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Evaluation of self-care practices and management of people with type two diabetes mellitus in Arusha City, Tanzania

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Abstract

Background: Self-care is integral to effective management of diabetes. Understanding and evaluation of factors influencing diabetes self-care management help to improve self-care practices such as achieving glycaemic control and preventing diabetes complications. The main objective of this study was to evaluate self- care and management practices of type 2 diabetes in Arusha municipality.

Methods: A cross sectional study was used whereby data were collected once from the respondents by using a structured questionnaire developed from Diabetes Self-care Knowledge (DSCK-30) and Summary of Diabetes Self-Care Activities (SDSCA) measure. Study sample was selected using purposive sampling method for all patients attending diabetic clinics in Arusha municipality. The entire study sample had an equal chance of being selected in to the study.

Results: The level of self-care practices was determined in the areas of diet, physical exercises, foot-care and blood glucose testing. The score for general diet was relatively high (5.07 ± 1.7 days per week) compared to specific diet (3.6 ± 1.21), physical exercise (4.34 ± 2.29) and foot-care (5.55 ± 1.97). Consumption of vegetables was low where 83.6% of the respondents consumed less than one cup to one cup per day despite having high self- care knowledge. Barriers hindering adherence to health diet plan, physical exercise, foot care practices, and clinic attendance were identified in which financial constraints, busy working schedule, lack of knowledge concerning foot care, poor services in the clinic was major barriers identified in each aspect respectively. Educational level, income inadequacy, and current occupation of respondents were not associated with knowledge while duration of diabetes was found to be significantly associated with self-care knowledge. Most of the patients had higher self-care knowledge ($\geq 70\%$).

Conclusion Patients demonstrated high level of self-care knowledge. The level of self-care was however not up to a desired level of recommendation. Financial constraints were the main barrier to self-care.

Background

Diabetes mellitus, is a serious, long-term chronic condition that occurs when there is raised level of glucose in a person's blood because the body cannot produce any or enough hormone or cannot effectively use the insulin it produces (IDF 2019; Litchman *et al.,* 2018). Insulin is an important and very essential hormone produced in the pancreas. It allows glucose from the bloodstream to enter the body's cells where the glucose is converted into energy. Insulin is also essential for the metabolism of protein and fat. Lack of insulin, or inability of cells to respond to it, leads to high levels of blood glucose (hyperglycemia), which is the clinical indicator of diabetes (IDF, 2019).

Diabetes exist in three forms namely type 1 diabetes, type 2 diabetes and gestation diabetes. Type 1 (insulin dependent) occurs in all age groups while type 2 is mostly seen

in mid and older aged adults. Gestational DM occurs in pregnancy and can lead to serious health risks for mothers and babies (Tarekegne *et al.,* 2018). Type 2 diabetes generally occur in persons above 30 years of age. Type 2 diabetes has several causes. Heredity, age and weight are important contributing factors. Most people with Type 2 diabetes make enough insulin, but are not able to use it properly. Weight loss and exercise can often improve this problem. Type 2 diabetes develops very slowly over the age. There are modifiable and preventable risk factors for type 2 diabetes which include excess body fat, poor diet, lack of physical activity, tobacco smoking and excess alcohol consumption (Tarekegne *et al.,* 2018; World Diabetes Foundation 2019). The self-management education needs to be considered by involving many factor such as promotion of healthy lifestyles that includes eating nutritious diet, regular physical exercises, smoking cessation and maintenance of a healthy body weight (Chatterjee *et al.,* 2018).

Diabetes is found in every population in the world and in all regions, including rural parts of low- and middle-income countries (WHO, 2019). According to international diabetes federation IDF (2019), it's estimated that 463 million adults aged 20–79 years are currently living with diabetes. This represents 9.3% of the world's population in this age group. The total number is predicted to rise to 578 million (10.2%) by 2030 and to 700 million (10.9%) by 2045. The estimated number of adults aged 20–79 years with impaired glucose tolerance is 374 million (7.5% of the world population in this age group). This is predicted to rise to 454 million (8.0%) by 2030 and 548 million (8.6%) by 2045.

The effects of diabetes extend beyond the individual to affect their families and whole societies. It has broad socio-economic consequences and threatens national productivity and economies, especially in low- and middle-income countries where diabetes is often accompanied by other diseases (WHO, 2019). Self-care in diabetes is defined as an evolutionary process of development of knowledge, attitude or awareness by learning to survive with the complex nature of diabetes in a social context (Shrivastava *et al.,* 2013). According to Shrivastava *et al.,* (2013), there are seven essential self-care behaviours in people with diabetes which predict good outcomes. These are healthy diet, physical exercise, blood sugar monitoring and testing, medications use, good problem-solving skills, healthy coping skills and risk-reduction behaviours. Diabetic educators and health care professionals and all clinicians are encouraged to develop approaches that will be useful in treating and evaluating new approach to self-care.

According to Understanding Diabetes and Self-Care Guideline (World Diabetes Foundation, 2012), health care providers should begin by taking time to evaluate the patient's perceptions and make realistic and specific recommendations for self-care activities. Some patients may experience difficulty in understanding and following the basics of diabetes self-care activities, hence medical practitioner contact with the health-care team is critical to evaluate and ensure effective long-term control and treatment of diabetes. Once people with diabetes have been empowered with knowledge, they will then be able to advocate for their own rights to obtain the best possible care. This will provide them with self-management skills and the necessary steps that the health-care team should take to assist in the prevention, detection, and management of long-term complications of their diabetes (IDF, 2006).

Physical activity/exercise is very important in individuals with type 2 diabetes because its reduces triglycerides, blood pressure, and insulin resistance, through this promotes and improves insulin sensitivity, fat mass, blood pressure, strength, lean body mass and regulation of glycaemic level in adults with type 2 diabetes (Colberg *et al.,* 2016). To minimize risk of hyperglycemia, type 2 diabetic patients generally do not need to postpone exercise because of high blood glucose, provided they feel well. If capillary blood glucose levels are elevated >16.7 mmol/L, it is important to ensure proper hydration and monitor for signs and symptoms of dehydration example increased thirst, nausea, severe fatigue, blurred vision or headache (Sigal *et al.,* 2018).

Studies have shown that people with type two diabetes do not have a knowledge on how to engage in physical exercise, importance and how to overcome barrier to physical exercise (Colberg et al., 2016; Djiby et al., 2018). This require a period of education with supervised sessions, leading to patient autonomy in management, teaching of self-perception of the intensity of the exercise. Healthcare professional, family level and policy issues should formulate Behaviour-Change Strategies such as prompt focus on barrier identification to physical exercise participation, hence by having this will contribute to development of self-care-knowledge on the importance of physical activity participation in diabetes. According to Mogre *et al.,* (2019), it brings to bear that both patients and healthcare providers comprehend similar challenges to diabetic self-care, providing an opportunity for improved patient provider collaboration for diabetic care. Both patient and provider perspectives are relevant when exploring barriers to self-care. Increased participation of patients in treatment decisions and satisfaction with provider communication can improve adherence to self- care behaviour. There are number of barriers that hinder diabetic people to follow good self-care practices, this includes both patients and healthcare providers barriers, such barrier are busy work schedules, inadequate access to a variety of foods, inadequate family support, attitudes/behavioural beliefs, difficulty changing habits, intentional non-adherence to self- care, worrying about the continuous taking of medication, feeling lazy to perform exercise and side effects of medications (Mogre *et al.,* 2019).

There are strongly association between barriers and excess complications associated with diabetes, different systems barriers, such as limitations in the organization of diabetes services, long distances to diabetes services, and delivery/accessibility of diabetes care programs. The association between long distances to diabetes related services and complications of T2DM can be a barrier of particular importance to rural populations, since diabetes care requires access to regular follow-up, Therefore, interventions with multiple strategies targeting clinicians and health systems rather than focusing solely on conventional patient-oriented strategies, could be a beneficial for self-care and management approach (Sina *et al.,* 2018).

Epidemiology of Diabetes and Ramadan (EPIDIAR) studies have demonstrated that only around two-thirds of patients with diabetes received recommendations from their healthcare professionals regarding management of their condition during Ramadan. There was a need for more intensive education prior to fasting, thus healthcare professionals should be trained to deliver Ramadan-focused diabetes education in a culturally sensitive manner and also the education should involve both three aspects

such as general public, health care professionals and patients with diabetes (IDF and DAR Alliance, 2016).

Management of diabetes and diabetic eye care requires integration across the health care system and involves the patient, health professionals and supportive health policies. For a diabetic patient to have good and health eyes requires the following social support i.e. Peer-to-peer, improvement in health behaviour, quality of life and improve metabolic control. Family support i.e. family-based psychosocial support (where available), such as weekly meal planning, improvement in self-management of diabetes (IDF and Fred Hollows Foundation, 2015).

To the best of our knowledge despite of the dissemination of self-care and management practices by the health workers for type 2 diabetic patients, there is little information existing regarding evaluation of self-care, management practices, and barrier they face in seeking care practices. Most of the study (Masaki *et al.,* 2015; Miller, 2013) have addressed the prevalence, risk factors and management of type 2 diabetes. Thus, to address this knowledge gap, this study was designed to evaluate the self-care, management care practices and barriers to seeking care among type 2 diabetic patients in Arusha municipality. This study will involve patients from different diabetic clinic found in Arusha municipal so that we can understand various barriers that tends to reduce the quality and good self-care and management practices among type 2 diabetic patents. The results obtained will help the health care providers and diabetic people to determine were the problem is on provision of type 2 diabetes self-care and management practices thus improving quality of life in type 2 diabetes peoples. The main objective of this study is to evaluate self- care and management practices of type 2 diabetes in Arusha municipality.

Methods

Study area
Arusha Urban District (or Arusha City Council) is one of the seven districts of the Arusha Region of Tanzania, and it contains the regional and economic capital; the city of Arusha. It is bordered to the south, west and north by Arusha Rural District and to east by Meru District, the district is found within the latitudes of -3° 22' 12.29" S and longitudes of 36° 41' 24.05" E. the current of population of the city is 489,848 (Population Stat, 2020). Arusha has a temperate climate. The area is inhabited by various ethno-linguistic groups and communities. Among these are the Iraq, Arusha, Maasai, Meru, Sonjo, Chagga, Pare, and Nguu. The main interest of groups in city governance are local politicians, religious leaders, business owners, Community Based Organizations (CBOs), Community leaders, Tourism and Conservation Societies. In Arusha city council, the issues of public concern includes solid waste management, roads, health services, clean water supply and education (Development Institute Overseas, 2016).

Study design
A cross-section study was conducted to evaluate the self-care and managing care practices among type 2 diabetic patient attended diabetic clinics of Mount Meru Regional Referral hospital and Kaloleni Health Centre in Arusha municipality. Convenience

sampling was done to select the study population where by Study Population were type 2 diabetes mellitus patients attended diabetic clinics of Mount Meru Regional Referral hospital and Kaloleni Health Centre in Arusha municipality. Inclusion criteria were all patients with type 2 diabetes visiting the diabetic clinic while the exclusion criterion was all patients with type 1 diabetes not allowed to participate in the study.

Sampling

Purposive sampling was done for all patients visited diabetic clinics of Mount Meru Regional Referral hospital and Kaloleni Health Centre in Arusha municipality. The current of population of the Arusha municipality is 489,848 (Population Stat, 2020). The sample size was calculated using statistical power estimate since because the population is greater than 10000. The formula $n = \frac{z^2 pq}{d^2}$ was used by one study conducted in Dare es Salaam (Mosha & Heri 2009). The value of (p) indicate the proportion in the target population with type two diabetes which is 22.9%, obtained from study conducted in Arusha municipality (Masaki *et al.,* 2015).

