ACCEPTANCE OF M-HEALTH AND ITS COMPLEXITY FOR THE PROVISION OF QUALITY HEALTHCARE SERVICES

Ambreen Akhtar[1], Ismail Alam Khan[2], Aziza Alam[3], Rubeena Gul[3], Azhar Ali Shah[4], Naeemullah[5]

[1]Population Welfare Department, Peshawar - Pakistan

[2]Department of Medical Education, Rehman College of Dentistry, Peshawar - Pakistan

[3]Department of Community Medicine, Khyber Medical College, Peshawar - Pakistan

[4]Pakistan Medical and Dental Council, Islamabad - Pakistan

[5]Department of Community Medicine, Saidu Medical College, Swat - Pakistan

ABSTRACT

Objectives: To identify the factors affecting the adoption of mobile health, assess the perception of the role of mobile health in health care service, and compare the technology acceptability and complexity trend among Community Health Workers.

Materials and methods: A cross-sectional quantitative study was done using a two-stage sampling technique to collect the required sample from 308 Community Health Workers (CHWs) comprising 258 Lady health workers (LHW), 21 Community midwives (CMWs), 18 Lady health visitors (LHVs) and 11 Family welfare workers /councilors (FWWs/FWCs) of district Peshawar. Data was analyzed using SPSS version 22.

Results: The majority of CHWs agree that mobile phones are useful in communication with fellow health professionals, diagnostic and treatment support, and medical data collection. The majority of CHWs were, willing to adopt mHealth technology. CHWs believed that mHealth adoption could make their job easier and improve access to healthcare services. mHealth can also enhance disease prevention and awareness. Affordability, result orientation, and easy usage are the significant factors in the adoption of mHealth.

Conclusion: mHealth usefulness and acceptance role for awareness, and disease prevention are the most agreed factors in the view of community health workers. Highest PCA score recordings for "m-health make it more accessible, affordable for the general population".

Key Words: Community Health Workers, Unified Theory of Acceptance and use of technology (UTAUT), mHealth.

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INTRODUCTION

The health management information system is functional at the district level in Pakistan but most health units in peripheral areas are still reporting manually which results in delayed and incomplete reporting that affects the overall effectiveness in terms of mismanaged stock positions at service delivery points. m-Health has the potential to tackle such issues by remote data collection, capacity building of service providers, sharing of knowledge/ information among the field workers, disease tracking and epidemic alerts, etc. Such latest technologies have the capability of improving healthcare services [1].

m-Health has the potential to transform the health system, reduce the time /travel cost of health care, and contribute to the provision of quality healthcare services. mHealth can add to cultivating "gross national happiness" by generating a gladder, healthier, prolific population, and has the potential to renovate health service delivery [2].

The use of wireless technologies with electronic health refers to the use of mobile devices such as smartphones to deliver or obtain health care information and services.

WHO defines m-Health as medical and public health practice supported by mobile devices such as mobile phones, patient monitoring devices, personal digital assistants, and other devices .it involves the use of voice, SMS, and other functions [3]. The use of telecommunication technologies for better provision of health care services and sharing of health information with the needful. This definition does not restrict to the role of ICT in health care but also to the change of attitude and commitment to-

Correspondence
Dr. Aziza Alam
Demonstrator
Department of Community Medicine, Khyber Medical College/ Khyber Teaching Hospital, Peshawar - Pakistan
Cell: +92-333-9231819
Email: azizagrc@yahoo.com
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wards the improvement in quality of health care services[4]. According to the World Health Organization mHealth is medical and public health practice supported by mobile devices such as mobile phones, personal digital assistants (PDA), patient monitoring devices, and other wireless devices. mHealth works through verbal communication, SMS, and other complex functions [3].

Scientific research illustrates that the provision of health care services by using ICT is generally termed as eHealth. Telehealth or telemedicine[4]. Telehealth is an umbrella term for both telemedicine and mobile devices for providing health services. Telehealth is the provision of health care services and health information exchange using information communication technology (ICT) among service providers as well as the community irrespective of social, cultural, time, and distance barriers[5]. In a broader sense, eHealth refers not merely to the use of communication technology in the health system but also to the mind trend, approach, and assurance for the provision of quality health care services using the ICT [6].

