Assessment of minilab adoption level in pharmaceutical service delivery in selected tertiary hospitals in south-western Nigeria.

Omoniyi J. Ola-Olorun[1], Margaret O. Afolabi[1] and Timothy O. Oyebisi[2]

[1]Department of Clinical Pharmacy and Pharmacy Administration, Faculty of Pharmacy; [2]African Institute for Science Policy and Innovation, Faculty of Technology, Obafemi Awolowo University, Ile-Ife. Nigeria.

Corresponding Author: Omoniyi Ola-Olorun
E-mail: niyiolaolorun@gmail.com Phone: +2348034119314

ABSTRACT

Background: One of the key strategies devised to overcome the menace of spurious medicines in pharmaceutical distribution globally has been the invention of mobile quality assessment technology (Minilab®) for use along medicine supply chain in developing countries.

Objectives: The objectives of the study were to assess the adoption level and determine the availability of Minilab in pharmaceutical service delivery in selected tertiary hospitals in South-western Nigeria.

Methods: Primary data were employed and study sample consisted of 91 pharmacists from eight of sixteen available hospitals. Instruments employed were a set of questionnaire and physical observation of Minilab. The questionnaire sought to elicit information on availability of Minilab and stages of Minilab's adoption on a scale of five alternative responses comprising knowledge, persuasion, decision, application and confirmation with weighting scores of 1 to 5. Level of adoption was computed as mean of weighted averages (MWA) of the respondents' scores. Data obtained were analyzed using descriptive and inferential statistics.

Results: The results showed that the adoption level of Minilab was low (MWA $\approx$ 2) and Minilab was available in three (37.5%) of the eight hospitals but used regularly in one (12.5%) only.

Conclusion: The study concluded that both the adoption level and availability of Minilab were low with implications for regulatory policy.

Key words: Minilab, adoption level, pharmaceutical service delivery, tertiary hospital, assessment of adoption level.

Evaluation du niveau d'adoption Minilab dans le service de livraison des produits pharmaceutiques dans certains centres hospitaliers universitaires au sud-ouest du Nigeria.

Auteur correspondant: Omoniyi Ola-Olorun
E-mail: niyiolaolorun@gmail.com Téléphone:: +2348034119314

RESUME

Contexte: L'une des stratégies fondamentales conçues pour vaincre la menace des faux médicaments parasites globalement dans la distribution des produits pharmaceutiques à l'échelle planétaire a été l'invention de la technologie mobile de contrôle de qualité (Minilab®) pour l'usage ensemble avec la chaine de distribution des médicaments dans les pays en voie de développement.

Objectifs: Les objectifs de l'étude étaient d'évaluer le niveau d'adoption et déterminer la disponibilité de Minilab dans le service de livraison des produits pharmaceutiques dans certains centres hospitaliers universitaires dans le sud-ouest du Nigeria.

Méthodes: Les données primaires étaient employées et l'échantillon d'étude consistait de 91 pharmaciens provenant de seize hôpitaux disponibles. Les instruments employés étaient une série de questionnaire et d'observation physique de Minilab. Le questionnaire entreprit de mettre au jour les informations sur la disponibilité de Minilab et des étapes de l'adoption de Minilab sur une échelle de cinq réponses alternatives comprenant la connaissance, la persuasion, la décision, l'application et la confirmation avec des notes pondérées de 1 à 5. Le niveau d'adoption fut calculé comme moyenne des notes pondérées (MP) des notes des intervenants. Les données obtenues étaient analysées à l'aide de la statistique descriptive et inférentielle.

Résultats: Les résultats ont montré que le niveau d'adoption du Minilab était bas (MP $\approx$ 2) et que Minilab était disponible dans (37.5%) des huit hôpitaux mais utilisé régulièrement dans un seul (12.5%).

Conclusion: L'étude a conclu que le niveau d'adoption ainsi que la disponibilité de Minilab étaient bas avec des implications pour la politique réglementaire.

Mots-clés: Minilab, niveau d'adoption, service de livraison pharmaceutique, centre hospitalier, évaluation du niveau d'adoption.

INTRODUCTION

The menace of spurious medicines has become a global challenge for several decades[1, 2] and it does not appear to be about to abate. Whether addressed as counterfeit, substandard, fake or adulterated medicines[3, 4],medicines in the market that do not meet the expected standards of safety, efficacy and quality pose threat to health, life and security of any nation and her citizens.

