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AN ASSESSMENT OF INFORMATION COMMUNICATION TECHNOLOGY CONTENT, CONTEXT AND PROCESS DIMENSIONS IN PUBLIC HEALTH FACILITIES IN MACHAKOS AND NAIROBI COUNTIES, KENYA.
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F. C. NGORETT, J. N. KARIUKI and J. K. KARIUKI

ABSTRACT

***Objective*: To establish the level of ICT related content, context and process dimensions vis- a- vis the upscaling of ICT in health care facilities in Nairobi and Machakos counties. *Design*: A cross sectional study**
***Setting*: Machakos and Nairobi counties levels 4-6 hospitals**
***Subjects*: Seventy three (73) respondents drawn from the health facilities were interviewed**
***Results*: ICT content variables studied were operations computerised, ICT facilities provided and breakdown-replacement protocol. Context variables included on-job ICT trainings, ICT training sponsorships by facility and presence of institutional ICT induction program. The process variables were staff involvement in design of ICT aspects and presence of ICT policy. Among contextual factors, presence of institutional induction training program on ICT was relatively high compared to ICT training on job and ICT training sponsorship offered by facility (χ= 28.15, d.f=2, p<0.001 at 95%CI). Under process dimensions, presence of ICT policy at facility was higher compared to staff involvement in design of ICT aspects (χ =15.03, d.f =2 and p<0.001). Among the content factors, the ICT facilities provided was relatively high in all the facilities compared to levels of services operations computerised and breakdown-replacement protocol (χ=18.4, d.f =6 and p<0.005). Under the challenges, reliability of ICT infrastructure posed the greatest challenge towards up scaling of ICT among the content factors (χ=10.79, d.f. = 4, p-value=0.029). Process factor related challenges also had major impact on up scaling of ICT i.e. less up scaling of ICT that was attributed to lack of support from hospital top management team (χ 9.44, d.f.=4 and p=0.005). Comparing levels 5 and 6 facilities, the context dimension; presence of institutional induction training on ICT was the main factor that affected both facilities equally in relation to up scaling of ICT (p-value=0.021). Comparing level 4 facilities to level 6, process and content dimensions were the main factors that determined ICT uptake specifically availability of ICT policies in the institutions (p=0.011) and the levels of services operations that have been computerized (p=0.010) respectively.**
***Conclusion*: The study findings showed that content and process dimensions were the major aspects that were critical for positive up scaling of ICT in public health facilities. These factors were setting-dependent on the classification of the facility levels, in this study the level 4 facilities had poor up scaling of ICT compared to level 5 and level 6. The specific key attributes included: Strong management involvement in ICT related matters (process dimensions), availability and implementation of an ICT policy especially among level 4(process dimension), presence of an institutional induction training program on ICT (context dimension), type of ICT support provided and its reliability (content dimension) and level of services operations computerized (content). The major challenges that hindered up scaling of ICT were reliability of ICT infrastructure under the content factors and lack of support from hospital top management team under the process related factors.**

INTRODUCTION

Globally, Information Communication Technologies have been used to address contemporary global health problems (1,2). Despite all these commitments there is still less uptake of ICT that has been attributed to shortage of global funding opportunities to support eHealth projects in developing nations (3). Regionally the health care system of many African countries including Ethiopia has been found to lack e-readiness (4,5) and determining investment priorities from scarce financial resources leads to dilemmas (5,6).

In Kenya, despite the government having endorsed the use of ICT to support health service delivery like the Division of Lung Disease Unit that has received over the last 10 years funds to specifically strengthen ICT in order to support service delivery and the Ministry of Medical Services that piloted an integrated Hospital Management Information Systems in Kayole District Hospital- level 4, Mbagathi- level 4, Nyanza PGH – level 5, Gatundu District Hospital - level 4 and Machakos district hospital-level 5 (7) the uptake of ICT is still low.

Boonstra and Govers (2008) provided the three (3) main reasons why hospitals differ from many other industries, and these differences by extension affect Electronic Health Records (EHR) implementations and related ICT uptake. The first reason is that hospitals have multiple objectives, such as curing and caring for patients, and educating new physicians and nurses. Second, hospitals have complicated and highly varied structures and processes.

Third, hospitals have a varied workforce including medical professionals who possess high levels of expertise, power, and autonomy. These distinct characteristics justify a study that focuses on the identification and analysis of the various factors that affect ICT upscaling specifically in the public health facilities. The aim of this study was to establish the level of ICT related content, context and process dimensions vis a vis the up scaling of ICT in health care facilities in Nairobi and Machakos counties.

MATERIALS AND METHODS

Study design: This study adopted a cross-sectional study design.

Study Sites: The study was conducted in selected Health Facilities in Machakos and Nairobi Counties.

