

Original Research Article

The availability, use and disposal of malaria and HIV rapid diagnostic test kits in health facilities in the greater Accra region of Ghana

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ABSTRACT

Background: The Malaria and HIV rapid diagnostic tests (RDTs) are some of the commonest tests that are used in Ghana to support malaria and HIV management/care respectively. When these devices are used, they are categorized as potentially infectious. This paper aims to highlight the availability and management of used malaria and HIV RDTs in various healthcare facilities and by health service providers in the greater Accra region of Ghana.

Methods: Data was obtained from 400 health facilities including hospitals, clinics, health centres, and pharmacies and over the counter medicine seller's shops using purposive sampling technique with the aid of structured questionnaires and observation of practices.

Results: Seventy percent of the facilities (n=280) used only malaria RDTs, 29% (n=116) used both malaria and HIV RDTs and 1% (n=4) reported using HIV RDTs only. 81.7% (n=326) which formed the majority used less than 10 RDTs daily. There was poor waste segregation, storage, transportation, treatment and disposal of waste. Facilities that had some sort of on-site treatment of waste used single chambered incinerators.

Conclusions: Each of the categories of health facilities had a common practice of poor hazardous waste management. We therefore recommend that there should be enhancement of education and training of practitioners in the health facilities and the general public on the optimal use of the RDTs and disposal or the management of healthcare waste in general. The environmental protection agency and ministry of health should collaborate and enforce all the regulations on healthcare waste management in the various facilities.

Keywords: Greater Accra region, HIV, Malaria, Rapid diagnostic tests

INTRODUCTION

Healthcare Waste (HCW) is defined as any waste material generated from medical procedures.¹ This implies that, the definition covers waste materials generated outside the walls of healthcare facilities thereby

extending to waste generated in ambulances, pharmacies, schools, homes etc. that are related to the administration of medical procedures. Asante et al reported that about 25% of HCW generated in Ghana are hazardous while the remaining 75% are non-hazardous.²

There is the need for proper management of HCW since the hazardous component can present high risk to the health of humans and the environment at large. In this regards, proper waste segregation, storage, transportation, treatment and disposal is required to prevent the spread of diseases such as HIV, hepatitis B and C among other infectious diseases.^{1,3}

The RDTs aid in the diagnosis of diseases through its rapid results, however it involves the use of body fluids such as blood, saliva and urine to help with the diagnostic procedure. A material is considered as potentially infectious when it comes into contact with the body fluids of a person.¹ In this regard, the components of the RDTs that come into contact with the body fluids is regarded as hazardous waste hence needs to be managed as such and properly disposed.

There are many reports on poor medical waste management which may include the disposal of these RDTs from the health facilities.^{2,4,5} However, no known study has been conducted specifically on the disposal of used RDTs. This study therefore sought to investigate the mode of disposal of the used RDTs and come out with recommendations for sustainable and environmentally friendly systems for proper management of used devices.

METHODS

Study design

A total of four hundred (400) health facilities were sampled. This is to enable the sample include most types of health providers. Sample size was calculated from the regional database of health facilities as compiled in the published facts and figures report 2017 of the Ghana Health service and the pharmacy council gazette of pharmaceutical facilities and over the counter medicine seller's shops 2018.

The minimum sample size of 352 was determined using the classic sample size formula. A four-stage sampling procedure was employed; a purposive sampling technique was used to select the districts to ensure a representation of urban, peri-urban and rural settlements; the second stage was a systematic selection of communities in the selected districts to ensure full coverage of each selected district, third stage was a purposive selection of health facilities to comprise a fair representation of health facilities designated as CHPS, health centres, polyclinics, clinics, hospitals, pharmacy and over the counter medicine seller's shops from the selected communities. The final stage was the simple random selection of health facilities.

This study was conducted in the greater Accra region of Ghana. The selection of this region for the study was

based on its composition as having urban, peri-urban, and rural settlements and therefore serves as a fair representation of the country.

This region is also home to the only quaternary hospital in Ghana. Both private and government health facilities including medicines outlets were visited. Some diseases in the study area include malaria, respiratory infections, hypertension, diarrhoea, diabetes, septic abortion, tuberculosis, and HIV/AIDS.