The developing countries are particularly at the receiving end of this problem since they often lack the fund as well as the human and technological resources to combat the threat.[5] This has led to frequent mass loss of lives of patients from poisoning with medicines obtained in hospitals.[6, 7] Many of these cases occur in developing countries, in major hospitals patronised by millions of patients daily. In Nigeria, healthcare is at three levels of primary, secondary and tertiary in parallel with the levels of government namely local, state and federal governments.[8] The tertiary hospitals, which are usually owned by the Federal Government, are large and serve thousands of patients daily which explains why tens to hundreds of patients can be affected within one to few days. Because of their large volume of operations, the tertiary hospitals usually have the capacity, and serve as entry point, for innovations and new technologies that may be too costly for the lower level facilities to afford. They can be university teaching hospitals (owned by Federal or State governments or private investors), federal medical centres and specialist hospitals.

Quality assurance of pharmaceuticals is a major public health challenge in developing countries where there is predominance of imported finished products coexisting with lack of adequate analytical services and human resources[5]. A major part of the essential medicines purchased into the public hospitals are imported mainly from countries which have been implicated as sources of spurious medicines.[5] If such medicines are assessed at the point of delivery into the hospital, spurious ones among them may be identified and their entry into the hospitals prevented. The recurrent episodic loss of tens of patients that presented for treatment in hospitals for decades show that no permanent check has been put in place to halt the menace.[6, 7]

In 1996, The German Pharma Health Fund (GPHF), a charity organisation of the German association of research based pharmaceutical companies, touched by the uncontrolled vulnerability of the developing countries, produced the mobile quality assessment technology tagged Minilab.®[9, 10] It is a self–contained mobile laboratory that provides the essential laboratory ware, chemicals, and reference materials to quickly determine medicine quality in non–laboratory settings. It was particularly designed to be portable, of relatively low cost, simple to use, and self-contained for all that is required by an analyst to use it. It can be used in any facility be it hospital, community or

wholesale pharmacy, medicine warehouse or stores, and can be used in the absence of electricity. It is accompanied by a protocol and following this protocol, it can be used for on-the-spot physical assessment by inspection of packages of medicines as well as rapid chemical screening of medicine quality.[3, 11] Risha *et al*.[13] reported as Minilab's main limitation its ability to detect adulterants in only grossly substandard or wrong drug samples which calls for a confirmatory testing resource when suspected products give positive result. The need for training and proficiency testing of its users is another requirement for its effective use.[13]

Adoption of technology can be defined as the acceptance and use of technology by an adopting unit on a permanent basis.[14] According to Roger's Innovation Decision Process theory[15], adoption is a process of five stages consisting of 1. Awareness (or knowledge) about the technology 2. Persuasion about its use 3. Decision to reject or accept the technology for use 4. Implementation which is the stage at which the technology has been commissioned and 5.

Confirmation which is the stage at which barrier to the use of the technology has been eliminated or reduced and the technology is in routine use (or its use institutionalised). These stages can be tagged adoption levels.[16, 17] The uptake of Minilab in tertiary hospitals in South-western Nigeria has not been reported in literature. The aims of the study therefore, were to assess the adoption level and determine the availability of Minilab in pharmaceutical service delivery in selected tertiary hospitals in South-western Nigeria.

METHODS Design

The study was a cross-sectional survey of pharmacists in tertiary hospitals in South western Nigeria. Ethical approval was obtained at each of all hospitals covered. The instrument employed for the study included a set of questionnaire and physical observation of the availability of Minilab. The questionnaire was pretested among tertiary hospital pharmacists and the comments of the hospital pharmacists were employed in making necessary corrections in the questionnaire. The test of reliability of the final copy of the questionnaire used

gave a Cronbach alpha value of 0.84. The questionnaire consisted of two main sections designed to elicit information on demographics and the level of adoption of Minilab respectively. Other information sought included availability of Minilab, year of acquisition, regularity of use, products that had benefited from its use and reasons for not using it when it has been acquired but not fully utilised. Adoption was measured on a scale of five alternative responses of awareness, persuasion, decision, application and confirmation with weighting scores of 1 to 5. Respondents were to select the highest stage of adoption attained for Minilab. The adoption level which was the stage of adoption of Minilab in the five-stage adoption process was computed as the weighted average (WA) of the respondents' scores rounded off to a whole number. The mean of the weighted averages (MWA) of the respondents' scores was also computed. Observation was carried out to inspect the physical condition of the Minilab and its accessories.

