand new desk top =1.5million (Source: Southern business solutions, Kampala)		Life exp =10 years				

2. Chairs	# Chairs			Life exp. =20				
3.Desks								
4.File cabinets								
5. PDA								
6.Printers	# Printers	250,000 midway between 100,000 and 500,000		Life exp= 10				
7. UPS	# UPS	150,000 latest APC printer costs 240,000 Source: Southern business solutions						
8. Solar panel	# panels							
9. Charger								

APPENDIX IV: HEALTH FACILITIES VISITED

Rakai district	Lyantonde district
1. Kacheera	1. Lyantonde muslim HCIII
2. Katatenga	**2.** Allen. D.Clinic
3. Kayonza	3. St.Elizabeth Kijjulizo
4. Kyalulangira	4. Kabayanda HCIII
5. Kibaale	5. Kaliro HCIII
6. Lwensinga	6. Kinuuka HCIII
7. Kiziba	7. Kasagaama HCIII
8. Lukerere	8. Mpumudde HCIII
9. Kibaale	9. Kaliro HCIII
10. Lwensinga	10. Kinuuka HCIII
11. Kiziba	11. Kasagaama HCIII
12. Lukerere	12. Mpumudde HCIII
13. Lwmbajjo	13. Lyantonde hospital
14. Lwanda	
15. Butiti	
16. Byakabanda	
17. Dwaniro Buyamba	
18. Lwakaloolo	
19. Kaleere	
20. Kagamba	
21. Kimuli	
22. Lwabakooba	
23. Kasankala	
24. Lwamaggwa	
25. Kakundi	
26. Kyabigondo	
27. Bugona	
28. Kibuuka	
29. Kabusota	
30. Lwamaggwa NGO	
31. Rakai Hospital	
32. St. Mugagga	
33. Kasaali	
34. Nkenge	
35. Buziranduulu	
36. Gayaaza	
37. Bikira	
38. Kyotera T.C/Mitukula	
39. Kyotera Moslems	
40. Kirumba Kabuwoko	
41. Lwamba	
42. Buyiisa	
43. Butembe	
44. Kabuwoko NGO	
45. Kalisizo /Kyanago	
46. Kyakanyomozi	
47. Nabigasa	
48. Betherehem	
49. Nakatoogo	
50. Nakasoga	
51. Kijjeja	
52. Kalisizo T.C / Hosp.	
53. Lwankoni	
54. Nabyajjwe	
55. Kabira	
56. Ndolo	
57. Bbakka	
58. Kakuuto	
59. Mutukula	
60. Mayanja	
61. Kyebe	