The following formula is used to determine the sample size

$$n = \frac{z^2 pq}{d^2}$$

Where by: **n**= the desired sample

Size **z**= the standard normal deviate (in this study it was 1.96 that corresponded to 95% CI).

p= the proportion in the target population with certain characteristics (The prevalence of T2D in Arusha municipality is 22.9%) (Masaki *et al.,* 2015).

q = 1.0 − p = (1-0.229) =0.771

(d) = degree of accuracy desired (in this study is 0.05).

$$n = \frac{1.96^2 \times 0.229 \times 0.771}{0.05^2}$$

$$n = \mathbf{271}$$

A total of 110 T2D patients were able to participate in the study due to occurrence of COVID-19, thus few patients attended in the hospital.

Data collection

The data was collected from the study participants by the use of structured questionnaire. The questionnaire was divided into four sections, where by section A was solicit information about the rapport, section B was soliciting information about social and demographic characteristics of respondents, section C was soliciting information on self-care knowledge of diabetes (DSCK-30-Diabetes Self-care Knowledge tool, and section D was soliciting information summary of diabetes self- care activities (SDSCA) measure).

Prior to the administration of questionnaire to the participant firstly questionnaire was being translated into Swahili language. Then data was collected by questionnaire through face to face interview. Structured questionnaire was developed by considering characteristics such as age, marital status, level of education, income, disease duration, family history of diabetes, type of treatment.

Information concerning self-care practices and activities was collected by using instrument known as Summary of Diabetes Self-Care Activities (SDSCA) measure, this tool was used collect information basing on five components which are general diet, specific diet, exercise, blood-glucose testing, foot care, and smoking, The revised SDSCA version was used by one study conducted in dare salaam because this measure have its consistency in sufficient variability and lack of ceiling or floor effects, temporal stability, internal consistency, predictive validity, sensitivity to change, ease of scoring, and ease of interpretation (Mosha & Heri 2009).

Demographic characteristics was taken so as to see how will have influence on quality of self-care practices, the following characteristic will be taken including age, marital status, level of education, income, disease duration, family history of diabetes, type of treatment. The demographic characteristics will be determined using questionnaire.

Self-care activities were assessed using(SDSCA) Summary of Diabetes Self-Care Activities (SDSCA) measure, a brief self-report instrument for measuring levels of self-management across different components of the diabetes regimen example includes items assessing the following aspects of the diabetes self-care behaviour such as general diet, specific diet, exercise, blood-glucose testing, foot care, and smoking (Toobert *et al,*.2000).

Diabetes Self-care Knowledge-30 tool
The self-care knowledge was assessed by some question adopted from Diabetes Self-care Knolwedge-30 (DSCK-30) tool questionnaire which was used by earlier study (Adibe *et al*, 2011). The question comprised of three main scale which are described below, the first scale included items specifically to address knowledge of modifiable lifestyles like diet, exercise, self-blood glucose monitoring, foot, tooth and eye cares, second included items concerning compliance and adherence to self-care practices , which included questions concerning the following, (adherence to medications, keeping medical appointments and regular medical check-ups), third dimension was consequences of uncontrolled blood sugar level, also included items associated with complications of prolonged uncontrolled high/low blood sugar levels such as heart attack, stroke, kidney problems, shaking, confusion, behavioural changes, sweating, eye problem or even blindness.

Results and discussion

General characteristics of the study population
The general characteristics of the study include age, sex, marital status, and education level, number of people in the family, occupation, income, family history of diabetes and the duration of people living with diabetes. A total of 110 out of 120 questionnaires distributed were completed and returned. The number of males was 52 (47.3%) while that of females was 58 (52.7%) where by most of the respondent 33 (31.4%) were in the age group between 46-55 years followed by age groups above 65 years 30(28.6%), Almost more than half of them 87 (79.1%) were married. Sixty-one 61 (55.5%) studied subjects had primary school education while 14(12.7%) (n = 110) had no formal education. In the study thirty percent (30.9%) of the patient were doing business, 21 (19.1%) were doing petty business, while the rest were involved in diverse occupations ranging from retired 6

(5.5%, n = 110) to housewife (3.6%, n = 110). In case of income adequate only 21.8% (n = 110) rated their incomes as adequate, 67.3% (n = 110) rated their income as barely enough, while 10.9% (n = 110) rated their incomes as totally inadequate. 34.5% (n=110) of patient have had diabetes for 0-3 years. About 56 (50.9%) respondents had any family members or relatives or with diabetes while 54 (49.1%) said they didn't (Table 1).

Table 1: Socio-economic and demographic characteristics of the respondents (n=110)

Variables		No. of respondents	Percent
Age category	20-35	6	5.7%
	36-45	13	12.4%
	46-55	33	31.4%
	56-64	23	21.9%
	>=65	30	28.6%
Sex of respondents	male	52	47.3%
	female	58	52.7%
	Total	**110**	**100%**
Marital status	Married	87	79.1%
	Single	9	8.2%
	divorced	8	7.3%
	Separated	1	.9%
	Cohabiting	0	0.0%
	Widow	5	4.5%
	Total	**110**	**100%**
Education level	No formal education	14	12.7%
	Primary education	61	55.5%
	Secondary education	24	21.8%
	Post-secondary or vocational education University	11	10.0%
	Total	**110**	**100%**
Current occupation	Wage employment	6	5.5%
	Petty business	21	19.1%
	Business.	34	30.9%
	Crop farming	20	18.2%
	Livestock farming	7	6.4%
	Mixed farming	0	0.0%
	Retired	6	5.5%
	housewife	4	3.6%

	No occupation	12	10.9%
	Total	**110**	**100%**
Income adequate	Enough	24	21.8%
	Barely enough	74	67.3%
	Total Inadequate	12	10.9%
	Total	**110**	**100%**
Religion	Christian	85	77.3%
	Islamic	21	19.1%
	traditional	4	3.6%
	Total	**110**	**100%**
Duration of diabetes	0-3 years	38	34.5%
	4-6 years	34	30.9%
	7 -10 years	15	13.6%
	11 and above	23	20.9%
	Total	**110**	**1000%**
Family History	Yes	56	50.9%
	No	54	49.1%
	Total	110	
Number of people	1-3	34	30.9%
	4-7	67	60.9%
	>=7	9	8.2%
	Total	**110**	**100%**

In this study the majority of population lie between 20 to > 65 age groups, this is because diabetes affect population between (20-79) i.e. working age (between 20 and 64 years old) and people over 65 years of age (IDF, 2019), also there were more female than male, the possible reason could be due to the combined effect of a greater number of elderly women than men in most populations and the increasing prevalence of diabetes with age (Jackson *et al.,* 2014), and also the previous study reported similar finding (Adibe *et al.,*2011; Adisa *et al.,*2011; Adebisi *et al.,*2009). Hence it is therefore not surprising that women constituted 52.7% of the present study sample while men 47.3%.

Self-care Knowledge
The average percentage of correct answer in three scales components, modifiable lifestyle (component 1), adherence to self-care practices and consequences of uncontrolled blood sugar (component 3) was 88.2%, 91.46% and 74.3% respectively (Table 2). Although high self-care knowledge (≥ 70%) was realized in both components but the third component (knowledge consequences of uncontrolled blood sugar) was low compared to other component one and two, this was because only 27 (24.5%) (n=110) got correct concerning this item (Shaking, confusion, behavioural changes and sweating are signs of high blood sugar) hence this show that many diabetic peoples did not have knowledge of sign of high blood sugar, this is also supported in the study conducted in Nigeria (Adibe *et al*, 2011). Self-care knowledge was assessed using cut-off points on the knowledge of self-care practices (DSCK-30) as: (i) High self-care knowledge (≥70%); (ii)

Low self-care knowledge (≤70%) (Jackson *et al.*, 2014; Adibe *et al.*, 2011) as shown in Table 2.

Table 2: Number and percentage of respondents' correct answers as regards to self-care knowledge of type two diabetic mellitus

Modifiable Lifestyle		No	%
Maintaining a healthy weight is not important in management of diabetes.	Yes: **No**	95	86.40%
Only the doctors should make plans on how a person with diabetes can achieve his/her target goals.	Yes: **No**	102	92.70%
A person with diabetes should take extra care of his/her feet especially when cutting his/her toenails	**Yes:** No	108	98.20%
Having physical activity for 20-30 minutes per session at least 3 days per week is essential. (Example of physical activities: walking, house activities, climbing staircase).	**Yes:** No	107	97.30%
Regular exercise does not reduce the need for insulin or other diabetic drugs.	Yes **:No**	73	66.40%
Adherence to Self-Care Practices			
A person with diabetes taking diabetic medicines even when he/she feels good is waste of money.	Yes: **No**	107	97.30%
Diet and exercise are not as important as medication in control of diabetes.	Yes: **No**	100	90.90%
Diabetes Drugs are not taken throughout the life time of a person with diabetes	Yes: **No**	94	85.50%
Being drunk while on diabetic drugs is not a serious problem	Yes: **No**	102	92.70%
Regular medical check-ups are not essential when a person with diabetes is feeling well.	Yes: **No**	100	90.90%
Consequences of uncontrolled blood sugar			
Prolonged high blood sugar level can cause eye problem or even blindness.	**Yes:** No	106	96.40%
Shaking, confusion, behavioural changes and sweating are signs of high blood sugar.	Yes: No	27	24.50%
Prolonged uncontrolled blood sugar level can cause heart attack, stroke and kidney problems.	**Yes:** No	103	93.60%
If blood sugar is close to normal, a person with diabetes is likely to have more energy, feel less thirsty and urinate less often.	**Yes :** No	91	82.70%

In this study most of the patients had higher self-care knowledge (≥ 70%), overall higher self-care knowledge, modifiable lifestyle, adherence to self-care practices and consequences of uncontrolled blood sugar was 99 (90%), 96 (87.3%), 105 (95.5%) and 85 (77.30%) respectively (Table 3). This show that component 3 was low compared to other component because item concerning knowledge of high/low blood sugar signs was unfamiliar to many diabetic patients in the study, and this is also supported by one study

that involve use of DSCK-30 (Jackson *et al.,* 2014) . Hence education concerning sign and symptom of uncontrolled blood glucose should be conducted so that they could be able to manage and control blood sugar so as to avoid several complications associated.

Table 3: Overall self-care, modifiable, adherence to self-care to self-care practices and consequences of uncontrolled blood sugar

Knowledge components	Level of Knowledge	No of respondents	Percent %
Overall Self-Care Knowledge	Low self-care knowledge	11	10.00
	High self-care knowledge	99	90.00
Modifiable Lifestyle	Low self-care knowledge	14	12.70
	High self-care knowledge	96	87.30
Adherence to Self-Care	Low self-care knowledge	5	4.50
	High self-care knowledge	105	95.50
Consequences of High Blood Sugar Level	Low self-care knowledge	25	22.70
	High self-care knowledge	85	77.30

Barriers that influence Self-Care Behaviour and Management Care Practices among Diabetic patients

In this study the following barriers were identified, Barrier to follow health diet plan, barrier to physical exercise, barrier to foot care practices, and barrier of adherence to clinic (Table 4).