As the potential role of communication technology in improving the health care services in district Peshawar has not been investigated so far, the present study wants to replicate this study in the context of district Peshawar with a special focus on factors affecting the adoption of information communication technology (m-Health) in public health programs by CHWs working in district Peshawar, the expected role of m-Health on the provision of quality health care services, perception and preparedness of CHWs towards the adoption of m-Health and comparing the technology acceptability trend among Community Health Workers.

MATERIALS AND METHODS

A mixed method approach, qualitative approach, and quantitative are used in this research. A quantitative approach objectively seeks to measure the phenomenon, it uses numerical values and statistical analysis[7]. While the qualitative approach seeks to find meaning that people attach to specific phenomena, it goes beyond the quantification[8]. In the research instrument survey questionnaire adopted from the study of Dr. Patrick (2016)[9]. Quality of health services was healthcare delivered through m-health interventions that were acceptable.

The descriptive quantitative approach (aimed at measuring the research problem using numeric values and statistical analysis). A 5-point Likert scale was used to scale the responses in survey research. The data from the Likert scale was considered quantitative data and statistically analyzed[10].

The research instrument i.e. survey questionnaire consists of various sections, Section A captures general demographic information of respondents such as gender, age, district, designation, and duties. Section B assesses the current usage of mHealth within their healthcare domain, it is further inquiring the use of cellphones for routine work-related purposes, with the subsequent aim of finding the frequency of that specific use by community health workers, moreover, the respondents were asked about the ownership and purposes of other mobile devices usage. Section B investigates the current use of mobile health in the healthcare sector. Section C focuses on the potential adoption of mHealth by the primary health care professionals in district Peshawar, on the grounds of mHealth acceptability, capability, mHealth complexity, mHealth relative advantage, mHealth compatibility, m-Health trial ability, and m-Health observability.

As this research is based on theoretical frameworks such as the Capability Approach and the DOI model all the questions in sections B and C of the questionnaire are aligned with these models to assess the research objectives and questions.

A cross-sectional analytical study was conducted in 2019 Target Population was Lady health workers, LHWs (1277), CMWs (106), FWWs/FCWs (37/18) LHVs (88) working in the Peshawar district covering a population of 1120,5000, 5000-7000, 1400-1500 respectively.

The Sample size as calculated by the WHO online sample size calculator was 308 Community Health workers working in the public sector of Peshawar district, where the population size was 1526, p-valve of 50%, confidence interval of 95%, and margin of error 5%. 20% of each sample was taken from each group. Two-stage sampling techniques comprising Quota Sampling and Systematic Random Sampling procedures were adopted. The respondents from each category were selected by the following formula: Total Number of CHWs/sample size for each category.

Data was analyzed using SPSS version 22. Descriptive statistics and frequency distribution were calculated and components by Principal Component Analysis.

Principal Components Analysis (PCA) was conducted for the generation of the index for m-Health capabilities and diffusion of Innovation factors, which were used for determining the key factors that influence m-Health adoption.

DOI factors and mHealth capabilities acceptance were analyzed, where the dependent variable was mHealth capabilities acceptance and independent variables were DOI factors such as mHealth complexity, mHealth relative advantage, and mHealth compatibility. The overall indexes of the DOI factors and capability acceptance calculated via PCA analysis were used in this correlation analysis. Correlation analysis was performed to determine a significant relationship, between variables derived from the Diffusion of Innovation (DOI) and use of Technology and mHealth capabilities acceptance.

Pearson coefficient test was applied and ranges from negative 1 (indicates the perfect negative relationship) to positive 1 (indicates the perfect positive relationship between variables), whereas the value of 0 indicates no relationship between variables.

RESULTS

The mHealth capabilities and the results are reflected in Table 1 "Communication with fellow health professionals using a mobile phone" was the most highly ranked m-health capability and training health workers using mobile devices has received the least acceptance.