Study population: The study population were the various public hospitals in Machakos and Nairobi Counties

Inclusion and Exclusion Criteria: Inclusion criteria included all public facilities in Machakos and Nairobi Counties where as the exclusion criteria included the public facilities where the medical superintendents refused to consent.

Sample size determination: Sample size will be determined using Fisher et al sample size calculation formulae (Fisher *et al* 1998);
Where;
n = Minimum sample size required
d2 = Absolute precision (5%)
α = Level of significance at 95% confidence interval (5%)

Z = Standard normal deviate corresponding to 95% confidence interval (1.96)
P = Assumed proportion of the units using ICT (50%)
Therefore,
$n = (1.96)\ 2 \times 0.50(1- 0.50) = 385$
$(0.05)^2$

$$n = \frac{Z^2_{1-\alpha/2}\, P\,(1-P)}{d^2}$$

The sample size was adjusted to 73 reasons being with the devolution, the counties had reclassified some of its facilities and also a greater percentage of staff approximately 19% from the respective facilities had been transferred. Therefore a sample size proportionate to the percentage of staff transferred was reached as follows: 19/100*385= 73.15. The sample sizes for respective facility level was as below: Level 4 facility; 2 facilities, 25 respondents. Level 5 facility; 1facility, 24 respondents. Level 6 facility; 1 facility, 24 respondents. A total of four facilities and 73 respondents.

Data Management Plan
Quantitative tool: A structured self-administered questionnaire was used to collect data from the respondents who are the health workers in each department within the public health facilities.

Qualitative tool: Key Informants Interviews (KIIs) and questionnaire was used to capture information from key county health facility administrators and ICT personnel.

Dependent variables: Public hospital categorization (Level-3, level-4, level-5 and level-6) was considered as the dependent variable.

Independent variables: Gender, ICT training, previous ICT usage, policies, design of ICT systems, types of equipment, work flow outcomes and performance outcomes were considered as independent variables.

Data management: All field questionnaires were checked for completeness before leaving field. All

the questionnaires were serialised from 001-073. The filled questionnaires were filed in a box file. Data was entered into the computer using excel software. The KII were keyed in to the computer using MS word software.
Backup of the database was done using flash disk and CD-ROM.

Data analysis: Unit of analysis was the facilities levels. The data was explored at 95% confidence Interval. Data was presented in form of graphs, tables and charts and the conclusions drawn from the finding while analysis was done using Statistical Package for Social Sciences (SPSSTM) analytical software version 18/23 for windows.

Ethical considerations: Clearance to carry out the study was obtained from KNH/UoN Ethics Review Committee. Informed consent was also obtained from the participants in the study. Confidentiality was observed, no names or identification was used in the process of data collection.

Limitation of the study
Data Limitation: The County government of Machakos was found to have reclassified some of its facilities; this resulted to 1 level 5, 4 level 4 Facilities, and 0 Level 3 facility. For the purpose of this study it was reconsidered to use level4 and 5 in Machakos County. Kenyatta National Hospital in Nairobi County which is a level 6 was included for the purpose of benchmarking.

RESULTS

This study was carried out between May 2015 and June 2015.A total of 73 respondents from public health facilities were interviewed and a pre-tested semi-structured questionnaire was used to obtain information regarding to ICT parameters.

Among the contextual factors, presence of institutional induction training program on ICT was found to be relatively high compared to level of ICT training on job and type of ICT training sponsorship offered by facility using chi-square = 28.15, d.f=2, p<0.001 at 95%CI. Among Level4, 16% are taken through the induction training on ICT skills at the facility, 50% in level 5 and 91.7% in level 6. Other contextual factors such as level of ICT training on job and type of ICT training sponsorship offered by the facility were not statistically significant. Table 1 profiles the contextual factors by level of facility classification.

Under the ICT related process dimensions, presence of ICT policy at facility level was found to be high compared to staff involvement in the design of ICT aspects at the facility level therefore statistically significant at chi-square =15.03, d.f =2 and p<0.001. Involvement of staff members in the design and the implementation of ICT aspects at the facility level was not statistically significant as shown in table 2.

Table 1
Bivariate analysis of the contextual factors by facility level classification

Context Factors d.f.	Health Facilities Level / classification Level-4 (n=25) Count	%	Level-5 (n=24) Count	%	Level-6 (n=24) Count	%	Chi-squire value	df	p-value (95% C.I)
Level of ICT training on job									
No training	9	36.0%	5	20.8%	7	29.2%	1.38	2	0.502
Trained on job	16	64.0%	19	79.2%	17	70.8%			
Types of ICT training sponsorship offered by facility									
None	9	36.0%	5	20.8%	7	29.2%	5.24	4	0.264
Basic application packages	15	60.0%	17	70.8%	12	50.0%			
Specialized courses	1	4.0%	2	8.3%	5	20.8%			
Presence of an institutional induction training program on ICT									
No ICT induction program	21	84.0%	12	50.0%	2	8.3%	28.15	2	<0.001*
ICT induction program available	4	16.0%	12	50.0%	22	91.7			

Note: d.f.– degree of freedom; * - statistical significance at 95% C.I.;

Among the ICT related content factors, the ICT support facilities provided was found to be relatively high in all the facilities compared to levels of services operations that were computerized and replacement protocol in case of an ICT breakdown thus statistically significant at chi-square =18.4, d.f =6 and p<0.005.