Table 4: Number and percentage (%) of respondents as regards to barriers to diabetic self-care

Barrier to health diet plan	No.	%
Economic factor	57	51.82
Lack of knowledge concerning healthy diet	11	10.00
I travel several time	3	2.73
Busy working schedule	26	23.64
Difficult to obtain meal plan away from home	6	5.45
Desire to consume sweet foods	5	4.55
Loneliness is a problem because I feel lazy to cook food	13	11.82
Availability and accessibility of healthy food is a barrier	16	14.55
Health condition i.e. ulcers	4	3.64
Not to consume certain types of foods	4	3.64
I don't prefer eating vegetable	5	4.55
Difficult to be around people who consume other food like soda	4	3.64
Eating large portion ,when am with people out	5	4.55
Larger portion size for preferred food	2	1.82
It's difficult to maintain diet during Ramadan	2	1.82
No support from family member	1	0.91
Barrier to physical exercise		
No instrument for exercise	11	10.00

Busy working schedule	39	35.45
Illness (leg)	23	20.91
Age related factor	15	13.64
Laziness	14	12.73
Lack of motivation	10	9.09
Tiredness	13	11.82
I hate sweating	15	13.64
Climatic condition	3	2.73
Disability	3	2.73
Barrier to foot care practices		
Foot swelling	5	4.55
Lack of knowledge concerning foot care	30	27.27
Pain in leg	6	5.45
No money to buy shoes	1	0.91
Wearing closed shoes is a challenge	7	6.36
Memory problem	2	1.82
Instrument for foot care practices	2	1.82
Barrier of adherence to diabetic clinic		
Long distance to clinic	20	18.18
Weather condition	5	4.55
Family problem	3	2.73
I travel several time	4	3.64
The services offered late	30	27.27
No constant doctor for ease tracking management	3	2.73
Medication not available/no cash	3	2.73
Transport problem	3	2.73
No money Available	10	9.09

Barrier to healthy diet plan

The identified barriers to health diet plan that were mentioned by several diabetic participants in the study are as follows, economic factor 51.82%, busy working schedule 23.64%, availability and accessibility of healthy food is challenges 14.55% (Table 4). Others were loneliness, feeling lazy to cook food 11.82%, lack of knowledge concerning health diet 10.0%, desire to consume sweet food 4.55%, difficult to obtain meal plan away from home 5.45%, non-preference for eating vegetable 4.55%, eating large portion 4.55%, not consuming certain food 3.64%, health condition example ulcers 3.64%, travels 2.73%, difficulties in maintaining diet during Ramadan 1.82%.

Most of the barriers were associated with economic and financial constraints, busy working schedule, difficulties in following health diet plan due to working environment and inadequate time for preparing or get healthy foods. Others were because so many elderly lives on their own due different reason hence this promote laziness to cook healthier foods. Previous studies (Mogre et *al.,* 2019;Marcy et *al.,* 2011), reported similar barriers, and especially economic factor was one with the highest mean scores. Hence cost of food is an important determinant of food choice due inadequate money to buy appropriate food was perceived by many participants in this population as a problem,

hence people should be encouraged on homestead production example plant of food around the house so that they can able to get enough food.

Barrier to physical exercise

The following are the barrier to physical exercise identified in this study, busy working schedule 39%, leg pain 20.91%, age related factor 13.64, and I hate sweating 13.64%, laziness 12.73, tiredness 11.82%, no instrument for exercise 10%, disability 2.73% and climatic condition 2.73%.

In this study almost, all participants mentioned that busy working schedule constituted a major barrier. They found it difficult to get time for physical activity, Lidegaard *et al.,*(2016) also found that the major barrier was lack of time for physical exercise among several participants. Another study, (Laranjo *et al.,* 2015) shows that some participant didn't participate in physical exercise because lack of motivation and some illness or injury in leg as similar in this study most of participant express lack of motivation and illness. Hence future exercise interventions targeting people with Type 2 diabetes should consider combining a professionally designed and individually tailored exercise plan with the establishment of customized local exercise communities that offer enjoyment and support (Lidegaard *et al.,* 2016).

Barrier to foot care practices

When study participants were asked whether they encounter barriers that limit them from proper foot care the following barriers to foot care practices were identified in this study, lack of knowledge concerning foot care 27.27%, wearing closed shoes is a challenge 6.36%, pain in leg 5.45%, foot swelling 4.55%, instrument for foot care practices 1.82%, memory problem 1.82%, family problem 1.82%no money to buy shoes 0.92%. The major barriers reported was lack of knowledge concerning foot care and challenge to wearing closed shoes which may be due to low awareness and education concerning principles of foot care practices. Previous studies such as (Bengalorkar, 2011; Seid & Tsige, 2015) also reported the similar result.

Barrier of adherence to clinic

The following are the barrier to physical exercise identified in this study, the services offered late 27.27%, long distance to clinic 18.18%, no money available 9.09%, weather condition 4.55%, i travel several time 3.64%, transport problem 2.73%, medication not available 2.73%, and different doctor for every hospital visit 2.73%. In this study many diabetic patients didn't manage to attend diabetic clinic because of the following mentioned reason, travel far so that they can reach diabetic clinic this is also reported by Sina *et al.,*(2018), some patient lack money for transport facilities but the major problem provided among study sample is the services are offered late when they attend earlier at the diabetic clinic centre but the services is not offered at a required time, hence due to this clients may decide to not attend the clinic next time until they get another time, but the possible reason is because many participants are entrepreneur and farmers i.e. (30.9% conduct business, 18.2% conduct petty business and 6.4% are livestock keeper) hence future intervention should focus on strengthening health services such diabetes education and provide quality services to diabetic patients so as to allow people engage in other activities.

Socio-demographic information and self-care knowledge

Patient's socio-demographic characteristics such as marital status, current occupation, income inadequate, duration of diabetes and family history were compared with self-care knowledge (Table 5). This study indicated that educational level, income inadequate, and current occupation of respondents was not associated with knowledge although the majority of those who have gone to school i.e. (completed primary, secondary school, post- secondary or vocational education or university) were more knowledgeable (high self-care knowledge) compared to those who didn't go to school as shown in Table 10. This is also reported in another study conducted by (Adibe et al., 2011), but the result is against the study (Jackson et al., 2014) which shows that there was a significant association between knowledge and education level among patients.

Table 5: Relationship between socio-demographic and self-care knowledge

Variable		Modifiable lifestyle		Adherence to self-care		Consequences of uncontrolled blood sugar	
		Low (n) %	High (n) %	Low (n) %	High (n)%	Low (n)%	High (n) %
Sex	Male	(11) 78.6	(41) 42.7	(4) 80	(48) 45.7	(12) 48	(40) 47.1
	Female	(3) 21.4	(55) 57.3	(1) 20	(57) 54.3	(13) 52	(45) 52.9
Marital status	Married	(11) 78.6	(76) 79.2	(4) 80	(83) 79	(21) 84	(66) 77.6
	Single	(2) 14.3	(7) 7.3	(0) 0	(9) 8.6	(3) 12	(6) 7.1
	Divorced	(1) 7.1	(7) 7.3	(1) 20	(7) 6.7	(1) 4	(7) 8.2
	Separated	(0) 0	(1) 1	(0) 0	(1) 1	(0) 0	(1) 1.2
	Cohabiting	(0) 0	(1) 0	(0) 0	(0) 0	(0) 0	(0) 0
	Widow	(0) 0	(5) 5.2	(0) 0	(5) 4.8	(0) 0	(5) 5.9
Education level	No formal education	(4) 28.6	(10) 10.4	(1) 20	(13) 12.4	(2) 8	(12) 14.1
	Primary education	(7) 50	(54) 56.2	(3) 60	(58) 55.2	(15) 60	(46) 54.1
	Secondary education	(2) 14.3	(22) 22.9	(1) 20	(23) 21.9	(5) 20	(19) 22.4
	Post-secondary	(1) 7.1	(10) 10.4	(0)0	(11) 10.5	(3)12	(8) 9.4
Occupation	Employment	(0) 0	(6) 6.2	(0) 0	(6) 5.7	(2) 8	(4) 4.7
	Petty business	(3) 21.4	(18) 18.8	(0) 0	(21) 20	(4) 16	(17) 20
	Business	(4) 28.6	(30) 31.2	(2) 40	(32) 30.5	(5) 20	(29) 34.1
	Crop farming	(5) 35.7	(15) 15.6	(2) 40	(18) 17.1	(5) 20	(15) 17.6
	Livestock farming	(2) 14.3	(5) 5.2	(0) 0	(7) 6.7	(3) 12	(4) 4.7
	Mixed farming	(0) 0	(0) 0	(0) 0	(0) 0	(0) 0	(0) 0

Variables							
	Retired	(0) 0	(6) 6.2	(0) 0	(6) 5.7	(2) 8	(4) 4.7
	Housewife	(0) 0	(4) 4.2	(1) 20	(3) 2.9	(2) 8	(2) 2.4
	None	(0) 0	(12) 12.5	(0) 0	(12) 11.4	(2) 8	(10) 11.8
Income adequate	Enough	(1) 7.1	(23) 24	(1) 20	(23) 21.9	(4) 16	(20) 23.5
	Barely enough	(9) 64.3	(65) 67.7	(3) 60	(71) 67.6	(17) 68	(57) 67.1
	Total inadequate	(4) 28.6	(8) 8.3	(1) 20	(11) 10.5	(4) 16	(8) 9.4
Duration of diabetes	0-5 years	(5) 35.7	(34) 35.4	(2) 40	(37) 35.2	(8) 32	(31) 36.5
	6-10 years	(3) 21.4	(37) 38.5	(2) 40	(38) 36.2	(10) 40	(30) 35.3
	11 and above	(6) 42.9	(2526	(1) 20	(30) 28.6	(7) 28	(24) 28.2
Family History	Yes	(6) 42.9	(50) 52.1	(4) 80	(52) 49.5	(16) 64	(40) 47.1
	No	(8) 57.1	(46) 47.9	(1) 20	(53) 50.5	(9) 36	(45) 52.9

Duration of diabetes was found to be significantly associated with self-care knowledge (P =0.008). Similar findings have been recorded (Adibe et al., 2011; Jackson et al., 2014). This is because with longer duration, there are more exposure to information concerning diabetes and they said to receive more diabetic education or lessons about diabetic self-care, also they tend to experience complication associated with diabetes hence this may lead to increase on diabetes knowledge. Table10 summarizes how overall self-care knowledge is associated with some of socio-demographic information.

Table 6: Overall self-care knowledge and socio-demographic characteristics

Variables		Low self-care knowledge		High self-care knowledge	
		N	%	N	%
Marital status	Married	7	63.60%	80	80.80%
	Single	2	18.20%	7	7.10%
	Divorced	2	18.20%	6	6.10%
	Separated	0	0.00%	1	1.00%
	Cohabiting	0	0.00%	0	0.00%
	Widow	0	0.00%	5	5.10%
Education level	No formal education	3	27.30%	11	11.10%
	Primary education	7	63.60%	54	54.50%
	Secondary education	0	0.00%	24	24.20%
	Post-secondary education	1	9.10%	10	10.10%
Current occupation	Wage employment	1	9.10%	5	5.10%
	Petty business	4	36.40%	17	17.20%
	Business	2	18.20%	32	32.30%
	Crop farming	4	36.40%	16	16.20%
	Livestock farming	0	0.00%	7	7.10%
	Mixed farming	0	0.00%	0	0.00%
	Retiree	0	0.00%	6	6.10%

	Housewife	0	0.00%	4	4.00%
	None	0	0.00%	12	12.10%
Level of income adequacy	Enough	3	27.30%	21	21.20%
	Barely enough	6	54.50%	68	68.70%
	Inadequate	2	18.20%	10	10.10%
Duration of diabetes	0-5 years	4	36.40%	35	35.40%
	6-10 years	4	36.40%	36	36.40%
	11 and above	3	27.30%	28	28.30%
Family History	Yes	5	45.50%	51	51.50%
	No	6	54.50%	48	48.50%

Self-care practices

The diet practices were determined by asking five questions on how the participants in the past seven days had accomplished various diet related practices. The average score for general diet was 5.07± 1.7 days per week while for specific diet was 3.6 ± 1.18 days per week (Table 6). The average score for males in general diet was 4.86± 1.61 days per week while the score for females was 5.26 ± 1.21 days per week. Regarding specific diet, average score for males was 3.83 ± 1.12 days per week while for female it was 3.4 ± 1.21 days per week. Hence concerning the result presented above female participants scored a little higher in almost in general diet compared to their male participants which is against the result obtained by Mosha and Heri (2009) which shows that male scored higher than female.