The higher-ranked m-Health capability according to data recordings reflects approval in favor of communication with fellow health professionals. Acceptance to send SMS to make people aware of different diseases stands on second number, monitoring and treatment of patients via mobile phones comes on third number with agree and strongly agree percentage recording of 54.6%, acceptance to use mobile for diagnostic support comes on fourth number with agree & strongly agree percentage of 53.3% and acceptance for treatment support comes on fifth number. Moreover, to have an overall index of the mHealth capabilities, the Principal Component Analysis (PCA) method was applied, which is a data reduction technique applicable to relatively large data series to create smaller components that can be interpreted easily. The highest PCA 0.727 is recorded for the use of mobile devices for diagnostic support which indicates that it has more impact (hence more importance) on the calculation of the m-Health capabilities acceptance index. The second-highest PCA index was calculated as 0.690 for the use of mobile devices for treatment support. Loading scores or PCA scores (listed in the loaded column) are weights by which each variable (in this case, m-health capabilities acceptance variables) is multiplied to get the main component index or score. Taking into consideration the m-health capabilities the overall m-health capability index is constructed as follows based on eight items (from questions 1.1 to 1.8):

mHealth capability acceptance index = 0.610 x Q 1.1 + 0.468 x Q 1.2 + 0.439 x Q1.3 + 0.489 x Q1.4 + 0.465 x Q1.5 + 0.501 x Q1.6 + 0.727 x Q1.7 + 0.690 x Q1.8

This index is a summary index that shows an individual score on m-health capabilities and will assist in determining the correlation coefficient to determine the relationship between m-health capability acceptance and the factors that may affect the acceptance.

PCA was carried out to find out the impact of the most significant construct on the mHealth complexities and the highest PCA score was found for health worker's desire to know how m-Health Works (table 2) 0.845, and the second high score was calculated as 0.80 for the factor that is Community worker would adopt mHealth because mHealth devices are easier to use. Overall m-health complexity index was constructed based questionnaire as follows (based on eight items from questions 2.1 to to2.8).

DOI-complexity = 0.692 x Q2.1+ 0.764 x Q2.2 + 0.709 x Q2.3 + 0.776 x Q2.4 + 0.845 x Q2.5+ 0.678 x Q2.6 + 0.636 x Q2.7+ 0.808 x Q2.8

The highest PCA value was recorded for the factor," mHealth makes my job easier" which highlights its importance that community health workers feel more at ease and enjoy their services if they are trained and provided with mobile phones for the execution of their routine tasks. Similarly, PCA scores for most of the relative advantage constructs are found higher which indicates that this program has more advantages if it is adopted and can contribute a lot of betterment to society (table 3). The overall relative advantage index based on six questions (from3.1 to3.6) is calculated as follows: DOI- relative advantage = 0.542 x Q3.1 + 0.822 x Q3.2 + 0.602 x Q3.3 + 0.787 x Q3.4 + 0.739 x Q 3.5 + 0.614 x Q3.6

The highest PCA factor is recorded for the factor, "m-Health is compatible with what is needed to execute daily tasks" and for "mHealth is compatible with duties". This indicates the importance of these factors with the mHealth compatibility. The overall compatibility index is calculated on 5 compatibility factors (from questions 4.1 to 4.5). DOI-Compatibility = 0.770 x Q 4.1 + 0.783 x Q4.2 + 0.569 x Q 4.3 + 0.739 x Q 4.4 + 0.638 x Q4.5

The results of correlation analysis showed that mHealth capabilities are significantly and positively correlated to compatibility. Whereas the correlation between mHealth capabilities m-Health Complexity and mHealth Relative Advantage are positive but insignificant as their p value is greater than the threshold level of 1, 5, or 10 percent level of significance.

DISCUSSION

The data regarding complexities of the m-Health acceptance shows that the majority of the CHWs disagreed that m-Health usage of mobile phones is difficult and most of them were willing to learn the use of mobile in m-Health, its phenomenon, and adoption because it is easier to use. However, those who were reluctant to use the m-Health application should be explored in debt. Based on research findings of the Wootton study,[13] the involvement of service providers in such activities is suggested to address the needs and quarries of disagreed and not sure proportion of community health workers and to make them comfortable with the use of m-Health by the provision of training, this effort can contribute to the self-efficacy of service providers, self-efficacy can be explained as apparent ease of use and apparent usability[14]. Perception of easy usage is identified as a predictor of M-Health diffusion into the system[15]. Thus, training could