Target Population/Sample size

The target population for the study comprised all 186 pharmacists in the sixteen tertiary hospitals in Southwestern Nigeria. Eight of the sixteen hospitals were purposively sampled for geographical spread and to cover all speciality areas. Some of the hospitals had only a few pharmacists while others had large numbers. The required sample size was determined by employing Yaro Yamane[18] formula for sample size calculation as below giving a sample size of one hundred and twenty seven. The pharmacists were served with questionnaire $\frac{N}{1+Ne^2}$ ……. Equation 1 n = through a purposive and convenience sampling process.

Where

n = desired sample size N = population size e = maximum acceptable margin of error = 5% = 0.05

1 = a theoretical constant

Data Analysis

The data obtained from the instruments were sorted, coded and analysed using the computer-based analytical software Statistical Package for Service Solutions (SPSS) Version 17. The data analysis involved descriptive statistics such as frequencies, percentages and means while Chi square, correlation and t-test were employed for inferential analyses.

RESULTS

Table 1 presents the distribution of the sampled hospitals by their types. Out of the population of sixteen tertiary hospitals in South-Western Nigeria, eight were sampled. They included one Federal University Teaching Hospital out of three, two State University Teaching Hospitals out of four, two Federal Medical Centres out of four, one Federal Psychiatric Hospital out of two, one State Psychiatric Hospital out of two and the only Federal Orthopaedic Hospital.

Table 1: Distribution of selected tertiary hospitals in Southwestern Nigeria by types

Type of hospital	Number in population	Number in sample
Federal teaching hospitals	3	1
State teaching hospitals	4	2
Federal Medical Centres	4	2
Federal Psychiatric hospital	2	1
State Psychiatric hospitals	2	1
Federal Orthopaedic hospital	1	1
Total	16	8

The sampling profile is provided in Table 2 with 91 of the selected participants responding for a returning rate of 71.7%.

Table 2: Sampling profile of respondents

S/N.	Hospital types	Number in population	Calculated sample size	Number of respondents	Response rate (%)
1	Federal Teaching Hospital	65	44	31	56.92
2	State Teaching Hospitals	30	20	19	92.76
3	Federal Medical Centres	56	38	29	75.84
4	Federal Specialist Hospital (Psychiatric)	15	10	6	60.00
5	State Specialist Hospital (Psychiatric)	1	1	1	100.00
6	Federal Specialist Hospital (Orthopaedic)	19	13	5	42.11
	Total	186	127	91	71.65

Table 3 presents the demographic profile of the respondents in the selected hospitals by gender, management status and hospital pharmacy work experience.

Table 3: Demographic profile of respondents

Variables	N	(%)
Population of Pharmacists by hospital type		
Federal Teaching Hospital	31	(34.07)
State Teaching Hospital	19	(20.88)
Federal Medical Centre	29	(31.87)
Federal Specialist Hospital (Neuropsychiatric)	6	(6.95)
Federal Specialist Hospital (Orthopaedic)	5	(5.49)
State Specialist Hospital (Neuropsychiatric)	1	(1.10)
Total	**91**	**(100.00)**
Gender of respondents (years) Female		
	39	(42.86)
Male	52	(57.14)
Total	**91**	**(100.00)**
Head of Department		
Yes	5	(5.49)
No	86	(94.51)
Total	**91**	**100.00**
Head of Unit		
Yes	19	(20.88)
No	72	(79.12)
Total	**91**	**100.00**
Hospital pharmacy work experience (years)		
0 to 1	29	(31.87)
2 to 5	31	(34.07)
6 to 10	11	(12.09)
11 to 20	11	(12.09)
21 to 30	9	(9.89)