Table 7: Mean (Standard Deviation) of the days on diet practices related to general and specific diet by sex (n = 110)

	Male (n=52)		Female (n =58)	
Practices during the last 7 days	Mean	SD	mean	SD
No. of days you have followed a healthful eating plan?	4.8	1.8	5.4	1.94
Number of days per week you followed your eating plan	4.83	1.57	5.12	1.71
Number of days you had eat five or more servings of fruits and vegetables?	5.04	1.88	5.64	2.06
Number of days you had high fat foods such as red meat/full-fat dairy products?	1.35	1.67	1.36	1.51
Number of days you spaced carbohydrates evenly through the day?	4.88	2.47	5.07	2.38

Based on the level of self-care practices, the results of general diet practice showed that, 34.50% (n = 110) had high level of diet practice, 36.04% (n = 110) had moderately high level of diet practice, 23.6% (n = 110) had low level of practice while 5.50% (n = 110) had very low level of diet practice (Table 7). Concerning specific diet, only 2.70% (n = 110) of respondents had high level of diet practice, 20.00% (n = 110) had moderately high level of diet practice, 71% (n =110) had low level of diet practice and 5.50% (n =110), had very low level of diet practice.

The majority (85.5%) of the respondents were having very low level of self-care practices related to eating food containing high fat food such as red meat, dairy product and also its was observed that participant have moderate to high self-care practices hence diabetic patients should be advised that, unhealthy fat raises blood cholesterol levels, high blood cholesterol is a risk factor for heart disease. People with diabetes are at high risk for heart disease and limiting your saturated fat can help lower your risk of having a heart attack or stroke (ADA, 2020; Sami *et al.,* 2017). Previous studies (Mosha and Heri 2009; Toobert *et al.,*2000) also indicated similar result.

Table 8: Levels of self-care practice related to diet (n = 110)

Questions related to diet	Level of practice	N	Percent
How many of the last 7 days have you followed a healthful eating plan?	very low level	11	10.00%
	low level	26	23.60%
	moderate high level	34	30.90%
	high level	39	35.50%
On average, over the past month, how many days per week have you followed	very low level	8	7.30%
	low level	29	26.40%
	moderate high level	53	48.20%
	high level	20	18.20%
On how many of the last 7 days did you eat five or more servings of fruits	very low level	12	10.90%
	low level	20	18.20%
	moderate high level	28	25.50%
	high level	50	45.50%
On how many of the last 7 days did you eat high fat foods such as red meat?	very low level	94	85.50%
	low level	12	10.90%
	moderate high level	1	0.90%
	high level	3	2.70%
On how many of the last 7 days did you space carbohydrates evenly through the day?	very low level	22	20.00%
	low level	16	14.50%
	moderate high level	20	18.20%
	high level	52	47.30%

Estimation on amount of vegetable consumption (in cups)
One cup (raw or uncooked vegetable) or half cup (1/2) of chopped or cooked at least five servings in total per day is recommended, higher fresh fruit and vegetable consumption among diabetic individuals, lower risks of death and development of major vascular complications (Huaidong *et al.,* 2017). In this study all diabetic patients were requested to estimate the amount of vegetable they ate per day by using a standard cup. The results were that, only 16.4% (n = 110) ate more than one cup per day, 36.4% (n=110) ate one cup per day, 44.5%, n = 110) ate less than one cup of vegetable per day and 2.7 % (n=110 never ate vegetables) (Figure 1).
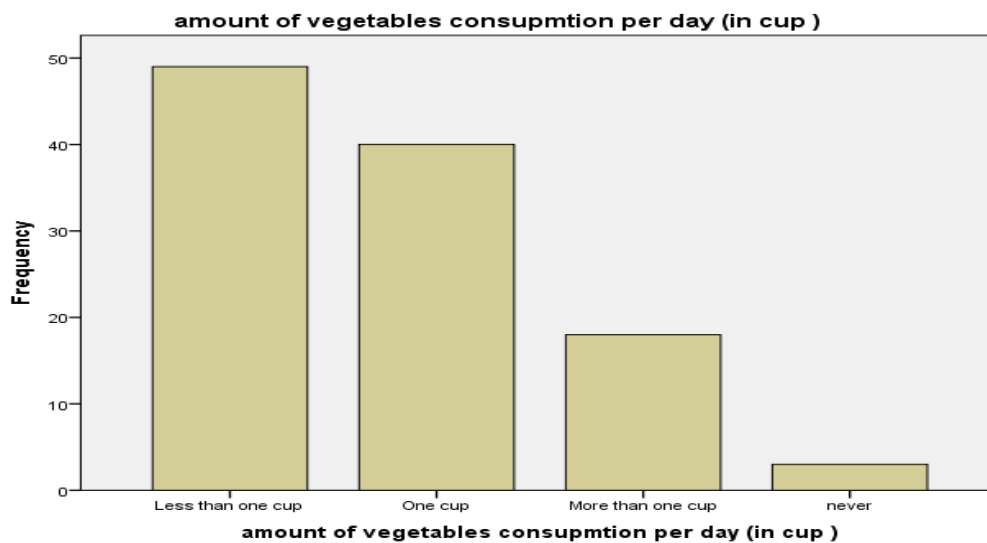
Figure 1: Estimated amount of vegetables (in cups) consumed per day

This study shows that consumption of vegetable was low whereby 83.6% of the population consume less than one cup per day despite of having high self-care knowledge hence this could increase risk of micronutrients deficiency among diabetic peoples (Mosha and Heri 2009), several efforts must be done to overcome barrier that limit people from consume recommended amount of vegetable. Future intervention should be targeted on agriculture sector so as to increase accessibility and availability of affordable vegetable, also people should be educated on how they can plant vegetable around their house so as to increase vegetable consumption.

Physical exercise
In this study two questions were asked to determine the physical exercise practices for the participants. When the respondents were asked about how many of the last seven days they participated in at least 30 minutes of physical activity, i.e. 30 minutes of continuous activity, including walking, the average score was 5.97 ± 1.93 days per week, with females scoring 6.26 ± 1.58 days per week and males scoring 5.65 ± 2.23 days per week. When the respondents were asked about how many of the last seven days they participated in a specific exercise session (such as swimming, walking, biking) other than what they do around the house or as part of their work, the average score was 2.72 ± 2.64 days per week with females scoring 2.41± 2.57 days per week and males 3.06 ± 2.71 days per week. When the two categories of exercises were combined to form a general score for physical exercise, the average score was 4.34 ± 2.29 days per week with females scoring 4.34±2.075 days per week and males 4.35 ± 2.47 days per week. In general, males had higher level of physical exercises than females. The level of physical exercises in the study group was generally low, since only 18.20% (n = 110) had high level of exercises self-care practice, 38.2% (n = 110) had moderately high level of practice, 31.8% (n = 110) had low level of practice 11.8% (n = 110) had very low levels of practice (Table 8).

Table 9: Levels of self-care practice related to physical exercises (n = 110)

Questions related to exercise	Level of practices	Count	Column N %
Participation in at least 30 minutes physical activity durin gthe past 7 days?	very low level	9	8.20%
	low level	7	6.40%
	moderate high level	21	19.10%
	high level	73	66.40%
Participation on specific exercise during the past 7 days?	very low level	59	53.60%
	low level	19	17.30%
	moderate high level	16	14.50%
	high level	16	14.50%

The result obtained from this study was comparable with that of (Mosha and Rashid 2009; Glasgow and Tolbert, 2000), since the scoring of most participants to engage in physical activities was little better compared specific exercise session (such as swimming, walking, biking). This is because most of the participants were of low income bracket who did most of their activities/business manually. also women score higher than men in physical exercise and this could due engage in domestic activities that may increase/offer opportunity to women to participate in physical exercise more compared to men, according to Lidegaard *et al.,* (2016) showed that women were more likely than men to emphasize the pleasure of doing something together for instance participation in physical activity. Participation in physical exercise scored low because of little motivation, busy working schedule (Table 9), hence future interventions targeting people with Type 2 diabetes should consider combining a professionally designed and individually tailored exercise plan with the establishment of customized local exercise communities that offer enjoyment and support (motivation) also Participants should be grouped with geographically to increase relationship and be encouraged to exercise together throughout the week (Lidegaard et al., 2016).

Blood glucose testing
Continuous glucose monitoring (CGM) continuously captures the glucose profile over a number of days and may be the best way to identify an individual's current glycaemic status. Increasing evidence shows that the use of Continuous Glucose Monitoring improves glycaemic control (Lu *et al.,* 2018)**,** (Zhu *et al.,* 2020) compared individuals with well-controlled BG and poor glycaemic control, poor glycaemic control in patients with COVID-19 and pre-existing T2D was associated with worse outcome, involving increased need for medical interventions, multi-organ injuries, and higher mortalities. In contrast to such patients, in those with glycaemic variability between 3.9 and 10.0 mmol/L there was a significant association with reduced medical interventions, major organ injuries, and all-cause mortality.

When the study participants were asked if they have ever tested their blood glucose levels since the last time they visited a diabetic clinic (about three months), 68.2% (n = 110) reported to have tested while 31.8% (n = 110) reported that they have never tested. When analysis was done among those who said they tested, 54.7% tested once, 33.3 tested at least once since last visit to the diabetic clinic, while the rest 12% did not

respond to the question. When participants were asked to give the reasons for testing blood glucose, they gave a diversity of reasons as summarized in Table 10. Four main reasons for testing blood glucose were, being sick (28.18%, n = 75), tiredness, (19.09%, n = 75), check health status (16.36%, n = 75) and frequent urination 15.45%.

Table 10: Reasons for testing blood glucose (n = 75)

Reasons for blood glucose testing	N	Percent
Being sick	31	28.18
Frequent urination	17	15.45
Dizziness	5	4.54
Feeling unwell	13	11.81
Unconsciousness	3	2.72
Extreme fatigue	4	3.63
Tiredness	21	19.09
Get advice from fellow worker	2	1.81
Get advice from healthcare provider after my brother diagnosed with diabetes	8	7.272
Elevated temperature	3	2.72
Headache	5	4.54
Feeling numbness in the extremities	1	0.90
Eye problem	7	6.363
Mass media	5	4.54
Check health status	18	16.36
Extreme thirst	5	4.54
Foot wounds	1	0.90
Dry throat	1	0.909
Fever	1	0.90
Frequent feeling of hunger	2	1.8181
Total	153	139.09

Add to more than 100% due to some answers given more than once

Foot-care practices

Foot-care practices were assessed by five questions, in which the first two questions were core questions. When the two core questions were combined, they gave the general foot care score. The combined score included the questions asking about how many in the last seven days did they check their feet and how many in the last seven days did they inspect the inside of their shoes. The average score from this combination was 5.55± 1.97 days per week, in which the score for female respondents was 5.67 ± 1.64 days per week while the score for the male respondents was 5.42 ± 2.28 days per week (Table 11).