In level 4 the content related challenges accounted for 44.4%, 50% in level 5 and 47.1% in level6. The context related challenges accounted for 38.8% in level4, 43.8% in level5 and 23.5% in level6. The process related challenges accounted for 16.65 in level4, 1% in level5 and 29.4% in level6. Figure 1 profiles the various ICT related content, context and process challenges

Table 2

Bivariate analysis of the process factors by facility level classification

Context Factors d.f.	Health Facilities Level / classification Level-4 (n=25)		Level-5 (n=24)		Level-6 (n=24)		Chi-squire value	df	p-value (95% C.I)
Staff involvement in the design of ICT aspects at the facility level									
Staff not involved	23	92.0%	22	91.7%	21	87.5%	0.351	2	0.839
Staff involved	2	8.0%	2	8.3%	3	12.5%			
Presence of ICT policy at facility level									
No ICT policy	15	60.0%	7	29.2%	2	8.3%	15.03	2	0.001*
ICT policy available	10	40.0%	17	70.8%	22	91.7%			

Note: d.f. – degree of freedom; * - statistical significance at 95% C.I.;

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Table 3

Bivariate analysis of the content factors by facility level classification

Context Factors d.f.	Health Facilities Level / classification Level-4 (n=25)		Level-5 (n=24)		Level-6 (n=24)		Chi-squire value	df	p-value (95% C.I)
ICT support facilities provided									
No ICT support facilities provided	11	44.0%	4	16.7%	2	8.3%	18.4	6	0.005*
Provision of ICT access-ories(hardware and software)	13	52.0%	12	50.0%	10	41.7%			
Others	1	4.0%	5	20.8%	5	20.8%			
Maintenance and troubleshooting	0	.0%	3	12.5%	7	29.2%			
Level of services operations computerized									
Less than 25%	13	52.0%	10	41.7%	6	25.0%	8.12	4	0.087
25-50%	9	36.0%	5	20.8%	7	29.2%			
Greater than 50%	3	12.0%	9	37.5%	11	45.8%			
Action taken(Replacement protocol) in case of an ICT breakdown									
No action taken	3	12.0%	4	16.7%	1	4.2%	15.16	8	0.056
Report to ICT department	7	28.0%	14	58.3%	17	70.8%			
Request for replacement	6	24.0%	1	4.2%	1	4.2%			
Outsource repairs through procurement department	3		12.0%		3	12.0%	1	4.2%	
Other actions	6	24%	2	8.3%	4	16.7%			

Table 4 profiles the ICT related context, content and process challenges specific to facility level. Among the level 4 facilities work overload accounted for 33% in the process dimension. Lack of finance accounted for 38% in the content category, while computer illiteracy accounted for 43% of the context dimension. In the level 5 categories lack of proper understanding of ICT by the staff (100%) was the main reason cited as the process related challenge. Lack of internet connectivity accounted for 25% among the content dimension, while lack of ICT skills accounted for 29% among the context factors. In the level 6 facility, the key process challenge was staff preference to manual way of doing things i.e. paper work (50%), lack of network connectivity in the content dimension accounted for 37%, while the trainers, analysts and designers using shorter time to explain the operations thus leaving out critical parts accounted for 20% in the context related challenge.

Table 4

ICT related context, content and process challenges by facility level

Facility	Types of challenges					
Level	Process Dimension		Content Dimension		Context Dimension	
Level 4	Work overload	33%	Lack of finance	38%	Computer illiteracy	43%
	Politics	33%	Poor infrastructure	25%	Availability of computers	29%
	Impatience by the staff due to slowdown of systems	33%	Poor electric supply	25%	Resistance to change	14%
	Limited resources	13%	Lack of support	14%		
	Total	3		8		7
Level 5	Lack of proper understanding of ICT by by the staff	100% 13%	Lack of internet connectivity	25%	Lack of ICT skills	29%
			Power failure, system -failure		Knowledge deficit in ICT	29%
			Poor infrastructure outside the organization for most of the suppliers are not connected	13%	Need for trainings, lack of computers(facilities)	14%
			Lack of finance.	13%	Good training	14%
			Lack of consistent flow of internet and also lack of bundles for modem when internet not available.	13%	Expenses	14%
			Getting ict materials	13%		
			Delays in service delivery when the system is not functional	13%		
	Total	1				7
Level 6	Preference to manual way of doing things i.e. paper work	50%	Lack of Network connectivity	37%	The trainers, analysts and designers use shorter time to explain the operations thus critical parts may be left out.	20%
	Workload	25%	Frequent breakdown of network associated with internet service provider	25%	Lack of refresher course	20%
	Budget allocation from the hospital management and government	25%	Lack of funding, changing technology	13	Inadequate resource allocation to roll out ICT. Lack of good-will	20%
			Electricity interruptions and upgrading to current OS	13%	Expensive	20%
			Completion of computeri -zation of the whole hospital	13%	Conversantness	20%
	Total	4			8	5