Table No 1: Capabilities Acceptance (Ca) of Mobile Health

m-Health Capabilities	Strongly Disagree	Disagree	I am not sure	Agree	Strongly Agree	Agree+ Strongly agree+ Strongly Agree	Rank	Principal Component	
								Loading	
1 I would accept sending SMS to make people aware of different methods of disease prevention	13.6	**9.4**	22.1	49	5.8	54.8	2	.610	Percentage of total variation 76.2%
1.2 I would accept to collect medical/health data by means of mobile devices	8.8	17.9	25	38	10.4	48.4	7	.468	
1.3 I would accept to monitor and treat patients using mobile devices	7.1	13.3	25	39	15.6	54.6	3	.439	
1.4 I would accept communicate with fellow health professionals using mobile devices	8.1	10.7	20.8	40.9	19.5	60.4	1	.489	
1.5 I would accept to train health workers using mobile devices	12.3	17.5	24.7	34.7	10.7	45.4	8	.465	
1.6 I would accept tracking diseases and epidemic outbreaks using mobile devices	13	13.3	22.7	31.8	19.2	51	6	.501	
1.7 I would accept to use of mobile devices for diagnostic support	16.2	12.3	18.2	32.5	20.8	53.3	4	.727	
1.8 I would accept to use mobile devices for treatment support	12	14.9	19.8	37.3	15.9	53.2	5	.690	

Table No 2: m-Health complexity and willingness to learn the usage of m-health

m-Health Capabilities	Strongly Disagree	Disagree	I am not sure	Agree	Strongly Agree	Agree+ Strongly agree+ Strongly Agree	Rank	Principal Component	
								Loading	
2.1 I would not adopt mHealth because mobile devices are difficult to use	16.2	**30.2**	23.4	22.4	7.8	30.2	**7**	.692	Percentage of total variation %53
2.2 I would not adopt mHealth if mHealth applications are difficult to learn	17.2	34.4	12	26.3	10.1	36.4	**4**	.764	
2.3 I am Willing to Learn to Use Mobile	17.5	10.4	14.7	35.3	22.1	57.4	**2**	.709	
2.4 I am Willing to Use MHealth Apps	12.7	17.2	17.9	32.8	19.5	52.3	**3**	.776	
2.5 I Need To Know How MHealth Works	18.2	11.4	12.4	36.6	21.4	58	**1**	.845	
2.6 I will not cope with using mHealth devices	18.8	30.2	16.2	27.3	7.5	34.8	**5**	.678	
2.7 I will not cope with using mHealth applications	18.2	25.3	24	21.1	11.4	32.5	**6**	.636	
2.8 I would adopt mHealth because mHealth devices are easier to use	16.6	10.9	17.5	43.4	14.6	58	**1**	.808	

Table No 3: Relative advantage of m-Health

m-Health Capabilities	Strongly Disagree	Disagree	I am not sure	Agree	Strongly Agree	Agree+ Strongly agree	Rank	Principal Component	
								Loading	
3.1 mHealth is useful to me	12.7	**17.9**	11.2	35.3	23	58.3	**1**	.542	Percentage of total variation 61.6 % %61.6
3.2 mHealth will make my job easier	17.5	14.9	18.4	36.5	12.7	49.2	**6**	.822	
3.3 M-heath will reduce the amount of effort spent on executing some tasks	16.9	15.9	16	32.3	19	51.3	**5**	.602	
3.4 mHealth would enable me to reach a larger portion of the country's population	8.4	19.5	20	29.9	22.2	52.1	**4**	.787	
3.5 A larger portion of the population will benefit from healthcare services if mHealth is implemented	12.3	12.3	22.9	31.2	21.2	52.4	**3**	.739	
3.6 There will be an increase in prevention and awareness of diseases if mHealth is adopted	12	10.1	21.4	39.3	17.2	56.5	**2**	.614	