Table 11: Foot-care practices during the previous 7 days (n = 110)

Practice	Male +female	Male	Female
Checked your feet?	6.35±3.26	3.13±1.14	3.22±1.06
Inspected the inside of your shoes?	6.46±3	3.17±1.12	3.29±094
Washed your feet?	7.51±1.94	3.67±0.76	3.84±0.59

	7.24±2.34	3.5±0.96	3.74±0.69
Soaked your feet?			
Dried between your toes after washing?	5.97±3.6	2.81±1.3	3.16±1.15

The level of foot-care in the study sample was moderately high as shown in the combined foot-care category, in which case, 54.1% (n = 110) of the respondents had high level of foot-care practice, 23.9% (n = 110) had moderately high level of foot-care practice, 13.0% (n = 110) had low level of foot-care practice while 8.3% (n = 110) had very low level of foot-care practice. The levels of care practice for individual foot items are shown in (Table 12). The result from this study is against Mosha and Heri (2009) because, of having a very high proportion approximately 87.3% (n=110) of diabetic subjects who practicing feet soaking. Soaking the feet affect the skin and make it susceptible to infections. Thus, it is not advised for diabetic people to soak their feet.

Table 12: Foot-care levels of self-care practices during the previous 7 days (n = 110)

Practices	Level of practice	N	Percent
Checked your feet?	very low level	17	15.50%
	low level	6	5.50%
	moderate high level	27	24.50%
	high level	60	54.50%
Inspected the inside of your shoes?	very low level	13	11.80%
	low level	8	7.30%
	moderate high level	29	26.40%
	high level	60	54.50%
Washed your feet?	very low level	3	2.70%
	low level	6	5.50%
	moderate high level	5	4.50%
	high level	96	87.30%
Soaked your feet?	very low level	6	5.50%
	low level	7	6.40%
	moderate high level	9	8.20%
	high level	88	80.00%
Dried between your toes after washing?	very low level	24	21.80%
	low level	11	10.00%
	moderate high level	17	15.50%
	high level	58	52.70%

It is widely accepted that cigarette smoking substantially increases the risk of micro and macro vascular complications in patients with type 2 DM (Campagna *et al.,* 2019). Cigarette smoking has been reported to be associated with diabetes and its macro vascular complications (Xia *et al.,* 2019). In the study sample, only 0.9% (n = 110) of subjects were active smokers, 78.2% did not smoke at all. Hence this indicated that, prevalence of smoking among the subjects was generally low. This practice helped them to minimize the risk from getting complication associated with smoking habit such as cardiovascular diseases, cancer and other non-communicable diseases, which is a leading cause of death among diabetic patients (Mosha and Heri 2009). Regarding history of smoking, 20.9% (n = 110) of the respondents have smoked in the past and 72.7% of these stopped/never smoking in the

past two years, 18.2% stopped smoking one to two years ago,3.6% stopped smoking one to three months ago, 0.9% stopped smoking four to twelve months ago. For the active smoker subject smoked one to two cigarette per day

Conclusions

Self-care and management practices of diabetic patients was evaluated by use of self-care knowledge, barriers that influence self-care practices, proportion of diabetics who was engage in various self-management practices i.e. dietary related practices, physical activities/exercise, foot-care and smoking practices. Most of the patients in this study had higher self-care knowledge (≥ 70%), overall higher self-care knowledge, modifiable lifestyle, adherence to self-care practices and consequences of uncontrolled blood sugar was 90%, 87.3%, 95.5% and 77.30%) respectively.

Barrier to follow health diet plan, barrier to physical exercise, barrier to foot care practices, and barrier of adherence to clinic was identified i.e. Among this barrier presented by patients most of it was associated with economic and financial constraints and busy working schedule. Barrier to physical exercise i.e. major barrier was lack of time for physical exercise among several participants. Barrier to foot care practices i.e. major barriers reported was lack of knowledge concerning foot care and challenge to wearing closed shoes which was be due to low awareness and education concerning principles of foot care practices. Barrier of attendance to clinic i.e. major problem provided among study sample was the services offered late when they attended earlier at the diabetic clinic centre but the services were not offered at a required time. Patient's socio-demographic characteristics such as marital status, current occupation, income inadequate, duration of diabetes and family history were compared with self-care knowledge.

Educational level, income inadequate, and current occupation of respondents was not associated with knowledge while duration of diabetes was found to be significantly associated with self-care knowledge. The level of self-care practices was determined in the area of diet, physical exercises, medication use, foot care and blood glucose testing. The score for general diet was relatively high (5.07 ± 1.7 days per week) compared to specific diet (3.6 ± 1.21 days per week), physical exercise (4.34±2.29) and foot care was (5.55±1.97). Consumption of vegetable was low because 83.6% of the population consumed less than one cup per day despite of having high self-care knowledge hence this could increase risk of micronutrients deficiency among diabetic peoples.

It is therefore recommended that: (i) Future interventions targeting people with Type 2 diabetes should consider combining a professionally designed and individually tailored exercise plan with the establishment of customized local exercise communities that offer enjoyment and support; (ii) The importance of self-monitoring of blood glucose and physical activity should be emphasized in diabetes mellitus type II patients education; (iii) Future intervention should focus on strengthening health services so as to allow people engage in other activities i.e. increase number of health professional personnel and improve health services; and (iv) The government should develop policies that

encourage health promotion from a public health aspect especially in providing an enabling environment for physical activity within the community.

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Evaluation of therapeutic efficacy of praziquantel against schistosomes in selected areas of North western Tanzania where large deworming programs has been ongoing

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Abstract
Background: The World Health Organization (WHO) recommends periodic assessment of the therapeutic efficacy of praziquantel (PZQ) to detect signs of reduced efficacy that may arise from drug resistance in schistosomes. In this regard continual monitoring of PZQ efficacy using standardized approaches is therefore important for early detection of reduced efficacies. The objective was to assess the therapeutic efficacy of a single oral dose of PZQ (40 mg/kg) against *Schistosoma mansoni* and *Schistosoma haematobium* in Tanzania sites in a multi-country study.
Methods: Tanzania was one of the multinational study partners in multi-centre/country study carried in seven countries to evaluate the efficacy of a single oral dose PZQ against *Schistosoma* species (*S. mansoni & S. haematobium*) in Ukerewe and Bariadi districts, respectively) according to the standardized methodology for evaluating PZQ efficacy as described by the WHO. Enrolled eligible participants after treatment with PZQ standard dosage (40mg/kg) were then followed up after 14 to 21 days for egg reduction rate and cure rate.
Results: Overall, therapeutic efficacy, measured as the reduction in arithmetic mean of schistosome egg counts following drug administration (egg reduction rate; ERR) was quite high for both species; [99.3% (CI 98.0 - 99.7) for *S. mansoni* and 98.9% (CI 98.0 -99.5) for *S. haematobium*)]. High individual egg reduction (iERR) was also observed with more than 95.0% of individuals for both schistosome species having (90%) a satisfactory response to PZQ, with no any non-responsive individuals. Cure rate as our other secondary therapeutic measures, was also found to be high for both species; 94.6% (CI 91.8 - 97.4) for *S. mansoni* and 88.5% (CI 84.6 –92.4) for *S. haematobium.*
Conclusion: Our results do not suggest any reduced efficacy of the standard PZQ treatment to any of the both schistosome species *(S. mansoni & S. haematobium*) in our local setting. Continual regular monitoring of PZQ efficacy against *S. mansoni* and *S. haematobium* is recommended to ensure early detection of reduced efficacies that could occur as drug pressure continues to increase.

Introduction

Schistosomiasis is a parasitic infection caused by *Schistosoma haematobium* (causing urogenital schistosomiasis), *S. mansoni, S. japonicum, S. guineensis, S. intercalatum* and *S. mekongi* (causing intestinal schistosomiasis). A recent systematic review of evidence estimates that 207 million people (97% in sub-Saharan Africa) are affected and 779 million people at great risk (85% in Africa) in 78 countries of which 42 in Africa (Steinmann et al 2006). In 2017, an estimated 1.4 million disability adjusted life years (DALYs) were lost to

schistosomiasis, accounting for 8.3% of the total disease burden attributable to the Neglected Tropical Diseases (NTDs) (collaborators, 2018).

Today, the backbone of schistosomiasis control remains large-scale preventive chemotherapy (PC) using praziquantel (PZQ), where a single oral dose praziquantel (PZQ; 40 mg/kg) is administered to at-risk populations such as school-aged children (SAC). During the last decades considerable progress has been made towards the control of schistosomiasis; the proportion of the at-risk SAC receiving PZQ increasing from 30 million (26%) in 2012 to 76.2 million (61.3%) in 2018 (WHO, 2014; WHO, 2019). With such great progress that has been achieved and taking into account that PZQ has been on use for more than three decades, but all that progress is threatened by the potential emergence of anthelmintic resistance. For example, Crellen et al. (2016) already observed suboptimal PZQ efficacy (reduction in schistosome egg counts following drug administration (ERR) <90%) in Ugandan SAC following multiple rounds of PZQ administration. In this study, ~16% of SAC that had received 8 - 9 rounds of PZQ showed a treatment response below 90%, compared to only ~5% in SAC who had received up to 5 rounds of PZQ, underpinning the need to closely monitor drug efficacy during a control program.

In 2013, the Department of Neglected Tropical Diseases of WHO has published guidelines on how to best monitor drug efficacy against both schistosomiasis and soil-transmitted helminthiasis (WHO, 2013). Over time, it has reached out to its partners to evaluate the efficacy of PZQ against different *Schistosoma* species in countries with ongoing large-scale deworming programs. The ultimate goal was to estimate the baseline efficacy that can be expected following a single PZQ treatment based on the current WHO guidelines, which can then serve as a reference for future efficacy studies in these countries.

In the present study, we report the data of a WHO-supported of Tanzania study site that was carried out in two selected sites in Ukerewe as a solely intestinal schistosomiasis endemic areas and Bariadi districts also as solely endemic areas of urinary schistosomiasis among school children aged between 6 and 18 years old to assess the therapeutic efficacy of a single oral dose of PZQ (40 mg/kg) against *S. mansoni* and *S. haematobium*. In this a multi-centre/country study was carried out in six countries in Asia (1), Latin America (1) and Africa (4) where large deworming program has been ongoing to evaluate the efficacy of a single dose PZQ against *Schistosoma* spp. based on a similar approach as applied for STHs.

Methods

Study site, design and target population
The field work was conducted among school children in Hamuyebe primary school in Ukerewe district and, Ngala and Nyanguge 'A' primary schools in Bariadi district from 13th July to 15th August 2014. In previous study, *S. mansoni* in Hamuyebe P/S was 89.2% in 2006 and *S. haematobium* in Ngala P/S prevalence was 50.0% in 2005. In the Lake zone there has been Intermittent distribution of PZQ since 2005 (i.e. 2005, 2006, 2008, 2009& 2013) in Ukerewe district Islands with a maximum of 5 rounds of PZQ where as in Bariadi

district was in 2005 and 2006 among SAC with a maximum of 2 rounds of PZQ prior to the start of the current trial.

After obtaining informed consent, SAC between the age of 6 and 18 were recruited and asked to provide a recent stool and/or urine sample. The aim was to enrol participants for the study at least 250 infected children (children that were positive at baseline that also provided a follow-up sample)in each study site, as per WHO guidelines(WHO, 2013a). This age group was chosen because it is the school age that children get heavily infected by schistosomes. It is also the age-group in which control of schistosomiasis is normally applied.

Outcome classification
The following are the study endpoints. Our main primary end point was (individual & group) egg reduction rate (ERR) at 14 - 21 days after treatment with a standard dosage of PZQ (40 mg/kg) and secondary endpoint was cure rate (CR) at 14 - 21 days after treatment with a standard dosage of PZQ (40 mg/kg).