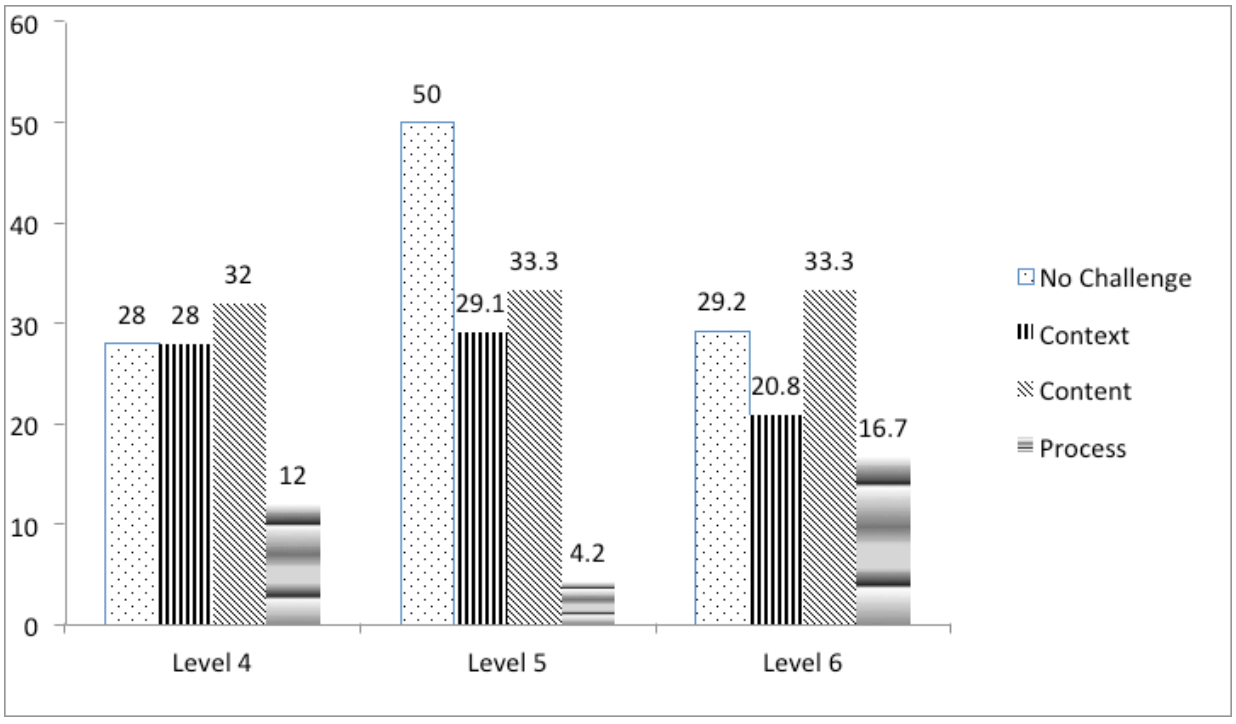
Table 5

Bivariate analysis of ICT content, context and process challenges in public health facilities