Table No 4: m-Health compatibility

m-Health Capabilities	Strongly Disagree	Disagree	I am not sure	Agree	Strongly Agree	Agree+Strongly agree	Rank	Principal Component	
								Loading	
4.1 mHealth is compatible with my duties	8.1	**14.6**	22.1	38.3	16.9	55.2	**1**	.770	Percentage of total variation %62.3 %62.3
4.2 mHealth is compatible with what I need to execute my daily tasks	9.4	13.6	23.7	36.4	16.9	53.3	**2**	.783	
4.3 mHealth is compatible with my experience with mobile devices	11.4	16.2	26.3	28.2	17.9	46.1	**5**	.569	
4.4 mHealth is compatible with my organizational working style	11	14	28.2	34.7	12	46.7	**4**	.739	
4.5 mHealth is compatible with my work ethics	7.5	22.4	20.2	30.8	19	49.8	**3**	.638	

Table No 4: m-Health compatibility

		capability	Complexity	Relative Advantage
Complexity	Correlation	.020		
	P Value	.727		
	N	308		
Relative Advantage	Correlation	.112*	.361**	
	P Value	.049	.000	
	N	308	308	
Compatibility	Correlation	.141*	.209**	.153**
	P Value	.013	.000	.007
	N	308	308	308

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

be the source of attaining self-efficacy which in turn can lead to the successful adoption of m-Health by CHWs.

The highlighted fact is that most of the community health service providers think that m-Health is useful to be adopted for the delivery of professional services, m-Health makes the job easier, and they also think that some tasks can easily be performed with the help of m Health, it makes easier to access the large portion of the population, and with the successful implementation of the project, large portion of population can be benefited from useful and timely services. Similarly, there was an increase in prevention and awareness of diseases with m-Health adoption by community health services providers such as LHWs, LHVs, CMWs, and FWWs, etc. The highest PCA value for the question' m-Health make it easier" highlights its importance that community health workers feel more at ease and enjoy their services if they are trained and provided with the facilities to deliver the services of health care through the adoption of mobile phones. Studies reveal that the relative advantage or usefulness of innovation is a very important factor in technology adoption[16].

The assessed variables of compatibility can be grouped into three categories that are organizational compatibility questions work work-related compatibility and experience-based compatibility questions [9]. According to Tornatzky, compatibility was divided into two categories, normative and practical compatibility. According to this, experience-based and work-related compatibility comes under practical, and organizational comes under normative compatibility[17]. Regarding m-Health friability, views of CHWs indicated that half of them want testing of m-Health before adoption, and more than half of CHWs are of the view that they adopt the m-Health and then evaluate the results. About 46% of respondents want to see clear and valid results of m-Health adoption before adopting it, and 49% said that they need to be shown where m-Health worked before. Whereas 41% of community health workers in Peshawar district said that they immediately adopted the m-Health without any query. More than half of the community health service providers such as LHWs, LHVs, CMWs, FWWs, etc. agree with the compatibility variables such that m-Health was compatible with their duties, execution of daily tasks, their experiences with mobile devices, organizational working style, and their work ethics. The high PCA value of 0.783 is calculated for the variable "m-Health was compatible with what needed to execute daily task" indicating that this variable has a strong impact on m-Health capability acceptance. This study reveals that the compatibility of technology depends on the diffusion rate of innovation and resistance to acceptance by service providers. An increase in compatibility of technology leads to an increase in diffusion of technology and a decrease in compatibility leads to acceptance resistance by service providers and vice versa[18].

CONCLUSIONS

m-Health usefulness and acceptance in awareness and disease prevention are the most agreed factors by the community health workers. Acceptance for m-Health capability "to communicate with fellow health service provider" was higher in the capability index for the use of mobile phones for health care purposes. The highest PCA score recordings for m-health made the job easier and improved accessibility for the community. The factors with high-loading PCA scores indicated that service providers are willing to adopt mHealth. Research recommends that comparison with other eHealth devices will make us understand how technology can be used for the betterment of the community and the service provider.

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Authors Contribution:

Following authors have made substantial contributions to the manuscript as under

Authors	Conceived & designed the analysis	Collected the data	Contributed data or analysis tools	Performed the analysis	Wrote the paper	Other contribution
Akhtar A	✓	✓	✓	×	✓	×
Khan IA	✓	✓	×	×	✓	×
Alam A	×	✓	×	×	×	✓
Gul R	✓	×	✓	✓	×	×
Shah AA	✓	✓	×	✓	×	×
Ullah N	×	✓	×	✓	✓	×

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethical Approval:

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