Screening and recruitment
Children aged 6 to 18 years attending primary school in both study sites, were screened by history taking and laboratory procedure. Patients who met the eligibility criteria were enrolled into the study.

PZQ drug administration and follow up
Praziquantel [Cesol bottle W/100 tab (600mg), by Merck SA, de CV] used in the study was procured by WHO from the same bunch. All children providing stool or urine samples were treated with PZQ (40 mg/kg) under direct observation with number of tablets administered to each child depended on their respective weight using weighing scale to ensure a minimum treatment dose of 40mg/kg body weight (15-22.4kg: 1.5 tablets; 22.5-29.9kg: 2 tablets; 30-37.4kg: 2.5 tablets; 37.5-44.9kg: 3 tablets and 45-59.9kg: 4 tablets). Each child was given adequate snack/meal intake (e.g. several slices of bread and porridge) before PZQ was administered. Children were observed for approximately four hours following drug administration while they remained at school and continued with their usual activities. They were asked to report any side effect as soon as they occurred. Study participants who reported to have vomited following drug administration were excluded from the analysis.

Fourteen to 21 days after PZQ administration, a second stool and/or a urine sample was collected from those SAC who had tested positive for *Schistosoma* infections at baseline. During follow-up examination, egg counts were determined in the same way as during baseline.

Sample collection and laboratory processing
Both sample collection of single stool or urine samples taken on only day one at baseline and at follow-up. Single stool sample were collected in the stool container and prepared in the field (using the 41.7mg faecal template) by the Kato-Katz technique as was described previously (WHO, 1991).The prepared Kato slides in the field underwent quantitative microscopic examination for *S. mansoni* ova and were expressed as eggs

per gram of stool (EPG) by multiplying the faecal egg count (FEC) with a factor 24. One urine sample was collected between 10 am and 2 pm in the urine container. The presence of *S. haematobium* eggs in urine samples was determined by urine syringe filtration method(WHO, 1991), and results were expressed as the number of eggs per 10 ml of urine (eggs/10 ml).

Subjects who were: (i) unable to provide a sample at follow-up; (ii) experienced a severe concurrent medical condition; (iii) had diarrhoea at time of the first sampling; (iv) were potentially pregnant; and (v)had shown adverse reactions to PZQ in the past were excluded from the study. After follow-up, subjects that were infected with soil-transmitted helminths (*Ascaris lumbricoides*, *Trichuris trichiura* and hookworm) at baseline were also treated with a single-oral dose of 400 mg albendazole or 500 mg of mebendazole.

Data analysis
Treatment efficacy was calculated on the data obtained from complete cases only (i.e., individuals who were positive at baseline and did also provide a follow-up sample), and was reported separately for each of the *Schistosoma* species (*S. mansoni, S. haematobium*). At baseline, the intensity of schistosome infection in the complete cases was classified into low or moderate-to-heavy based on the thresholds proposed by WHO (WHO, 2013b). For *S. mansoni* infections this threshold was 100 EPG, while for *S. haematobium*, ≥50 eggs per 10 ml urine represent a moderate-to-heavy intensity infection (WHO, 2013b).

Efficacy was expressed as ERR, applying the formula: ERR = 100% x (1 – arithmetic mean (egg count at follow-up)/ arithmetic mean (egg count at baseline))(WHO, 2013a). The corresponding 95% confidence intervals (95% CI) were calculated as described by Levecke (Levecke et al., 2018). Efficacy classification was based on the WHO thresholds (WHO, 2013a), whereby a point estimate of ERR of ≥90% is considered satisfactory, between 80% and 90% as doubtful, <80% as reduced, and ERR<0 % is considered non-response. Individual egg reduction rates (iERRs) were also calculated as follows: iERR = 100% x (1- egg count at follow-up/egg count at baseline) to determine proportion of individuals falling in four categories of PZQ efficacy also similarly as described above.

Ethical considerations
The overall protocol was reviewed by the Ethics committee of the Faculty of Medicine, Ghent University, Belgium. For each proposed study, a separate ethical clearance was obtained. In Tanzania, this study protocol was granted by Lake Zone Ethical Review Board (LZERB), which acts as the National Ethics Committee in Tanzania for the Lake Zone.

Results

Baseline characteristics of study participants, enrolment & coverage
The age of recruited study participants in Hamuyebe P/S (Ukerewe district) in *S. mansoni* site ranged from 7 to 18 years, with a mean age (mean +2SD) of 10.6 ± 2.4. For PZQ efficacy study, 255/331(77.0%) of the infected, were enrolled, of whom 105 (41.2%) were

male. After 2-3 weeks during the follow up survey, 234 (91.8%) out of 255 enrolled eligible individuals recruited during baseline survey were successfully followed up. The age of recruited study participants in Ngala & Nyanguge primary schools (Simiyu district) in *S. haematobium* site ranged from 6 to 18 years, with a mean age (mean +2SD) of 11.2 ± 2.6. For PZQ efficacy study, 252/255(98.8%) were enrolled, 158 (58.7%) were male. Of those enrolled eligible during the baseline, 224 (88.9%) of 255 individuals were successfully followed up after 2-3 weeks later (Table 1).

Table 1: Baseline characteristics of recruited participant in the trial

Variable	Category	Study site	
		S. mansoni	*S. haematobium*
Age (mean ± SD)		10.6 ± 2.4	11.2 ± 2.6
Sex (% male)		40.6%	58.5%
Weight (mean ± SD)		27.9 ± 7.5	32.8 ± 7.8
Epg (mean ± SD)		470.4 ± 547.7	32.1 ± 63.3
Compliance/coverage			
Intensity	Light		
	Heavy		

S. mansoni and S. haematobium infections before and after 2-3 weeks of treatment

Overall, complete data were available for 458 individuals in Tanzania study site, with 234 for *S. mansoni* in Ukerewe district and 224 for *S. haematobium* in Bariadi district; whom then were followed up on 14 to 21 days after PZQ administration. For *S. mansoni* the number of eggs per gm of faeces (epg) from 24 to 3,432 with overall arithmetic mean (mean ± SD) of 494.8±611.5 epg before treatment and was remarkably reduced to range of 0 to 144 with overall arithmetic mean of (3.5±26.7) equivalent to 99.3%(CI 98.0 – 99.7) eggs reduction rate (EsRR) as shown in table 2 &3. For individual egg reduction rate (iERR), about 96.6% had egg reduction greater than (>) 90% considered as satisfactory, 2.1% had egg reduction of between 80 – 90% categorized as doubtful where as 1.3% had egg reduction less than 80%, categorised as reduced. However, none of those less 80%, were equal to 0% or less than 0 considered as non-response or negative response individual as shown in Figure 1. Three individual who were less than 80% categorized as reduced, had egg reduction rate (iERR) of 50%, 69.2% & 75%.

Table 2: Infection intensity (mean and grading) during the baseline and follow up after treatment

Variable	*S. mansoni*		*S. haematobium*	
	Baseline	Follow up	Baseline	Follow up
Epg / (Ep 10mls) (mean±SD)	(494.8±611.5)	3.5±26.7	32.1±63.3	0.4±1.3
Intensity(light)	26.9%	99.6%	83.0%	100%
Intensity(mod-heavy)	73.1%	0.4%	17.0%	0%

For *S. haematobium* number of eggs for every10 ml urine ranged from 1 to 556 with overall arithmetic mean of (32.5±61.4) eggs per 10 ml before treatment was also markedly reduced to range of 0 to 6, with a geometric mean of (0.4±1.3) eggs per 10 ml after treatment equivalent to 98.8% reduction rate as shown in Tables 2 and 3. For individual egg reduction rate(iERR), about 95.5% had egg reduction greater than (>) 90% considered as satisfactory, 1.8% had egg reduction of between 80 – 90% categorized as doubtful where as 2.7% had egg reduction less than 80%, categorised as reduced.

Similarly, as well none of those less 80%, were equal to 0% or less than 0 considered as non-response individual as indicated in Figure 1. Six individuals who were less than 80% categorized as reduced, had egg reduction rate(iERR) of 33.3%, 50%, 50%, 63.6%, 63.6% & 66.7%.

Table 3: Egg reduction and crude cure rate on day 14 and 21 follow up

Variable	S. mansoni	S. haematobium
	% (CI)	N % (CI)
Egg reduction(Am)	99.3%(98.0 - 99.7))	125 (98.8%)
Crude cure rate	94.4% (92.8 - 95.7)	86.6% (84.3 - 88.6)
Reduction of proportion of heavy infection	99.4% (98.7 – 99.4)	100%

In regarding with cure rate as secondary outcome measure, 221 had no *S. mansoni* ova in their stool sample out of 234 giving an overall cure rate of 94.4% (CI 92.8 – 95.7) whereas for *S. haematobium,* 194 had no ova *S. haematobium* in their urine samples out of 224, equivalent to the cure rate of 86.6% CI 84.3 – 88.6) on 14 to 21 days follow up. Proportion for *S. mansoni* with heavy infection was 73.1% before treatment and remarkable reduced to 0.4% equivalent to 99.4% reduction rate, whereas the corresponding remarkable reduction for *S. haematobium,* was also from 17.0% before treatment to 0.0% during 2 - 3 weeks follow up after treatment, equivalent to about 100% (Table 3).
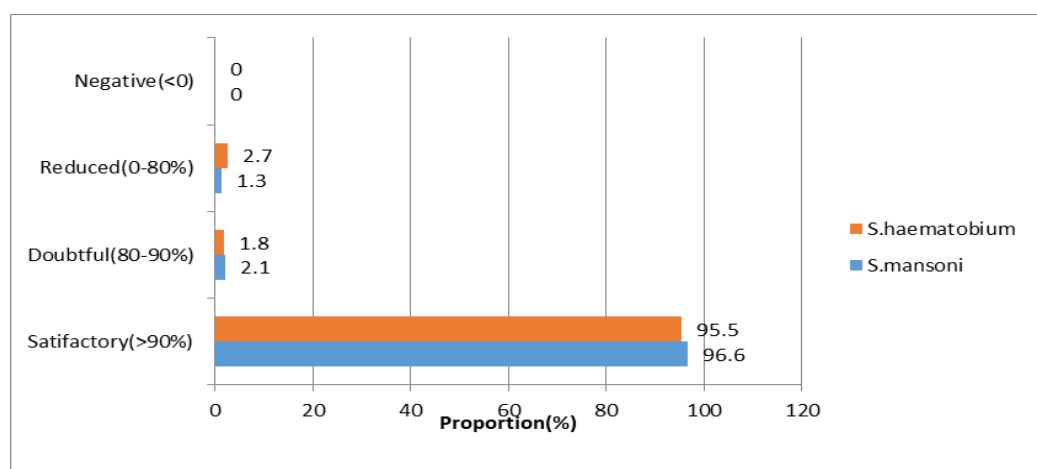
Figure1: Individual egg reduction rates following a single treatment with 40mg/kg of praziquantel against both *Schistosoma haematobium* and *S. mansoni*

Discussion

The study showed that PZQ efficacy against both schistosome species (*S. mansoni* and *S. haematobium*) endemic in our area, was satisfactory (i.e. >90%) based on ERR calculated by arithmetic means. The finding of remarkably percentage egg reduction as determined by arithmetic mean above 98% against both species in our study site (with also lower range of CI above 98.0) is quite high and in agreement with satisfactory level according WHO recommendation (Montresor et al., 2013). WHO recommend the percentage egg

reduction to be at least above 90% to be considered as satisfactory and 80-90% as doubtful; our level is quite higher in line with satisfactory cut off level. Overall, these results appear to be consistent with the findings of previous meta-analyses that found that a single oral dose of PZQ (40 mg/kg) was highly effective against *Schistosoma* spp. infections without any reports of severe adverse events (Zwang & Olliaro, 2014; 2017).This study was carried out in the area of Lake zone in school children using standardized protocol taking into consideration the detection technique (Kato-Katz) using a single stool with single slide based on collected well-formed stool samples. It is well recognized that well-formed stools can concentrate helminth eggs, compared to looser or diarrheic faeces where they are diluted (WHO, 1961), thus confounding assessment of drug efficacy. Moreover, efficacy was evaluated by both the CR and the ERR (*S. mansoni* & *S. haematobium*), but in this current study, ERR was the main primary outcome while CR was just taken as secondary outcome measure of efficacy.