Total	**91**	**100.00**

Of the 91 respondents, 31 (34.1%) were from Federal Teaching Hospital, 19 (20.9%) were from State Teaching Hospitals and 29 (31.9%) were from Federal Medical
Centres (FMC). 6 (7.0%) were from Federal Neuropsychiatric Specialist Hospital and 5 (5.5%) were from Federal Orthopaedic Specialist Hospital while only 1 (1.1%) was from State Neuropsychiatric Specialist Hospital.
Of the 91 respondents, 31 (34.1%) were from Federal Teaching Hospital, 19 (20.9%) were from State Teaching Hospitals and 29 (31.9%) were from Federal Medical
Centres (FMC). 6 (7.0%) were from Federal Neuropsychiatric Specialist Hospital and 5 (5.5%) were from Federal Orthopaedic Specialist Hospital while only 1 (1.1%) was from State Neuropsychiatric Specialist Hospital.
With respect to gender, 39 (42.9%) and 52 (57.1%) of the respondents were females and males respectively. 5 (5.5%) and 19 (20.9%) were heads of department and heads of units respectively within the Pharmacy department. With regard to hospital work experience, 29 (31.9%) possessed 0-1 year experience, 31 (34.1%) possessed 2-5 years experience, 11 (12.1%) each possessed 6-10 and 11-20 years experience respectively and 9 (9.9%) possessed 21-30 years experience.

Level of Minilab adoption in the Hospitals

The perception of respondents about the level of Minilab adoption in the sampled hospitals is presented in Table 4. Of the 31 respondents in Federal Teaching hospital, the weighted average (WA) score was computed as 2.42 (≈ 2) whereas which implies that Minilab adoption was at persuasion level in the hospital. at the State Teaching Hospital A, the WA score of the 13 respondents was computed as 2.00 implying that Minilab adoption was at persuasion level in both hospitals. With respect to the 6 respondents in the State Teaching Hospital B, the WA score was computed as 2.50 (≈3) which implies that Minilab adoption was at decision (or trial) level whereas, of the 12 respondents at Federal Medical Centre A, the WA score was computed as 2.17 (≈2) which implies that adoption of Minilab was at persuasion level in the hospital. However, for the 17 respondents at Federal Medical Centre B, the WA score was computed as 3.53 (≈ 4.) This implies that Minilab adoption was at implementation level in the hospital. Of the 6 respondents from Federal Neuropsychiatric hospital, the WA score was computed as 1.83 (≈2) implying that adoption of Minilab was at persuasion level in the hospital. At the State Neuropsychiatric hospital, the only pharmacist and respondent believed Minilab's adoption was at persuasion level in the hospital whereas at the Federal Orthopaedic Hospital, out of the five respondents, the WA score was computed as 1.80 (≈ 2) meaning that Minilab adoption was at persuasion level in the hospital. The mean of weighted averages (MWA) score was computed as 2.3 (≈ 2). This implies that overall, adoption of Minilab in the selected tertiary hospitals, based on results from individual hospitals, was at persuasion level.

Table 4: Respondents perception of the level of Minilab adoption in the selected Hospitals

Tertiary Hospitals		Awareness stage	Persuasion Stage	Decision Stage	Implementation Stage	Confirmation Stage	Total Number of Respdts (?f)	Weighted Average scores (adoption level) WA=?fx/?f	Mean of Weighted Averages (MWA)
	x	1	2	3	4	5			
Federal teaching hospital	f	8	10	5	8	0	31	2.42	2.28
	%	25.81	32.26	16.13	25.81	0.00			
State teaching hospital A	f	2	9	2	0	0	13	2.00	
	%	15.38	69.23	15.38	0.00	0.00			
State teaching hospital B	f	0	4	1	1	0	6	2.50	
	%	0.00	66.67	16.67	16.67	0.00			
Federal Medical Centre A	f	2	8	1	0	1	12	2.17	
	%	16.67	66.67	8.33	0.00	8.33			
Federal Medical Centre B	f	2	1	1	12	1	17	3.53	
	%	11.76	5.88	5.88	70.59	5.88			
Federal Psychiatric hospital	f	2	3	1	0	0	6	1.83	
	%	33.33	50.00	16.67	0.00	0.00			
State Psychiatric hospital	f	0	1	0	0	0	1	2.00	
	%	0.00	100.00	0.00	0.00	0.00			
Federal Orthopaedic hospital	f	3	1	0	1	0	5	1.80	
	%	60.00	20.00	0.00	20.00	0.00			

Table 5 presents the respondents' perception of the level of Minilab adoption, based on the types of tertiary hospital. The results for Federal Teaching hospital, Federal Neuropsychiatric hospital, Federal Orthopaedic Hospital and State Teaching Hospitals show Minilab adoption to be at persuasion level for each of the four hospital types with weighted average scores of 2.42, 1.83, 1.80 and 2.16 respectively. However, with respect to Federal Medical Centres, the WA score was computed to be 2.97 (≈3) which implies that Minilab's adoption within Federal Medical Centres was at decision (trial) level. The mean of weighted averages (MWA) score for all the hospital types was computed as 2.2 (≈2) implying that overall, the adoption of Minilab in the tertiary hospitals, based on hospital types, was at persuasion level.