Factors	Description	Health Facilities Level / classification						Bivariate Analysis			
		Level-4 (n=25)		Level-5 (n=24)		Level-6 (n=24)		Total	Chi-squire value	p-value df	(95% C.I)
Content Factors	(1) Power Supply Reliability										
	No challenges	11	44.0%	7	29.2%	13	54.2%	31	3.99	4	0.407
	Minimal challenges	11	44.0%	13	54.2%	10	41.7%	34			
	Major challenges	3	12.0%	4	16.7%	1	4.2%	8			
	(2) Adequacy of ICT systems (hardware / software)										
	No challenges	3	12.0%	7	29.2%	5	20.8%	15	4.15	4	0.386
	Minimal challenges	8	32.0%	10	41.7%	9	37.5%	27			
	Major challenges	14	56.0%	7	29.2%	10	41.7%	31			
	(3) Reliability of ICT infrastructure e.g. local area network										
	No challenges	3	12.0%	7	29.2%	4	16.7%	14	10.79	4	0.029*
	Minimal challenges	4	16.0%	6	25.0%	12	50.0%	22			
	Major challenges	18	72.0%	11	45.8%	8	33.3%	37			
Context Factors	(4) Adequate ICT skills										
	No challenges	3	12.0%	3	12.5%	4	16.7%	10	0.46	4	0.977
	Minimal challenges	14	56.0%	14	58.3%	14	58.3%	42			
	Major challenges	8	32.0%	7	29.2%	6	25.0%	21			
	(5) Staff members have ICT literacy										
	No challenges	5	20.0%	4	16.7%	7	29.2%	16	1.71	4	0.789
	Minimal challenges	13	52.0%	12	50.0%	9	37.5%	34			
	Major challenges	7	28.0%	8	33.3%	8	33.3%	23			
Process Factors	(6) Support from hospital top management teamx										
	No challenges	1	4.0%	8	33.3%	4	40%	13	9.44	4	0.005*
	Minimal challenges	13	52.0%	10	41.7%	15	39.2%	38			
	Major challenges	11	44.0%	6	25.0%	5	20.8%	22			

Figure 1

ICT context, content and process challenges by facility level



A binary regression model was constructed between the dependent (facility level) by the independent content, context and process ICT variables. In the dependent variable, level 6 facilities were considered as the reference point. Two sets of analysis were performed, level 4 by the various independent variables controlling for level 6 facilities. The second set of analysis had level 5 by the same independent variables. This are presented as table 6 and 7 respectively. Context factors related challenges did not have a significant impact on up scaling of ICT in relation to facility classification level. Under the content related challenges, reliability of ICT infrastructure posed the greatest challenge in up scaling of ICT which was found to be statistically significant at (χ=10.79, d.f. = 4, p-value=0.029).this factor was mentioned by 88%, 70.8% and 83.8% of the level 4, level5 and level 6 respondents respectively. Process factor related challenges also had a major impact on upscaling of ICT i.e. less up scaling of ICT that was attributed to lack of support from hospital top management team with level 4 facilities being affected the most at 96%, then level 5 at 66.7% and finally level 6 at 60% at chi-square 9.44, d.f.=4 and p=0.005 (See table 5).

Table 6

*Binary regression between Level 5 facilities and ICT related context, content and process factors**

Factors category / Variables in the Equation		Binary Regression Statistic(95% CI)				
		β	S.E.	Wald	df	p-value
Context Dimensions	Gender	0.18	0.92	0.04	1	0.844
	Level of individual ICT training	0.33	1.15	0.08	1	0.773
	Presence of institutional induction training program on ICT	2.68	1.16	5.32	1	0.021
	External assistance that promote up scaling of ICT	-0.06	0.89	0.00	1	0.947
	Individual use of ICT in the past	-0.64	1.06	0.37	1	0.545
	Constant	-0.30	0.82	0.14	1	0.711
Process Dimensions				1.34	3	0.719
	Support from hospital management	0.93	0.96	0.93	1	0.335
	Staff involvement in the initial ICT design	0.48	1.05	0.21	1	0.650
	Presence of an ICT policy	1.48	0.91	2.67	1	0.102
	Constant	-1.45	1.21	1.44	1	0.231
Content Dimensions	Level of services operations computerized			2.07	2	0.355
	<50%	0.93	0.80	1.35	1	0.245
	>50%	-0.38	0.82	0.21	1	0.647
	Challenges faced from ICT infrastructures			0.76	3	0.859
	No challenge	-0.34	0.79	0.19	1	0.667
	Minimal challenge	-21.64	0. 016	0.00	1	0.999
	Major challenge	0.40	0.83	0.23	1	0.629
	Efficiency rating in use of ICT(work process)	-0.11	0.74	0.02	1	0.879
	Constant	0.17	0.86	0.04	1	0.84

Note: * - Level 6 facilities were used as the reference comparator group in binary regression equation

From table 6, only one parameter in the context dimension (presence of an institutional induction training program on) was found to be the main factor that promotes uptake of ICT in level 5 facilities(β=2.68, d.f=1, p-value=0.021). The content and process factors did not have a positive impact on uptake of ICT therefore were not statistically significant in the regression model.

Among the level 4 facilities, content and process factors were important determinants of uptake of ICT operations. Among the process factors, absence of ICT policy in the institution was the main factor that hindered smooth ICT operations (β=3.12, d.f=1, p-value=0.011). in the context dimension, percentage of routine operations that were computerized (<50%) was the main factor that hindered ICT operations (β=2.34, d.f=1, p-value=0.010).Table 7 shows the binary regression between Level 4 facilities and ICT related context, content and process factors.