However, when we classify the individual responses (iERRs) to the treatment (Figure 1), we notice that for *S. mansoni* there were 8 (3.4%) out of 234 of individuals in Ukerewe Islands district and 10 (4.5%) for *S. haematobium* in Bariadi district out of 224 whom there was no satisfactory response (iERR<90%). Fortunately, in Tanzania, those few individuals with no satisfactory response had no much impact on overall efficacy rate as 95% CI was still stretching within and much higher (>98.0) of satisfactory level when compared to what has been observed elsewhere (Crellen et al., 2016), where 95%CI stretched within doubtful or even reduced ERR level. In the current WHO guidelines (WHO, 2013a), a measure of uncertainty around the calculated ERR is not considered in the interpretation of the results. Yet, such an indicator of uncertainty does carry important additional information on the possible variation in drug efficacy that can be expected. A large measure of uncertainty indicates that the measured efficacy is highly variable and integrating this variation in the interpretation of trial data is important to reach the appropriate conclusions with regards to true drug efficacy.

The reasons for the lack of observed drug efficacy in certain individuals as has been observed elsewhere (Crellen et al., 2016) are unclear. Although this might be explained by potential emergence of anthelmintic resistance, multiple other factors can affect the observed drug efficacy(WHO, 2013a). It is for example possible that participants do not report having vomited following treatment, leading to the inclusion of individuals that actually did not receive the optimal dose. The occurrence of non-compliers and their impact on reported drug efficacy estimates is a well-established in the field of schistosomiasis and soil-transmitted helminthiasis (Montresor, 2007; Moser et al., 2020; Olliaro et al., 2015). However, the important debate on how to address these outliers or non-responders in the context of drug efficacy studies is still ongoing (Moser et al., 2020).

In this study, a cure rate of 88.5% and egg count reduction of 98.8% for *S. haematobium* found 2-3 weeks' post-treatment, is also almost comparable to the findings of similar studies conducted in Cameroon (Coulibaly et al, 2012) and Zimbabwe (Midzi et al, 2008) but higher than those observed north-western Ethiopia (Mekonnen et al, 2014). Similarly, a cure rate of 94.6% for *S. mansoni* as observed in our study is also comparable to 92% of the previous study done in the same Lake zone carried in Magu, north-western Tanzania

(Olliaro et al, 2010) and 96.7% in Cameroon (Coulibaly et al, 2012); almost with same post-treatment duration of 3 weeks. The egg count reduction for *S. mansoni* observed 2-3 weeks after treatment was 99.3%. This is higher than 92 % as was observed in previous study in the Lake zone (Olliaro et al, 2010) and 88.6% in Lake Albert, Uganda (Kabatereine, 2003).

Overall, our results confirm that, at the time of performing these efficacy trials (2014), there was little reason to doubt the high efficacy of a single oral dose PZQ against schistosome infections in SAC, that an ERR point estimate exceeding 90% should be expected for all schistosome species in future surveys and that any deviation from this expected therapeutic efficacy should be viewed with concern in light of potential development of drug resistance. In 2016, Crellen and colleagues (Crellen et al., 2016) reported the first indications of reduced PZQ efficacy to *S. mansoni* in Uganda more than 10 years into the control program (program started in 2003, the efficacy trial was performed in 2014). In contrast, none of the sites in Tanzania evaluated in the current study had been exposed to as many treatment rounds with longest maximum exposure being 5 rounds of annual MDA in Ukerewe district for *S. mansoni* site. Nevertheless, the need for continued vigilance of PZQ efficacy in the large-scale deworming programs era remains, especially while alternative therapies remain absent and studies indicate the possible existence of a negative effect of multiple rounds on PZQ efficacy.

The relatively higher cure & egg reduction rate and lower rate of no satisfactory response (iERR<90%) observed for *S. mansoni* than *S. haematobium* and as well as has been observed elsewhere (Coulibaly et al, 2012, Mekonnen et al, 2014 and, Midzi et al, 2008) might have been due to dead eggs. Unfortunately, as one limitation of our study we didn't determine the viability of excreted eggs. However, few about 11 positive cases for egg excretion that we attempted to collect miracidia for molecular analysis was futile, that probably suggest were dead egg. Dead eggs that may be present for months in the urine of treated patients infected with *S. haematobium* (McMahon and Kolstrup, 1979) will falsely decrease the egg reduction and cure rate results as has been observed in our cases.

In conclusion, our results do not suggest any reduced efficacy of the standard PZQ treatment to any of the both schistosome species *(S. mansoni & S. haematobium)* in our local setting. Continual regular monitoring of PZQ efficacy against *S. mansoni & S. haematobium* is recommended to ensure early detection of reduced efficacies that could occur as drug pressure continues to increase.

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The potential of family health practice in achieving universal health coverage in Tanzania and Africa Region

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Abstract
Background: Universal Health Coverage (UHC) is the ultimate Sustainable Development Goal (SDG) for guaranteed access to quality and affordable essential healthcare services for all in Tanzania health system. However, there is no evidence based data to substitute its implementation in Tanzania to date. The worldwide concepts and practice of family oriented and centred comprehensive primary Health care (cPHC0 offers unique opportunity for health system transformation and achieving UHC in Tanzania.
Methods: We conducted review of documents and data on Tanzania UHC-Services Coverage Index (SCI) status; illnesses and injury, healthcare system and performance; and family health practices (FHP).
Results: Tanzania has a UHC-SCI of 44 and 22nd position (in 2017) among countries in the least performing WHO-AFRO region in the World. Fevers and malaria accounted for 62 % of all illness and injuries at household individuals and are among top 10 diagnosis at all healthcare delivery levels and cause of deaths in Tanzania. Health expenditure per capita is highest at Ministry health level (55%) and District Councils health facilities (99.99) leaving a trivial (0.01%) for community health. The standing of FHP model in fast-tracking UHC scored higher for each health system component.
COnclusion: There is quantum potential of FHP model in transforming Tanzania health system towards UHC by 2030, even before. It is recommended to initiate FHP models in selected districts and regions with least UHC-SCI in the country or WHO-AFRO region.

Background

Family is defined as a natural society; the practice of individual and family healthcare can be traced back to origin of first man on earth in Olduvai, Ngorongoro Crater, about 3.7 million years ago (https://www.britannica.com/place/Olduvai-Gorge). Western Medicinal Practice (WMP) is relatively a recent event having evolved from the days of Hippocrates (460 BC); the father of WMP (Kleisiaris et al., 2014). Family Health Practice (FHP) is the brain child of WMP; the Hippocratic practice of individual patient seeking treatment gradually transformed to home visit of the sick by Doctor or General Practitioner (GP) and currently to a specialty dedicated to providing family-oriented and cantered healthcare for all members of all ages over their entire lifespan (Zosia, 2006; Haq et al., 1996). FHP has worldwide recognition as a specialty (Family Doctor/Physical) with the additional advantage of accommodating the complex genetics, biological, social, cultural and economic relationships and concerns of the individual, family, community, subnational and national healthcare systems, comprehensive Primary Health Care (PHC) and to guarantee the goal of Universal Healthcare Coverage (United Nations, 2015; WHO, 2014; WONCA, 2013).

The first ever WMP -treatment post in Tanzania was establishment (1789) in Mingoyo, Mpwapwa, Dodoma by British Church Missionary Society (CMS); that is 2.500 years after Hippocrates (http://www.ampltd.co.uk/digital_guide/church_missionary_society/). The German Colonial rule (1886-1919) established medical services in the country (1905) comprising of curative facilities; endemic and epidemic disease control. The British Rule (1919-1961) and Post-independence state scaling up the two practices in keeping with health needs and demands of growing population and advances in science, medicine and technology (Bruchhausen, 2003; Clyde, 1962).

Tanzania has continued to be part and parcel of global health initiatives and commitments. These include the Ata Declaration (1978) on primary health care (PHC) and health for ALL by year 2000; the Millenniums Development Goals (MDGs) by 2015 and currently the Global Sustainable Development Goals (SDGs) for ALL by 2030 (UN, 1978; UN, 2000), SDG has a set of 17 Goals; Goal No. 3 is Good Health and Well-being for ALL; which aims to realize Universal Health Coverage (UHC) by 2030. UHC is to guarantee all individuals, families and communities receive the full spectrum of essential, quality and comprehensive Primary Health Care-PHC (cPHC) services: - health promotion, prevention, treatment, rehabilitation and palliative care; without suffering financial hardship (WHO, 2020).

It's is well acknowledged that 80–90% of people's health needs across their lifetime can be provided within PHC framework (Annonym, 2018 (Astana). National Household Budgetary Surveys has provided us with reliable information of illnesses and injuries at households (NBS, 2014). Tanzania Health Sector Strategic Plan, July 2015 – June 2020 (HSSP IV) envision to reach ALL households with quality health care; and ultimately achieve UHC by 2030 (MoSWH, 2015), Tanzania has yet to introduce the FHP models in the national health system (NHS) notwithstanding the household reach initiative and anticipation of UHC (Ratanzi & Gaede, 2020). This paper underscore the urgency of exploiting the potentiality of FHP for the achievement of UHC by 2030 in Tanzania.

Methods

The methodology included review of relevant documents and data on Tanzania health conditions, healthcare system and performance; Services Coverage Index (SCI) of Universal Health Coverage (UHC) and Family Health Practice among others. The main documents included National Household Budgetary Survey, Tanzania Health Sector Strategic Plan (HSSP IV) 2015-2020 and Family Health Practices. The main sources of secondary data were the World Bank Report WHO, Global Health Observatory and Tanzania Health Sector Performance Reports (Piatti-Funfkirchen & Alli, 2020; WHO-GHO, MoHCDGEC, 2016; MoHCDGEC, 2019; WHO-2017; TDCCCS, 2017; NBS, 2016, 2017; Boex et al., 2015). The key component of health systems under Tanzania HSSP IV were compared to Family Health Practice (FHP) model for qualified Universal Health Coverage (UHC) by 2030, (table-1) (WHO, 2010). The nominal score for each component was rated as minimum (+) or maximum (++)'.