Study period

Study was conducted within a period of thirteen months from June 2019 to July 2020.

Inclusion criteria

Inclusion criteria included all health facilities including medicines outlets were eligible to be part of study after informed consent and accent have been duly and properly attained.

Exclusion criteria

Exclusion criteria were excluded specialized health facilities such as eye clinics, dental clinics, mental hospitals were.

Data collection

Interviews

Interviews were conducted with relevant staff of the health facilities. These included the Health and Safety Officers, Biomedical Engineers, Nurses, Waste Handlers, Pharmacists, over the counter medicine sellers etc. The interviews involved a series of questions relating to training in Healthcare Waste Management (HCWM), generation rate of RDTs, waste segregation, storage, transportation, treatment and disposal of waste.

Observations

To attain first-hand information on the waste management practices at the health facility, visits were made to the health facilities to observe how the various protocols in HCWM were being implemented. A checklist was designed to aid with this survey.

Data analysis

All data collected through various means were compiled and entered into computer for storage and analysis. Microsoft excel and STATA Version 15 were used for analysis.

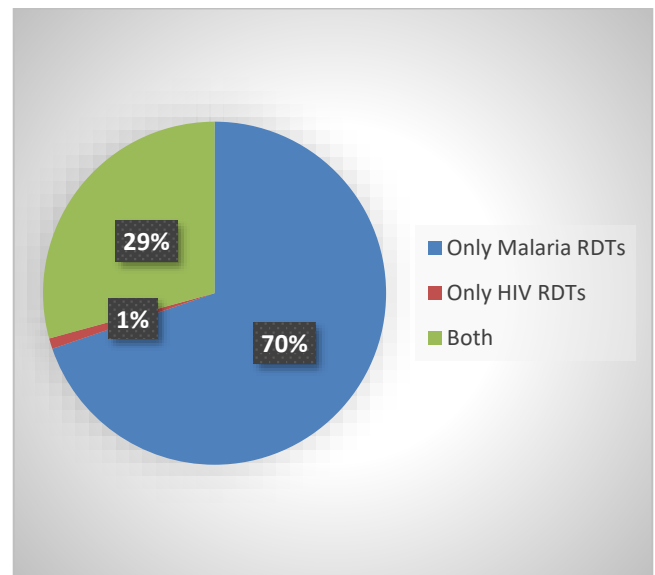
RESULTS

Health facilities

Table 1: Health facility of study participants.

Cadre of health facility	N	%
Pharmacy	253	63.3
Clinic	65	16.2
Hospital	36	9.0
Over the counter medicine sellers' shop	20	5.0
Health Centre	13	3.3
Polyclinic	6	1.5
CHPS	5	1.2
District hospital	2	0.5
Ownership status		
Private	368	92.0
Government	28	7.0
Quasi-government	2	0.5
Faith Based Health Institution	2	0.5

Use of RDTs



Source: Field Data, 2019

Figure 1: Type of RDTs used by health facility.

Disposal of RDTs and knowledge of MOH healthcare waste management

Table 2: Disposal of RDTs.

Variable	Frequency (N)	Percentage (%)
H/mRDTs used daily		
Less than 10	327	81.7
10 to 50	68	17.0
51 and 100	4	1.0
Above 100	1	0.3
Frequency of RDT disposal		
Daily	299	74.7
Weekly	77	19.3
Monthly	9	2.3
*Other	15	3.7
Satisfied with self-disposal by practitioner of used HIV/ malaria RDTs		
Yes	367	91.7
No	33	8.3
Know about MoH Health Care Waste Management Guidelines		
Yes	262	65.5
No	138	34.5
Ever read the document		
Yes	101	38.6
No	149	56.9
Started but did not complete	12	4.6

*Disposal of RDTs by cadre of facility***Table 3: Percentage distribution regarding the mode of disposal of RDTs by cadre of facility.**

