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Exploring healthcare professionals adoption and use of Information and Communication Technology using Q-methodology and Models of **Technology Acceptance**

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Background

Information and communication technologies (ICTs) and more specifically e-health are viewed as important tools within healthcare. They are used to support clinical activities such as interactions between healthcare professionals and patients, clinical self-development, patient education, routine clinical activities, and also have the potential to address many challenges affecting healthcare sectors globally. However, there is still limited information on how technologies are adopted and used within clinical practice by health professionals particularly in countries in Sub Saharan Africa (SSA).

Method

This study used Q-methodology and models of technology acceptance (Technology Acceptance Model-TAM and Unified Theory of Acceptance and Use of Technology-UTUAT) to explore the factors that influence ICT adoption among nurses and physicians in clinical practice in SSA. Thirty-six participants from a tertiary hospital in SSA were recruited and conducted Q-sorting of 46 statements derived from the literature around e-health adoption and use and were organised around six combined themes of both the TAM and UTAUT, relating to their interaction with e-health in their clinical practice.

Results Four factors emerged after both Centroid factor analysis and Varimax rotation. Both Crib sheets and agreement/disagreement statements were used in the interpretation of the Factors.

Factor 1: Patient-focused e-health advocates

Factor 1 has seven significantly loading participants and explains 13% of the study variance. It has an eigenvalue of 4.68. Five of the loading participants are physicians and two are nurses. There are two females and five males with an average age of 37.7 years. Healthcare professionals (HCPs) within this factor recognise that clinical ICT/ e-health improves their work efficiency without the influence of their personal characteristics such as age and gender or their previous ICT experience. They consider the views of their patients/families when using e-health and will continue using it if it is made available beyond

Factor 3: Traditionalistic-pragmatists

Factor 3 has six significantly loading participants and explains 10% of the study variance. It has an eigenvalue of 3.6. Three of the participants are nurses and three are physicians. There are three females and three males within this Factor and they have an average age of 42.8 years.

Having identified that their use of clinical ICT resources as voluntary and within their control, HCPs within this factor indicate that the available e-health resources enables them to accomplish their clinical tasks quickly, even though its use interferes with other routine clinical activities. Although the HCPs have some

their departments. Though they identify it is difficult to become used to the ICTs, it still helps them accomplish tasks more quickly. Diminished support from management and superiors led to provision of e-health resources which are challenging to adopt and use. HCPs have concerns when it comes to access to such technologies and this affects their confidence when applying these technologies within their clinical practice.

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
#28.Mngt organize regular training on the use of CIS at the work place	#40 My gender affects my use of the CIS	#38 There are available resources to use the CIS	#22.The CiS and understand able	#16.It is easy to get the system to do what I want it to do	#34.Using CIS is easier than other computer systems I use	#31.1 could complete the job using the CIS if there was no one around to	#26. It is easy for me to become skatful at using CIS	#1.It is easy to remember how to perform tasks with the CIS	#9.Using CIS facilitates better patient care decision making	#2.Using CIS Improves patient care	#24.My age has nothing to do with my ability to use the CIS effectively	#5. If the clinical system is extended would us it
	#32.There is evailability of technical assistance for CIS in my hospital	#19 The senior Mngt of this organization has been helpful in the use of the CIS	#25.My use of CI5 is entirely under my control	#17 Interact ion with the CIS does not require a lot of mental effort	#45.The CIS is not compatible with other platforms I use	842 Patients /families believe Cf5 use is good for quality patient care	#18 Not having the CIS in some departments hinders my work in these areas	#35 Patients /families believe C/5 use reduces chances of medication errors	#23.My use of CI5 is entirely voluntary	#10.Using CI5 makes caring for patients easier	#29.CIS are upeful in the hospital	1
	#11.Mngt support staff innovations on CIS use in the workplace	#13 The use of CIS makes me apprehensive	#34 Using the CIS is a status symbol in my organization	#20.Using CIS increases my chance of getting a praise or reward	#4 Superiors at work think (thould use the CIS	#3.Using CIS reduces likelihood of medication error	#45.My use of the CIS is specific to the task want to carry out	#6 Using CIS Increases my productivity	#27.1 always look for opportuniti es to use the system whenever I can	#7.Using CIS Improves my performanc e	#33.CIS Improves work efficiency	
			#44.The information in the system is always updated	#12.People in my organization who use the CIS have none prestige	#30 My routine tasks prevent me from having time to use the CIS	#21. The use of CIS is pertinent to my various related tasks	#8.1 am certain about the reliability of the information I get from the system	#37.Reople who influence my clinical behaviour think 1 should the system	#39.Using CIS enables me to accomplish tasks more quickly			1
					#36.My ICT experience affects my use of the CIS	#41.People who are important to me think i should use the CIS	#35 Patients/F amilies like it when Luges the CIS					
						#43.1 hesitate to use the CIS for fear of making						