Table 5: Respondents perception of the level of adoption of Minilab by types of Hospital

Tertiary hospital types	Aware-ness Stage	Persua-sion Stage	Decision Stage	Confirm-ation Stage	Implemen-tation Stage	Number of Respon-dents	Weighted Averages (MWA)	Total scores (adoption level)	Mean of Average of stage

	x	1	2	3	4	5		
Federal teaching hospital	f	8	10	5	8	0	31	2.42
	%	25.81	32.26	16.13	25.81	0.00	19	2.16
State teaching hospitals	f	2	13	3	1	0	29	2.97
	%	10.53	68.42	15.79	5.26	0.00	6	1.83
Federal Medical Centres	f	4	9	2	12	2	15	2.00
	%	13.79	31.03	6.90	41.38	6.90	5	1.80
Federal Psychiatric hospital	f	2	3	1	0	0	10	2.20
	%	33.33	50.00	16.67	0.00	0.00		
State Psychiatric hospital	f	0	1	0	0	0	1	1.80
	%	0.00	100.00	0.00	0.00	0.00		
Federal Orthopaedic hospital	f	3	1	0	1	0		
	%	60.00	20.00	0.00	20.00	0.00		

Availability of Minilab in the Hospitals

The findings about the availability of Minilabat the tertiary hospitals are presented in Table 6. Minilabwas available in only three (37.5%) of the eight hospitals. The three hospitals were the Federal Teaching Hospital and

the two Federal Medical Centres (FMCs). At the Federal Teaching Hospital, Minilab was acquired in 2010 and used 1-2 times per year in its two years since acquisition. It had been used for quinine tablets only that were suspected to be counterfeit. At FMC A, Minilabwas acquired in 2009 and had never been used

Table 6: Availability of Minilab in the selected tertiary Hospitals in Southwestern Nigeria

Hospital	Availability of Minilab	Year of acquisition	Regularity of use	Products that have benefited from equipment use
Federal teaching hospital	Available	2010	1 - 2 times per year	Quinine tablets
State teaching hospital A	-	-	-	-
State teaching hospital B	-	-	-	-
Federal Medical Centre A	Available	2009	Not in use	-
Federal Medical Centre B	Available	2008	Regularly during procurement (4 times per year) and if stocked product is suspected	Tetracycline Capsules, (250mg); Paracetamol Syrup, (125mg/5ml); Paracetamol Tablets, (500mg); Sulfadoxine/pyrimethamine Tablets (500mg + 25mg), sulphamethoxazole/trimethoprim tablets, 400mg+80mg
Federal Psychiatric hospital	-	-	-	-
State Psychiatric hospital	-	-	-	-
Federal Orthopaedic hospital	-	-	-	-

At FMC B, Minilabwas acquired in 2008 and had been used regularly during procurement which was on average four times annually and when a stocked product was suspected to be of doubtful quality. It had been used for Tetracycline capsules (250mg), Paracetamol syrups (125mg/5ml), Paracetamol Tablets (500mg), Sulfadoxine/Pyrimethamine tablets (500mg+25mg) and sulphamethoxazole/Trimethoprim tablets (400mg+80mg). Those were five of the fifteen drug products for which Minilab had been designed. Minilab was not available in the remaining five hospitals. The reasons adduced for not having acquired Minilab included lack of fund and/or human resource and the reasons adduced for under-utilisation or outright lack of utilisation in hospitals that had acquired Minilab included human resource shortage and lack of support infrastructure. A chi-square analysis showed that there was a significant association ($\chi^2 = 14.29$, $P < .05$) between the types of tertiary hospital and levels of adoption of Minilab while a correlation analysis showed that there was a significant relationship ($r = .924$, $P < .05$) between the population of pharmacists in the tertiary hospitals and the level of adoption of Minilab. A t-test analysis showed that there was no significant difference ($t = -3.48$, $P > .05$) between the responses of heads of pharmacy department and other pharmacists in the sampled hospitals.