Variable	Cadre of facility							
	CHPS N (%)	Health centre N (%)	Clinic N (%)	Polyclinic N (%)	Hospital N (%)	District hospital N (%)	Pharmacy/ Chemist N (%)	OTC N (%)
Have policy on malaria/HIV RDTs disposal***								
Yes	2 (40.0)	10 (76.9)	51 (78.5)	4 (66.7)	31 (86.1)	2 (100.0)	141 (55.7)	4 (20.0)
No	3 (60.0)	3 (23.1)	13 (20.0)	2 (33.3)	5 (13.9)	0 (0.0)	109 (43.1)	16 (80.0)
Don't know	0 (0.0)	0 (0.0)	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.2)	0 (0.0)
Have protocol/guideline on disposal of RDTs***								
Yes	2 (40.0)	10 (76.9)	52 (80.0)	4 (66.7)	32 (88.9)	2 (100.0)	137 (54.2)	5 (25.0)
No	3 (60.0)	3 (23.1)	13 (20.0)	2 (33.3)	4 (11.1)	0 (0.0)	112 (44.3)	15 (75.0)
Don't know	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (1.6)	0 (0.0)
Have guidelines concerning disposal of expired RDTs***								
Yes	0 (0.0)	9 (69.2)	44 (67.7)	6 (100.0)	23 (63.9)	1 (50.0)	127 (50.2)	4 (20.0)
No	5 (100.0)	4 (30.8)	20 (30.8)	0 (0.0)	13 (36.1)	0 (0.0)	124 (49.0)	16 (80.0)
Don't know	0 (0.0)	0 (0.0)	1 (1.5)	0 (0.0)	0 (0.0)	1 (50.0)	2 (0.8)	0 (0.0)
Ever trained on disposal of used RDTs**								
Yes	2 (40.0)	8 (61.5)	44 (67.7)	3 (50.0)	17 (47.2)	0 (0.0)	99 (39.1)	6 (30.0)
No	3 (60.0)	5 (38.5)	21 (32.3)	3 (50.0)	19 (52.8)	2 (100.0)	154 (60.9)	14 (70.0)
Where training done								
In-house	0 (0.0)	5 (62.5)	26 (59.1)	2 (66.7)	9 (52.9)	-	59 (56.7)	3 (50.0)
External training	2 (100.0)	3 (37.5)	18 (40.9)	1 (33.3)	8 (47.1)	-	40 (53.3)	3 (50.0)
Trained by**								
Supervisor	-	4 (80.0)	5 (19.2)	1 (50.0)	5 (55.6)	-	42 (71.2)	2 (66.7)
Co-worker	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	-	4 (6.8)	0 (0.0)
Lab technicians	-	0 (0.0)	2 (7.7)	0 (0.0)	1 (11.1)	-	3 (5.1)	0 (0.0)
External technical resource persons	-	1 (20.0)	19 (73.1)	1 (50.0)	3 (33.3)	-	10 (16.9)	1 (33.3)
Every health worker trained								
Yes	2 (100.0)	7 (87.5)	33 (75.0)	2 (66.7)	15 (88.2)	-	86 (86.9)	6 (100.0)
No	0 (0.0)	1 (12.5)	11 (25.0)	1 (33.3)	2 (11.8)	-	13 (13.1)	0 (0.0)
Received refresher training on disposal of RDT								
Yes	1 (50.0)	5 (62.5)	14 (31.8)	2 (66.7)	6 (35.3)	-	23 (23.2)	0 (0.0)
No	1 (50.0)	3 (27.5)	30 (68.2)	1 (33.3)	11 (64.7)	-	76 (76.8)	6 (100.0)

Continued.