Table 7

Binary regression between Level 4 facilities and ICT related context, content and process factors

Factors category / Variables in the Equation		Binary Regression Statistic(95% CI)				
		β	S.E.	Wald	df	p-valu
Context Factors	Gender	19.90	11274.24	0.00	1	0.999
	Level of individual ICT training	2.09	1.93	1.17	1	0.279
	Presence of an institutional induction training program on ICT	23.48	11274.24	0.00	1	0.998
	External assistance that promote up scaling of ICT	-0.19	1.62	0.01	1	0.906
	Individual use of ICT in the past	-0.22	1.68	0.02	1	0.894
	Constant	-21.58	11274.24	0.00	1	0.998
				3.83	3	0.281
Process Factors	Support from hospital management	23.01	13850.08	0.00	1	0.999
	Staff involvement in initial ICT design	-0.34	1.36	0.06	1	0.800
	Presence of an ICT policy	3.12	1.23	6.48	1	0.011
	Constant	-22.10	13850.08	0.00	1	0.999
	Level of services operations computerized			6.64	2	0.036
	<50%	2.24	0.87	6.64	1	0.010
	>50%	1.13	0.94	1.44	1	0.230
Context Factors	Challenges faced from ICT infrastructures			2.64	3	0.451
	No challenge	-0.07	1.03	0.00	1	0.949
	Minimal challenge	-0.57	1.10	0.27	1	0.604
	Major challenge	1.08	0.89	1.49	1	0.221
	Efficiency rating in use of ICT(work process)	-0.02	0.77	0.00	1	0.982
	Constant	-1.43	1.12	1.63	1	0.202

Note: * - Level 6 facilities were used as the reference comparator group in binary regression equation

DISCUSSION

Among the context dimension,presence of institutional induction training programme on ICT was found to be relatively high, thus the main reason that promote ICT uptake compared to level of ICT training on job and type of ICT training sponsorship offered by facility using χ= 28.15, d.f=2, p<0.001 at 95%CI. Among the Level 4, 16% were taken through the induction training on ICT skills at the facility, 50% in level 5 and 91.7% in level 6. Other contextual factors such as level of ICT training on job and type of ICT training sponsorship offered by the facility were not statistically significant.Under the level 4 facilities 84% had no ICT induction training program compared to 50% in level 5 and 8.3% in level 6.This is suggestive that that the importance of induction training program is often ignored by the low facility levels, and inadequate induction training or absence of it usually leads to a slow ICT uptake in comparison to a study done by Simon *et.al* [8] that argued for the appropriate adequate induction training on ICT to all end-users at the right times and location in terms of quantity and quality.

Among the ICT related content factors, the ICT support facilities provided was found to be relatively high in all the facilities compared to levels of services operations that were computeried and replacement protocol in case of an ICT breakdown thus statistically significant at χ=18.4, d.f =6 and p<0.005 .Among the level 4 facility, (44%) were not provided with end-user support compared to level 5(16.7%) and level 6 (8.3%). The most frequently mentioned end-user support offered by various facilities included provision of ICT accessories that is, hardware and software which was mentioned by 52% of level 4 respondents, 50% of level 5 and 41.7% of level 6 respondents. This is in agreement with the studies done by various authors that have argued that creating a balance between technology and daily work practices is an essential factor in the implementation and up scaling of ICT usage (9-11).

Under the ICT related process dimensions, presence of ICT policy at facility level was found to be high compared to staff involvement in the design of ICT aspects at the facility level therefore statistically significant at χ=15.03, d.f =2 and p<0.001. Among the level 4 facilities 60% did not have any ICT policy in place compared to level 5(29.2%) and level 6(8.3%) and this impacted negatively on the uptake of ICT

especially at the level 4 facilities. This is similar findings to the results from a study done by Kifle and Mbarika in Sub Saharan Africa that showed policies specific to the advancement of ICT influence the country's advancement in ICT infrastructure capabilities (12).

Under the challenges, the content related challenges accounted for the highest percentage in all the facility level an indication that it is the major obstacle towards up scaling of ICT .In level 4 the content related challenges accounted for 44.4%, 50% in level 5 and 47.1% in level6. The context related challenges accounted for 38.8% in level4, 43.8% in level5 and 23.5% in level6. The process related challenges accounted for 16.65 in level4, 1% in level5 and 29.4% in level6. Reliability of ICT infrastructure posed the greatest challenge for the up scaling of ICT among the content factors which was found to be statistically significant (χ=10.79, d.f. = 4, p-value=0.029).This factor was mentioned by 88%, 70.8% and 83.8% of the level 4, level5 and level 6 respondents respectively. This implies that although sharing of ICT resources are in place in most facilities, they are likely not to be used as they are either down as a result of either network connectivity, breakdown or not available to end users. This concurs with a study by Ovretveit *et. al* (13) that argues that hardware and software must be available and reliable at all times for up scaling of ICT to be effective.