Factor 2: Task-focused e-health advocates

This has seven significantly loading participants and explains 13% of the study variance. It has an eigenvalue of 4.68. Five of the loading participants are physicians and two are nurses. There are two females and five males within this factor and have an average age of 42.6 years. HCPs within this factor show high value of e-health resources within their clinical practice but they still put a lot of mental effort to get used to it despite having ICT experience. Accordingly, they use these technologies specifically for the tasks they want to perform and without interruption to their routine activities. However, healthcare

professionals within this factor still have concerns with the reliability of these technologies. Despite considering the patients/families views as contributors to their own choice to use the e-health resources, e-health resources contribution to their tasks/activities are the main motivators to their use. The hospital management have been more helpful compared to clinical superiors in the provision of voluntary, clear and understandable clinical ICT resources.

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
#14:Using the CIS is a status symbol in my organization	#40.My gender affects my use of the CIS	#11.Mngt support staff innovations on CIS use in the workplace	#8. I am certain about the reliability of the information I get	#25.My use of CIS is entirely under my control	#18.Not having the CIS in some departments hinders my work in these areas	#1.it is easy to remember how to perform tasks with the CIS	#21.The use of CIS is pertinent to my various related tasks	#3.Using CIS reduces likelihood of medication error	#36.My ICT experience affects my use of the CIS	W6.Using CIS increases my productivity	#7.Using CIS improves my performance	#9.Using CIS facilitate better patient care decision
	#13.The use of CIS makes me apprehen sive	#17.Interact ion with the CIS does not require a lot of mental effort	#28.Mngt organise regular training on the use of CIS at the work place	#4.Superior s at work think I should use the CIS	#32.There is availability of technical assistance for CIS in my hospital	#37.People who influence my clinical behaviour think I should the system	#5. If the clinical system is extended I would use it	#19. The senior Mogt of this organization has been helpful in the use of the CIS	#22.The CIS are clear and understanda ble	#39.Using CIS enables me to accomplish tasks more quickly	#29.CIS are useful in the hospital	
	#43.1 hesitate to use the CIS for fear of making	#12.People in my organization who use the CIS have more prestige	#30.My routine tasks prevent me from having time to use the CIS	#20.Using CIS increases my chance of getting a praise or reward	#41.People who are important to me think I should use the CIS	#16.It is easy to get the system to do what I want it to do	#38.There are available resources to use the CIS	#24.My age has nothing to do with my ability to use the CIS effectively	#10.Using CI5 makes caring for patients easier	#33.CIS improves work efficiency	#2.Using CIS improves patient care	
			#46.The CIS is not compatible with other platforms I use	#44.The information in the system is always updated	#35.Patients/fami lies like it when (uses the CIS	#23.My use of CIS is entirely voluntary	#42.Patients /families believe CIS use is good for quality patient care	#45.My use of the CIS is specific to the task want to carry out	#26. It is easy for me to become skilful at using CIS			
					#34.Using CIS is easier than other computer systems I use	#31.i could complete the job using the CIS if there was no one around to	#27.1 always look for opportuniti es to use the system whenever I can					
						#15.Patients/fami lies believe CIS use reduces chances of medication errors						

Consensus statements

All the study factors agree that their gender does not influence their choice to adopt and use the clinical ehealth resource for their clinical practices. Moreover, participants across all the four factors also agree that clinical information systems are useful in the hospital, and they agree on the positive contributions of the e-health resources towards their clinical efficiency. However, participants across the four factors seem to acknowledge that their superiors do not support them towards the adoption and use of these e-health resource at the workplace. In addition, participants across the four factors seem to recognise that though it might be easy to become skilful in using the e-health resources, remembering how to use it may not be as easy with the highest ranking identified as +2 and the least ranking identified as 0.

confidence in the use of the e-health technologies they are still hesitant in the use of it. Moreover, participants within this factor can continue carrying out their clinical responsibilities without the e-health resources. Patients/families views are not considered to be determinants for the uptake of such technologies by these HCPs