Variable	Cadre of facility							
	CHPS N (%)	Health centre N (%)	Clinic N (%)	Polyclinic N (%)	Hospital N (%)	District hospital N (%)	Pharmacy/ Chemist N (%)	OTC N (%)
Ways of disposing used RDT and its accessories								
We put them all together in a general bin and burn them	1 (20.0)	1 (7.7)	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	33 (13.1)	1 (5.0)
We separate the sharps and put them in the sharp box and put the rest of the test kit and other accessories in a specially lined bin for biological waste for the cleaners to pick them up and burn them	0 (0.0)	0 (0.0)	5 (7.7)	0 (0.0)	2 (5.6)	0 (0.0)	43 (17.1)	0 (0.0)
We separate the sharps and put them in the sharp box, the packet inserts into the general waste bin and put the rest of the test kit and other accessories in a specially lined bin for biological waste for the cleaners to pick them up and incinerate	0 (0.0)	4 (30.8)	29 (44.6)	0 (0.0)	18 (50.0)	2 (100.0)	14 (5.6)	0 (0.0)
We have incinerator so we incinerate them all together with other biological waste in our facility	0 (0.0)	0 (0.0)	3 (4.6)	0 (0.0)	3 (8.3)	0 (0.0)	4 (1.6)	0 (0.0)
We have an agreement with a waste management company so they pick up the waste as biological waste for disposal	0 (0.0)	3 (23.1)	7 (10.8)	0 (0.0)	8 (22.2)	0 (0.0)	36 (14.2)	2 (10.0)
We have an agreement with a waste management company so they pick up the waste as general waste for disposal	0 (0.0)	0 (0.0)	2 (3.1)	0 (0.0)	1 (2.8)	0 (0.0)	76 (30.1)	15 (75.0)
We put them in a special bin and bury them when the bin is full	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
We separate the waste into bins and later add to all other waste for burning	3 (60.0)	3 (23.1)	79 (10.8)	1 (33.3)	1 (2.8)	0 (0.0)	5 (2.0)	0 (0.0)
We give it to the customer to dispose off	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.8)	0 (0.0)
We separate the waste and the biological waste is buried	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (2.0)	0 (0.0)
We dispose them at community refuse dump	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.8)	0 (0.0)
The waste is carefully separated and given to the appropriate waste companies for disposal	1 (20.0)	2 (15.3)	9 (13.8)	0 (0.0)	0 (0.0)	0 (0.0)	15 (6.0)	0 (0.0)
The waste are separated in the bin and don't know what happens to it	0 (0.0)	0 (0.0)	2 (3.1)	2 (66.7)	3 (8.3)	0 (0.0)	17 (6.7)	2 (10.0)

significant at $p < 0.001$; *significant at $p < 0.0001$ Source: Field Data, 2019

Disposal of RDTs by district**Table 4: Percentage distribution regarding the mode of disposal of RDTs by districts.**

Variable	District			Chi square/ Fisher's exact P value
	Accra Metropolitan Area N (%)	Tema Metropolitan Area N (%)	Ga West N (%)	
Have policy on malaria/HIV RDTs disposal				0.327a
Yes	161 (58.5)	63 (70.0)	21 (60.0)	
No	111 (40.4)	26 (28.9)	14 (40.0)	
Don't know	3 (1.1)	1 (1.1)	0 (0.0)	
Have protocol/guideline on disposal of RDTs				0.073 a
Yes	160 (58.2)	64 (71.1)	20 (57.1)	
No	113 (41.1)	24 (26.7)	15 (42.9)	
Don't know	2 (0.7)	2 (2.2)	0 (0.0)	
Have guidelines concerning disposal of expired RDTs				0.0001a
Yes	145 (52.7)	61 (67.8)	8 (22.9)	
No	128 (46.5)	27 (30.0)	27 (77.1)	
Don't know	2 (0.8)	2 (2.2)	0 (0.0)	
Ever trained on disposal of used RDT				0.001
Yes	103 (37.9)	54 (60.0)	19 (54.3)	
No	169 (63.1)	36 (40.0)	16 (45.7)	
Where training done				0.0001a
In-house	75 (70.8)	25 (46.3)	4 (21.1)	
External training	31 (29.2)	29 (53.7)	15 (78.9)	
Trained by				0.0001a
Supervisor	37 (49.3)	22 (88.0)	0 (0.0)	
Co-worker	3 (4.0)	1 (4.0)	0 (0.0)	
Lab technicians	4 (5.3)	2 (8.0)	0 (0.0)	
External technical resource persons	31 (41.3)	0 (0.0)	4 (100.0)	
Every health worker trained				0.085a
Yes	89 (92.7)	43 (52.4)	19 (100.0)	
No	17 (7.3)	39 (47.6)	0 (0.0)	
Received refresher training on disposal of RDT				0.012
Yes	25 (23.6)	15 (27.8)	11 (42.1)	
No	81 (76.4)	39 (72.2)	8 (57.9)	
Ways of disposing used RDT and its accessories				-
We put them all together in a general bin and burn them	28 (10.2)	6 (6.7)	3 (8.6)	
We separate the sharps and put them in the sharp box and put the rest of the test kit and other accessories in a specially lined bin for biological waste for the cleaners to pick them up and burn them	23 (8.4)	26 (28.9)	1 (2.9)	
We separate the sharps and put them in the sharp box, the packet inserts into the general waste bin and put the rest of the test kit and other accessories in a specially lined bin for biological waste for the cleaners to pick them up and incinerate	57 (20.8)	13 (14.4)	0 (0.0)	
We have incinerator so we incinerate them all together with other biological waste in our facility	5 (1.8)	2 (2.2)	3 (8.6)	
We have an agreement with a waste management company so they pick up the waste as biological waste for disposal	51 (18.6)	5 (5.6)	0 (0.0)	
We have an agreement with a waste management company so they pick up the waste as general waste for disposal	71 (25.9)	21 (23.3)	2 (5.7)	