Process factor related challenges also had major impact on up scaling of ICT i.e. less up scaling of ICT that was attributed to lack of support from hospital top management team. this was reported by 96%, 66.7% and 83.3% of the level 4, level 5 and level6 respondents respectively at χ 9.44, d.f.=4 and p=0.005. This is suggestive that the benefits that accrue from using ICT is not well understood and implemented by the hospitals top management teams. This could be a possible reason of the low support extended to the end-users by management resulting to low levels of computerisation of service operations in their respective facilities. This is consistent with studies that have shown that supportive leadership, strong and active management involvement is positively associated with ICT implementation (14) (15). In addition Ovretveit *et. al* (13) argues that senior management should repeatedly declare that ICT implementation is the highest organization priority and thus they should support it with sufficient financial and human resources.

Using level 6 facility as a reference point, there was no much ICT uptake variation in the content and process dimensions between levels 5 and 6 facilities. However in the context dimension, presence of institutional induction training program on ICT was the main factor that affected the two facilities equally in relation to up scaling of ICT (p-value=0.021). This is consistent with previous findings by Siender *et.al.* (16). and Azfar *et. al.* (17) who demonstrated that lack of induction training program on ICT and infrastructure availability were a major challenge for many African health systems that were implementing ICT platforms for effective and efficient service delivery.

Comparing level 4 facilities to level 6, process and content dimensions were the main factors that determine ICT uptake more specifically availability of ICT policies in the institutions (p=0.011) and the levels of services operations that have been computerized (p=0.010) were the main process and content factors associated with uptake of ICT respectively. This finding is suggestive that ICT uptake in level 4 facilities is a setting-dependent attribute.

In conclusion, this study demonstrates that content and process dimensions were the most critical success factors associated with uptake of ICT utilisation in public health facilities. These factors are setting-dependent on the classification of the facility levels. The specific key attributes included the following: Strong management involvement in ICT related matters (process dimensions), availability and implementation of an ICT policy especially among level 4(process dimension), presence of an institutional induction training program on ICT (context dimension), type of ICT support provided and its reliability (content dimension) and level of services operations computerised (content).

We therefore recommend a sensitisation and a possible field tours to selected public and private facilities in Kenya and in East Africa where health care managers can actually learn and benchmark with some of the best performing facilities who have embraced ICT full-scale operationalisation. Furthermore, another study is required to elucidate factors of low ICT support by hospitals top management team.

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REFERENCES

1. Venkatesh, V., Bala, H. and Sykes, T A (2010).Impacts of Information and Communication Technology Implementations on Employees' Jobs in Service Organizations in India: A Multi-Method Longitudinal Field Study. *Production Operation Manager*, **19:** 591-613.
2. Ameh, N., Kene, T. and Ameh, E (2008).Computer knowledge amongst clinical year medical students in a