6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+0
#40.My gender affects my use of the CIS	#12.People in my organization who use the CIS have more prestige	#44.The information in the system is always updated	W19.The senior Mogt of this organization has been helpful in the use of the CIS	#38.There are available resources to use the CIS	#17.Interactio n with the CIS does not require a lot of mental effort	#22.The CIS are clear and understandable	#16.It is easy to get the system to do what I want It to do	#25.My use of CIS is entirely under my control	#27.1 always look for opportunities to use the system whenever I can	#24.My age has nothing to do with my ability to use the CIS effectively	#29.CIS are useful in the hospital	#23 use is e vol
	#35.Patients/f amilies like it when juses the CI5	#20.Using CIS increases my chance of getting a praise or reward	#46.The CIS is not compatible with other platforms I use	#45.My use of the CIS is specific to the task want to carry out	#43.I hesitate to use the CIS for fear of making	#21.The use of CIS is pertinent to my various related tasks	#2:Using CIS improves patient care	#34.Using CIS is easier than other computer systems I use	#S. I am certain about the reliability of the information I get	#33.CIS improves work efficiency	#39.Using CIS enables me to accomplish tasks more quickly	
	#15.Patients/f amilies believe CIS use reduces chances of medication errors	#18.Not having the CIS in some departments hinders my work in these areas	#28.Mngt organise regular training on the use of CIS at the work place	#3.Using CIS reduces likelihood of medication error	#32.There is availability of technical assistance for CIS in my hospital	#36.My ICT experience affects my use of the CIS	#10.Using CIS makes caring for patients easier	#7.Using CIS improves my performanc e	#31.1 could complete the job using the CIS if there was no one around to	#6.Using CIS increases my productivity	#30.My routine tasks prevent me from having time to use the CIS	
			#42.Patients/fa milles believe CIS use is good for quality patient care	#4.Superiors at work think t should use the CIS	#11.Mngt support staff innovations on CIS use in the workplace	#1.it is easy to remember how to perform tasks with the CIS	#41.People who are important to me think I should use the CIS	#5. If the clinical system is extended I would use it	#26. It is easy for me to become skilful at using CIS		-	
					#13.The use of CIS makes me apprehensive	#37.People who influence my clinical behaviour think I should the system	#9.Using CIS facilitates better patient care decision					
						CIS is a status symbol in my organization						

Factor 4: Tech-focused e-health advocates

Factor 4 has eight significantly loading participants and explains 15% of the study variance. It has an eigenvalue of 5.4. Five of the participants are nurses and three are physicians. There are four females and four males within this factor and they have an average age of 44.9 years. HCPs acknowledge the importance of the clinical ICT/ e-health within their clinical practice. They recognise that the use of the ehealth is crucial to their individual clinical practices and even look for opportunities to use it. This is because they find these technologies not difficult to become used to. Despite this however, they do not

strongly rely on it for their clinical decisions because there is less routine update of the e-health and this hinders their adoption and use of it in areas of the hospital where it is lacking. This is also made more challenging by the poor management and technical support including support from both colleagues within and outside the clinical environment.



Consensus Statements		Rank			
	Factor 1	Factor 2	Factor 3	Factor 4	
It is easy to remember how to perform tasks with the clinical	2	0	0	2	Colour Kov
information systems					Derceived usefulness/Derformance
Superiors at work think I should use the clinical information	-1	-2	-2	-2	expectancy Decrained according official expectancy
systems					Social influence/ subjective norm
It is easy to become skilful at using the clinical information	1	3	3	4	Facilitating conditions Individual differences
systems					Behavioural intention
Clinical information systems are useful in the hospital	5	5	5	6	
Clinical information systems improves work efficiency	5	4	4	5	
My gender affects my use of the clinical information systems	-5	-5	-6	-5	

Discussion

The **patient-driven adopters** suggests that the HCPs choice of e-health is influenced by the patient preferences to use it in their care (Trivedi et al., 2009). The **task-driven adopters** like in Hains et al. (2009), use the e-health resource only due to convenience and its ability to consolidate the information that they need. The traditionalist-pragmatists were similar to the HCPs captured by Hains et al. (2009) and Verhoeven et al. (2009) as clinically autonomous who don't see e-health as part of routine clinical practice. The **e-health champions** look for opportunities to use e-health. Heir et al. (2004) and Joos et al. (2004) describe such HCPs as positive and efficient towards e-health adoption and use.

Conclusion

Using Q methodology and models of technology acceptance, the study explored issues influencing HCPs adoption and use of e-health in their clinical practice. HCPs prioritised sample statements based on how each statement influence their clinical practice. Findings suggest four different viewpoints to the adoption and use of e-health resources in clinical practice. These may help understand how they make their choices about e-health and suggest conceptual application in other similar settings. HCPs should be provided with both routine training and technical support by management and superiors and should be part of decisions on e-health adoption and use in clinical practice. Hypothesis could be generated around these four factors to test application in wider a context for future studies.

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