Continued.

Variable	District			Chi square/ Fisher's exact ^a P value
	Accra Metropolitan Area N (%)	Tema Metropolitan Area N (%)	Ga West N (%)	
We put them in a special bin and bury them when the bin is full	0 (0.0)	0 (0.0)	0 (0.0)	
We separate the waste into bins and later added to all other waste for burning	3 (1.1)	2 (2.2)	15 (42.8)	
We give it to the customer to dispose off	0 (0.0)	2 (2.2)	0 (0.0)	
We separate the waste and the biological waste is buried	3 (1.1)	2 (2.2)	0 (0.0)	
We dispose them at community refuse dump	1 (0.3)	1 (1.1)	0 (0.0)	
The waste is carefully separated and given to the appropriate waste companies for disposal	12 (3.6)	7 (7.8)	8 (22.8)	
The waste is separated and put in the bin and don't know what happens to it	20 (6.0)	3 (3.3)	3 (8.6)	

Source: Field Data, 2019

Disposal of RDTs by ownership of facility**Table 5: Percentage distribution regarding the mode of disposal of RDTs by ownership of facility.**

Variable	Ownership				Chi square/ Fisher's exact ^a p
	Private N (%)	Government N (%)	Quasi- government N (%)	Faith- based N (%)	
Have policy on malaria/HIV RDTs disposal					0.216
Yes	219 (59.5)	22 (78.6)	2 (100.0)	2 (100.0)	
No	145 (39.4)	6 (21.4)	0 (0.0)	0 (0.0)	
Don't know	4 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	
Have protocol/guideline on disposal of RDTs					0.350
Yes	219 (59.5)	21 (75.0)	2 (100.0)	2 (100.0)	
No	145 (39.4)	7 (25.0)	0 (0.0)	0 (0.0)	
Don't know	4 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	
Have guidelines concerning disposal of expired RDTs					0.004
Yes	195 (53.0)	18 (64.3)	1 (50.0)	0 (0.0)	
No	171 (46.5)	9 (32.1)	0 (0.0)	2 (100.0)	
Don't know	2 (0.5)	1 (3.6)	1 (50.0)	0 (0.0)	
Ever trained on disposal of used RDT					0.089
Yes	161 (43.7)	16 (57.1)	0 (0.0)	2 (100.0)	
No	207 (56.3)	12 (42.9)	2 (100.0)	0 (0.0)	
Where training done					0.256
In-house	94 (58.4)	10 (62.5)	-	0 (0.0)	
External training	67 (41.6)	6 (37.5)	-	2 (100.0)	
Trained by					0.080
Supervisor	56 (59.6)	3 (30.0)	-	-	
Co-worker	4 (4.3)	0 (0.0)	-	-	
Lab technicians	4 (4.3)	2 (20.0)	-	-	
External technical resource persons	30 (31.9)	5 (50.0)	-	-	
Every health worker trained					0.802
Yes	25 (15.5)	3 (18.7)	-	0 (0.0)	
No	136 (84.5)	13 (81.3)	-	2 (100.0)	
Received refresher training on disposal of RDT					0.058
Yes	43 (26.7)	6 (37.5)	-	2 (100.0)	
No	118 (73.3)	10 (62.5)	-	0 (0.0)	
Ways of disposing used RDT and its accessories					-
We put them all together in a general bin and burn them	36 (9.8)	1 (3.6)	0 (0.0)	0 (0.0)	
We separate the sharps and put them in the sharp box and put the rest of the test kit and other accessories in a specially lined bin for biological waste for the cleaners to pick them up and burn them	50 (13.6)	0 (0.0)	0 (0.0)	0 (0.0)	