DISCUSSION

The study had set out to assess the level of adoption of Minilab in tertiary hospitals in Southwestern Nigeria and determine its availability in the hospitals. The threat to health and life of patients from medicines in distribution chain that do not meet the safety, efficacy and quality standards can neither be denied nor wished away.[6, 7] Developing countries in particular lack resources to meet the challenge of this threat as most of the medicines in such countries are imported from countries that have been implicated as sources of spurious medicines.[5] Tertiary hospitals with large volumes of operations and expectedly centres for innovation ought to be able to assure the quality of the medicines they procure. This is the purpose for which Minilab has been designed for developing countries.[9, 12] The five stage model of adoption process had been employed in this study.[15] These stages can be tagged adoption levels.[16] The adoption can be considered at the systemic (or macro) level, when the aggregate levels of the adopters are being considered in line with the Rogers' model[15, 16] giving rise to the levels of awareness (WA≈ 1), planning, trial (WA≈ 3), implementation (WA≈ 4) and institutionalisation (WA≈ 5). At the awareness stage, the technology is barely known to potential adopters but not sufficiently as to consider its uptake. At the persuasion level, the potential adopters know enough of the technology and its characteristics to begin to consider the possibility of its uptake. At the decision stage, the potential adopters are taking decision to acquire or reject the technology. At this systemic level, a fraction of the population may have already implemented the technology such that the WA may be somewhat higher than 3 but lower than 4 hence this stage has been described as trial stage.[16] At the implementation level, the technology becomes available and assumedly being used. However, it is one issue to be available, it is another to have been used or even to be routinely used and institutionalised. The adoption becomes confirmed at level 5 when the uptake of the technology has become institutionalised. From the results, the level of adoption of Minilab was low at persuasion stage (WA≈2). This implies that on the overall, Minilab had not been effectively adopted in the tertiary hospitals.[15, 17] Adoption becomes effective at implementation level (stage 4 of the adoption process). At the Federal teaching hospital where it had been acquired, only 25.8% of the respondents were aware that it was available and already in use and the adoption level was at the persuasion level (≈2).

The low level of Minilab's adoption was corroborated by low level of availability (37.5%) in the tertiary hospitals. None of the state teaching hospitals and Federal Specialist hospitals (Neuropsychiatric and Orthopaedic hospitals) had acquired Minilab. The implication is that in the absence of any other affordable means of quality assessment for medicines being procured into their stock, the hospitals lacked effective means of assessing the quality of such medicines.[5] Even in hospitals where Minilab had been acquired, it was not effectively engaged. Of the three hospitals that had acquired it, it had never been used in one of the two FMCs and it was used for only suspected fake quinine tablets based on customer complaint at the Federal Teaching Hospital. With respect to year of acquisition, the earliest acquisition of Minilab among the tertiary hospitals in

Southwestern Nigeria was in 2008, twelve years after it was launched in 1996.[9] Its acquisition appears to be delayed considering the fact that Minilab was designed for developing countries of which Nigeria is notable. Minilab had been engaged in only two of the hospitals. Minilab has in its portfolio about fifteen products.[9, 10] Even at the Federal Medical Centre B where Minilab had been most utilised, only five products had benefitted. This is less than 50% of the portfolio of products for which Minilab is available.

The tertiary hospitals are major hospitals with large volume of operations.[8] They are therefore expected to have larger amount of fund available which could enable them adopt technological innovations thereby serving as entry point for such innovations in the health sector. The low level of adoption and availability of Minilab in these hospitals, therefore, may be a reflection of generally low intake of Minilab in hospitals in Southwestern Nigeria. Improved uptake and use of Minilab in the hospitals can be achieved through increased commitment of pharmacy department leadership and central management in the hospitals as well as awareness campaign by professional associations and through government regulatory control.

The findings on the adoption of Minilab and its availability in the hospitals appear to be related as the hospitals that provided the empirical evidence of availability also gave the highest values of adoption level. This shows that the five stage model of adoption level computations can be a useful benchmarking tool for uptake of technologies and other innovations[16] in pharmaceutical service delivery in hospitals but the tool remains to be validated. The study has been limited by the fact that hospitals in the private sector were not covered and sampling was not random.

CONCLUSION

From the findings of this study, the adoption level of Minilab in the selected tertiary hospitals was low (WA $\approx$ 2). Adoption of Minilab was at the persuasion level and not effective in pharmaceutical service delivery (PSD) in the selected tertiary hospitals. Availability of Minilab was also low (37.5%) and it was only being utilised in two (25%) of the selected hospitals.

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