resource poor setting. African Health Science, 8:40-43.
3. Gour, N. and Srivastava, D. (2010).Knowledge of computer among healthcare professionals of India: a key toward e-health. *Telemedicine Journal on E. Health*, **16**:957-962.
4. Kumar, S., Balasubramanyam, G., Duraiswamy, P.and Kulkarni S (2009).Information Technology Practices Amongst Dental Undergraduate Students at a Private Dental Institution in India. *Journal of Dentistry*, Tehran University of Medical Sciences, Tehran, Iran, **6**:130-138.
5. Nurjahan, M., Lim T., Yeong, S., Foong, A. and Ware J (2002).Utilization of information technology in medical education: a questionnaire survey of students in a Malaysian institution. *Medical. Journal Malaysia*, **57**(Suppl E):58-66.
6. Howard, P. N. (2007).Testing the Leap-Frog hypothesis. The impact of existing infrastructure and telecommunications policy on the global digital divide. In Information, Communication & Society, **10**:133-157.
7. Kenya National e-Health Strategy for the year 2011-2017. Ministry of Medical Services and Ministry of Public Health and Sanitation (MMS & MPHS)
8. Simon, S. R., Keohane, C. A., Amato, M., Coffey, M., Cadet, M. and Zimlichman, E. (2013). Lessons learned from implementation of computerized provider order entry in 5 community hospitals: a qualitative study. BMC Medical Information Decision Making. **13**:67.
9. Cresswell, K. M., Worth. A. and Sheikh, A. (2012). Integration of a nationally procured electronic health record system into user work practices. BMC Medical Information Decision Making. **12**:15.
10. Katsma, C. P., Spil, T. A. M., Ligt, E. and Wassenaar, A. (2007). Implementation and use of an electronic health record: measuring relevance and participation in four hospitals. Int. *J. Healthc. Technol. Manag.* Vol **8**(6):625–643.
11. Takian, A., Sheikh, A. and Barber, N. (2012). We are bitter, but we are better off: case study of the implementation of an electronic health record system into a mental health hospital in England. BMC Health Serv. Res. **12**:484.
12. KifleMengistu, Victor, M. (2008). "A Telemedicine Transfer Model for Sub-Saharan Africa", Proceedings of the 41st Hawaii International Conference on System Sciences.
13. Ovretveit, J., Scott, T., Rundall, T. G., Shortell, S. M. and Brommels, M.(2007). Improving quality through effective implementation of information technology in healthcare. International Journal of Quality Health Care. Vol **19**(5):259–266.
14. Weir, C., Lincoln, M., Roscoe, D., Turner, C. and Moreshead, G. (1994). Dimensions associated with successful implementation of a hospital based integrated order entry system. Proc Annu Symp Comput Appl [Sic] in Med. Care Symp. Comput. Appl. Med. Care. 653:7.
15. Ash, J. S., Gorman, P. N., Lavelle, M., Payne, T. H., Massaro, T. A., Frantz, G. L. and Lyman, J. A. (2003). A cross-site qualitative study of physician order entry. *J. Am. Med. Inform. Assoc.* Vol **10**(2):188–200
16. Siedner, M. J., Haberer, J. E., Bwana, M. B., Ware, N. C. and Bangsberg, D. R. (2012). High acceptability for cell phone text messages to improve communication of laboratory results with HIV-infected patients in rural Uganda: a cross sectional survey study. BMC Med Inform Decis Mak. **12**:56.
17. Azfar, R. S., Weinberg, J. L., Cavric, G., Lee-Keltner, I. A., Bilker, W. B., Gelfand, J. M. and Kovarik, C. L. (2011). HIV-positive patients in Botswana state that mobile teledermatology is an acceptable method for receiving dermatology care. *J. Telemed. Telecare*. Vol **17**(6):338–340.
18. Kamssu, A. J., Siekpe, J. S. and Ellzy, J. A.The *Journal of Developing Areas*: Shortcomings to Globalization: Using Internet Technology and Electronic Commerce in Developing Countries. 2004; **38**: 151-169 | 10.1353/jda.2005.0010. Available from http://muse.jhu.edu/login?auth=0&type=summary&url=/journals/journal_of_developing_areas/v038/38.1kamssu.html
19. World Health Organization (2004).Strategy 2004–2007. E-health for Health Care Delivery.Geneva: WHO
20. Drury, P. E. *Health international journal*: A Model for Developing Countries. Developing eHealth Connections in Kenya Programme Manager. [Updated November 2005; cited 2015].Available from: http://www.ehealthinternational.net/
21. Lanre, A. O and Makanjuola, A. T. (2009). Knowledge and perception of e-health and telemedicine among health professionals in LAUTECH teaching hospital, Osogbo, Nigeria. *International Journal of Health Research*, **2**(1):51–58.
22. Tom, H. F., Broens, Rianne, M. H. A., Huisin'tVeldw., Miriam, M. R., Vollenbroek-Huttenw., Hermie, J., Hermenswz., Aart, T., van Halteren, Y. and Lambert, J. M. Nieuwenhuis (2007). Determinants of successful telemedicine implementations: a literature study. *Journal of Telemedicine and Telecare*, **13**: 303–309
23. www.americantelemed.org. American Telemedicine Association-2006
24. http:www.ncbi.nlm.nih.gov/pmc/articles/PMC
25. Barlow, J., Bayer, S., Castleton, B. and Curry, R. (2005). Meeting government objectives for telecare in moving from local implementation to mainstream services. *Journal of Telemedicine andTelecare*, **11**(Suppl. 1):49–51
26. Kaplan, W. A. (2006). Can the ubiquitous power of mobile phones be used to improve health outcomes in developing countries? Globalization and Health, **23**(2):9.
27. Kerr, C., Murray, E., Stevenson, F., Gore, C. and Nazareth, I. (2005). Interactive health communication applications for chronic disease: patient and career perspective. *Journal of Telemedicine andTelecare* **11** (Suppl. 1):32–4
28. Rotich, J. K., Hannan, T. J., Smith, F. E., Bii, J., Odero, W. W., Vu, N., Mamlin, B. W., Mamlin, J. J., Einterz, R. M. and Tierney, W. M. Installing and implementing a computer-based patient record system in sub-Saharan Africa: The Mosoriot Medical Record System. *Journal of American Medicine Information Association*. **10** (2003)293-303.
29. Murray,J."Cloud network architecture and ICT-Modern Network Architecture". ITKnowledgeExchange. TechTarget.[Updated 2011 Cited 2013].Retrieved from: http://itknowledgeexchange.techtarget.com/modern-network-architecture/cloud-network-architecture-and-ict/
30. Pettigrew AM. (1987); Context and action in the transformation of the firm. Journal of Management Studies. Vol 24 (6): 649-670.