Continued.

Variable	Ownership				Chi square/ Fisher's exact ^a p
	Private N (%)	Government N (%)	Quasi- government N (%)	Faith- based N (%)	
We separate the sharps and put them in the sharp box, the packet inserts into the general waste bin and put the rest of the test kit and other accessories in a specially lined bin for biological waste for the cleaners to pick them up and incinerate	55 (15.0)	14 (50.0)	1 (50.0)	0 (0.0)	
We have incinerator so we incinerate them all together with other biological waste in our facility	10 (2.7)	0 (0.0)	0 (0.0)	0 (0.0)	
We have an agreement with a waste management company so they pick up the waste as biological waste for disposal	55 (15.0)	0 (0.0)	0 (0.0)	1 (50.0)	
We have an agreement with a waste management company so they pick up the waste as general waste for disposal	94 (25.6)	0 (0.0)	0 (0.0)	0 (0.0)	
We put them in a special bin and bury them when the bin is full	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
We separate the waste into bins and later added to all other waste for burning	11 (3.0)	8 (28.6)	0 (0.0)	1 (50.0)	
We give it to the customer to dispose off	2 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	
We separate the waste and the biological waste is buried	5 (1.4)	0 (0.0)	0 (0.0)	0 (0.0)	
We dispose them at community refuse dump	2 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	
The waste is carefully separated and given to the appropriate waste companies for disposal	25 (6.8)	2 (7.1)	0 (0.0)	0 (0.0)	
Waste are separated in the bin and don't know what happens to it	22 (6.0)	3 (10.7)	1 (50.0)	0 (0.0)	

Source: Field Data, 2019

DISCUSSION

About 63% of the participants (n=253) worked in pharmacies. Ninety two percent of the facilities (n=368) were owned by private individuals (Table 1). Seventy percent of the facilities (n=280) used only malaria RDTs, 29% (n=116) used both malaria and HIV RDTs and only 1% (n=4) reported using HIV RDTs only. The sample had more pharmacies than the other health providers as evident in Table 1. This could be attributed to the fact that, many people in Ghana would like to go to the pharmacy first when unwell for medicine before going to the hospital. In this regards, the Pharmacies have a high tendency of utilizing more of the RDTs as compared to the other facilities. Pharmacies are also numerous in the region and they are easily accessible without joining long queues hence this trend.

Statistics from the Ghana health service also indicate that, there are more private health facilities in the Greater Accra Region than government and other facilities. In this regards, there is a high probability of having higher numbers of private facilities in a sample size. This therefore justifies the results of the samples collected. Tenengey also obtained similar results when researching on the impact of a centralized medical waste treatment facility in the health sector.⁶ Majority (67%) of the health facilities assessed were privately owned hence coincides with this study.

Over eighty one percent of the respondents (n=327) indicated that they used less than 10 malaria/HIV RDTs daily. Over seventy four percent (n=299) of the facilities disposed their RDTs on a daily basis and over ninety one

percent (n=367) of the participants were satisfied with self-disposal of used HIV/malaria RDTs. About a third (n=138) of the participants did not know of MoH health care waste management guidelines. Regarding the use

of RDTs, the data as seen in Figure 1 is a reflection of the high rate of malaria cases in Ghana and Africa at large. Malaria is one of the commonest diseases affecting people in the region hence most facilities have the malaria RDTs to meet the demand. On the other side of the coin, you find few people testing for HIV unless prescribed by medical practitioner hence most pharmacies do not bother not having it. The stigma and psychological trauma attached to having an HIV test also repels people from having it. All these contributes to the above data trend.

The result on disposal of RDTs and knowledge of MOH healthcare waste management is consistent with research results of Tenengey where majority of the respondents had knowledge about the MoH policy and guidelines for Healthcare Waste management.⁶ However, more than half of them had not completely read the document to grasp the full details. Yawson also reported that, majority of his respondents did not have knowledge about the policy and guidelines.⁷

Table 3 shows the mode of disposal and the training given to the personnel on how to effectively dispose RDTs. Almost half (43.1%) of the study participants in the pharmacy have no policy on the disposal of HIV/malaria RDTs and expired RDTs. More than a quarter (30.2%) of the pharmacies openly burn the used RDTs. Almost half (49.2%) of the clinics incinerate the used RDTs and accessories. The cadre of facility was found to have a statistically significant influence on

having a policy on the disposal of malaria/HIV RDTs, having protocol/guideline on disposal of RDTs ($p<0.001$), guidelines concerning disposal of expired RDTs ($p<0.001$) and ever trained on disposal of used RDTs ($p<0.001$).

Table 4 shows the distribution of the mode of disposal of the RDTs per the district in which the health facilities are located. About 40.4% of the facilities located in the Accra metropolitan area had no policy on malaria/HIV RDTs disposal. In the Tema metropolitan area, 88% of those trained, had their training from their supervisor and almost half of the workers were never trained (47.6%). In the Accra metropolitan area, 22.6% of the health facilities located there incinerate the used RDTs while 35.6% of the facilities located in Tema metropolitan area practice open burning. The district in which the health facilities are located was associated with the guidelines concerning disposal of RDTs ($p<0.0001$), training on disposal of RDTs ($p<0.001$) and being given refresher training ($p<0.012$). However, there was no association between the districts in which the facilities are located and whether or not they have policy on malaria/HIV RDT disposal ($p=0.327$).

The Table 5 shows the distribution of disposal of RDTs by ownership of the facility. More than half (59.5%) of the private-owned facilities have policy on disposal of malaria/HIV RDTs. However, more than half (56.3%) had never been trained on disposal of RDTs. Open burning of the used RDTs is practised by 23.4% of the privately owned facilities and half (50.0%) of the government owned facilities incinerate their waste. Availability of guidelines concerning disposal of expired RDTs was associated with the ownership of the facility ($p=0.004$). However, there was no significant association between the other factors and the ownership status. Asante et al, Ayiku et al and Tengey reported similar practices where different degrees of improper waste management activities were recorded.^{2,4,6} Conditions at each facility were different depending on distinct factors. This research however is the first of its kind that has analyzed the waste management situations in various health facilities in this form of categorization.

CONCLUSION

The most commonly stocked RDTs in all the outlets assessed were malaria RDTs. Over a quarter of the facilities stocks and used both Malaria and HIV RDTs. Very few had only HIV RDTs. The use of the RDTs to support case management were however not optimal (less than 10 a day in most of the outlets).

The malaria and HIV RDTs kits become potentially infectious after usage hence requires proper segregation, storage, transportation, treatment and disposal to avoid any potential spread of infections in the environment. The various health facilities assessed had various ways of disposing their used RDTs however, majority of them

present high risk of infection to people in the environment when exposed to it.

Recommendations

The following recommendations when implemented will help address the situation and improve environmental health and safety;

Relevant stakeholders and the public should be educated on the policy and guidelines on healthcare waste management.

The Ministry of Health and Environmental Protection Agency (EPA) should improve their strategies in enforcing the Policy and Guidelines on Healthcare Waste Management in the country.

Health facility managers should make available the needed logistics for proper waste segregation such as pedaled bins, colour coded liners, sharps containers etc.

Regular training sessions in healthcare waste management should be conducted for health facility workers.

Special arrangements should be made with waste management contractors who operate centralized medical waste treatment facilities to help properly manage such infectious waste.

The use of centralized medical waste treatment facilities that operate with environmentally friendly technologies should be encouraged in Ghana since it will help solve the issues of individually acquiring expensive waste treatment equipment.

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