Results

Governance and leadership

The Global and World Health Organization (WHO) Regions (Africa, Americas, South-East Asia (S.E. Asia), Europe, Eastern Mediterranean (E. Medit.) and Western Pacific (W. Pacific)) Universal Health Coverage (UHC) - Services Coverage Index (SCI and Current Health Expenditure (CHE) per capita in US$ in 2015 and 2017 (Figure 1).
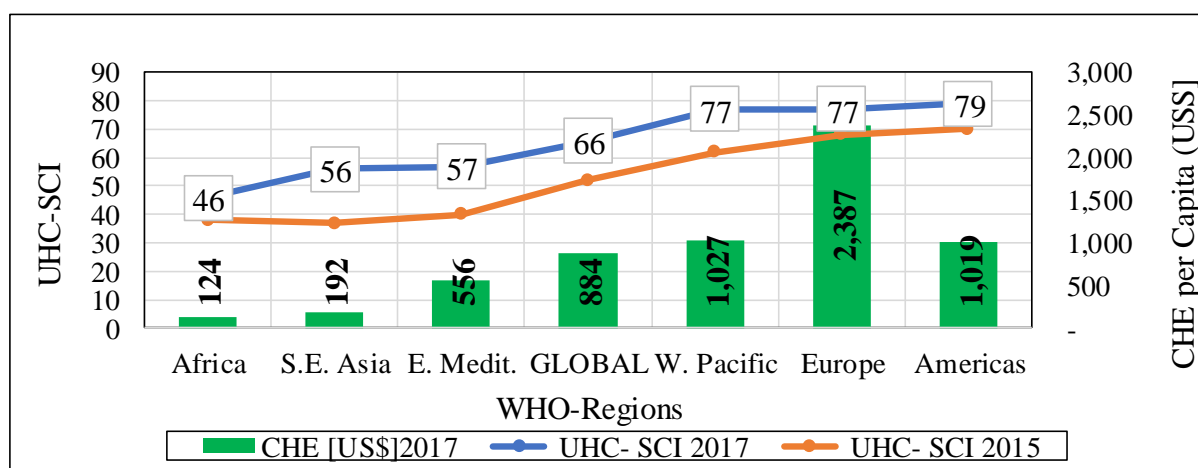

Figure 1: Global and WHO Region's Universal health coverage services and coverage
Source: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/uhc-index-of-service-coverage. https://apps.who.int/nha/database/Select/Indicators/en

The UHC-SCI in WHO regions during 2015 and 2017 was lowest for Africa region and highest in the Americas (70-79) with a Global average of (52-66). Africa region had the least increase of the index (8) and compared to highest figure of (17) in Eastern Mediterranean region and global figure of (14). Africa has the current health expenditure per capita (US$ 124) and the highest was for Europe (US$ 2,387). The CSI appear to grow with higher CHE per capita, however, the Americans region had higher indices than Europe for less than half of CHE per capita; although they both a similar increase of the index by nine units,

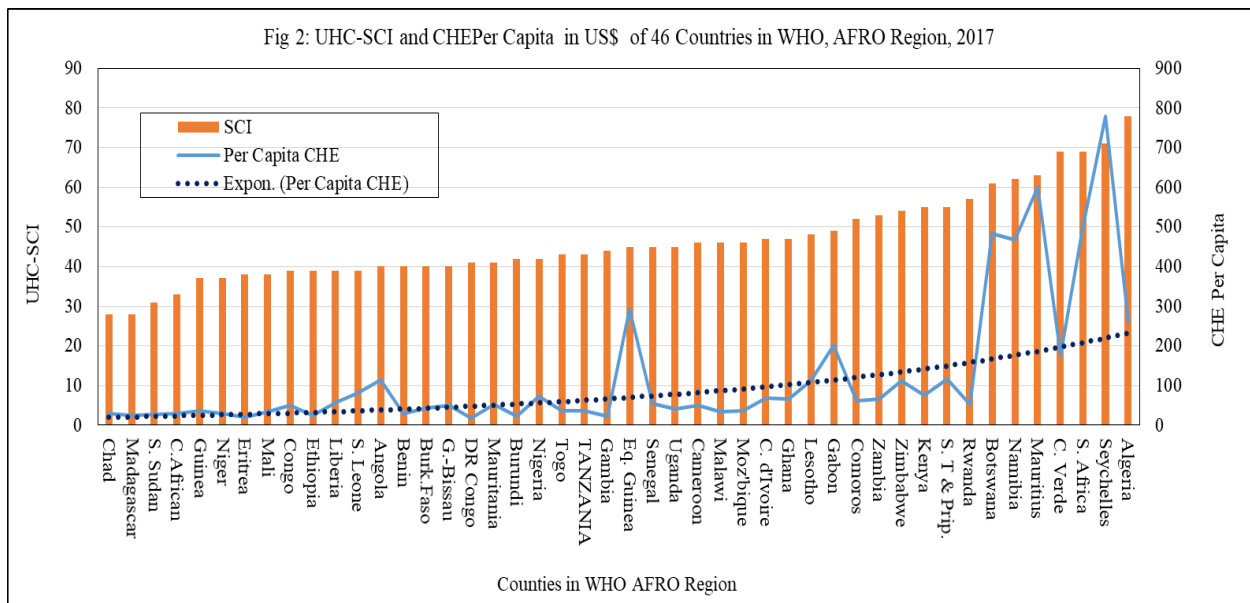UHC - SCI and CHE Per Capita in US$ of 47 Countries in WHO AFRO Region in 2017 is as shown in figure 2.

Figure 2: UHC-SCI and CHEP per capita in US$ of 46 countries in the WHO Africa Region, 2017 (Source: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/uhc-index-of-service coverage and https://apps.who.int/nha/database/Select/Indicators/en)

The UHC-SCI in the 46 countries of WHO-AFRO region in 2017 range from (28 -79), Tanzania has a SCI of 44, the 22nd highest position in the region. There are 33 (72%) countries in the region with SCI below 50 including Tanzania with a figure of 43; the remaining 13 (28%) are above 50 and none is above 80. The CHE per capita range is US$ (19-599), raising slightly for indices below 50 and thereafter noticeably to the peak; with several spikes. The exponential trend indicates the optimum path of increasing CHE per capita for much higher SCI.

Within WHO Afro region there is considerable variation in the CHE per capita for SCI of each country. Interestingly Algeria can obtain a much higher SCI with less CHE per capita compared to Equatorial Guinea. The percentage of household's members reporting illness and injury in the past four week preceding the 2000, 2007 and 2011 national surveys for Tanzania mainland (Figure 3). The level of illness and injury in 2011 was higher in rural (22%) than urban areas (20%) with a national figure of (20%). There was an overall decline of 7% of illness and injury in the county during the 10-year period with a higher figure in rural (6%) than in urban (2%) areas.
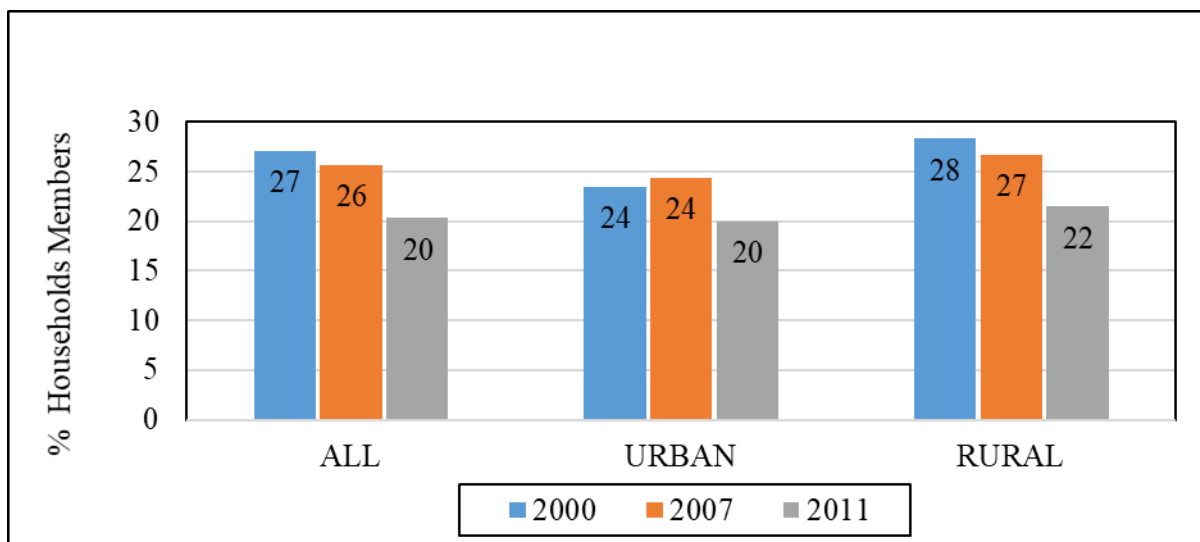
Figure 3: Percentage of household members responding illness and injury in Tanzania Mainland, 2007, 2011 (Source: Household Budget Survey, 2011/12, National Bureau of Statistics)

The cumulative percentage of Household Members Reporting Illness or Injury by Type of Illness or Injury, Age Group, (2011/12) are summarised in Figure 4.
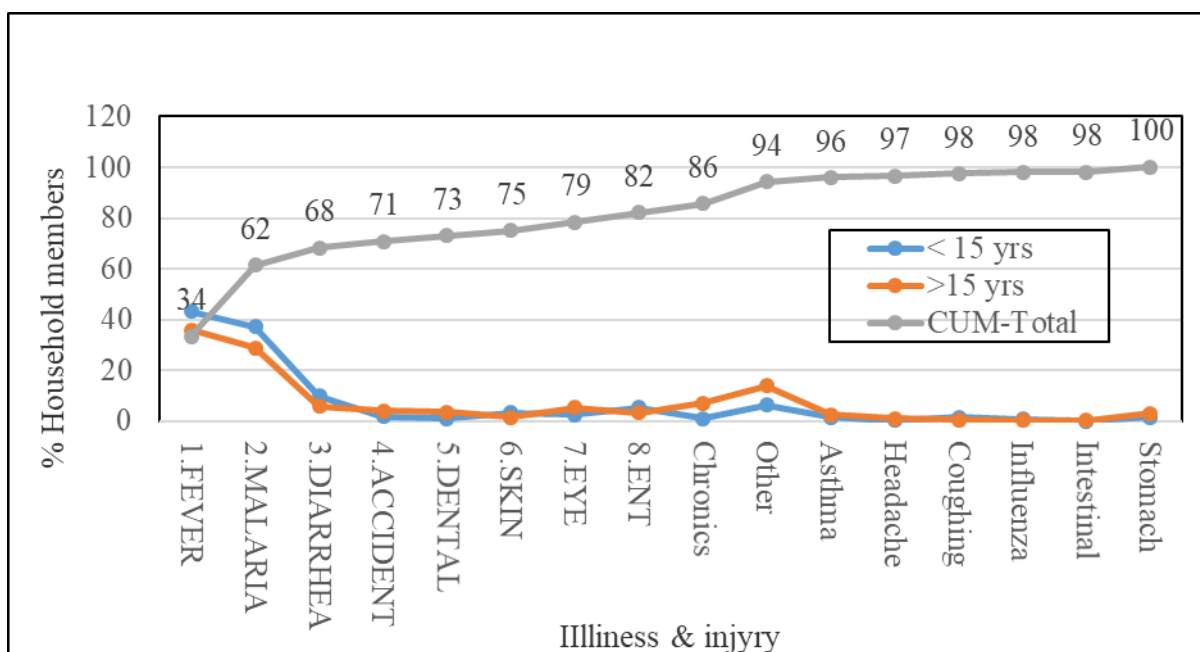

 Figure 4: Cumulative and percentage of household members by type of illness or injury by age group in Tanzania Mainland (Source: Household Budget Survey, 2011/12, National Bureau of Statistics)

About 80% of Household Members Reporting on Illness or Injury are due to only eight (1-8), conditions namely fever, malaria, diarrhoea, accidents, skin, eye and ENT conditions; the remaining 20% are to the rest of illnesses. Fevers and malaria accounted for 62 percent of all conditions. The percent distribution of Disease Diagnoses at Out Patient Departments (OPD) and In-patient (IP) of all health facilities and causes of deaths in Tanzania during 2014 (Figure 5).
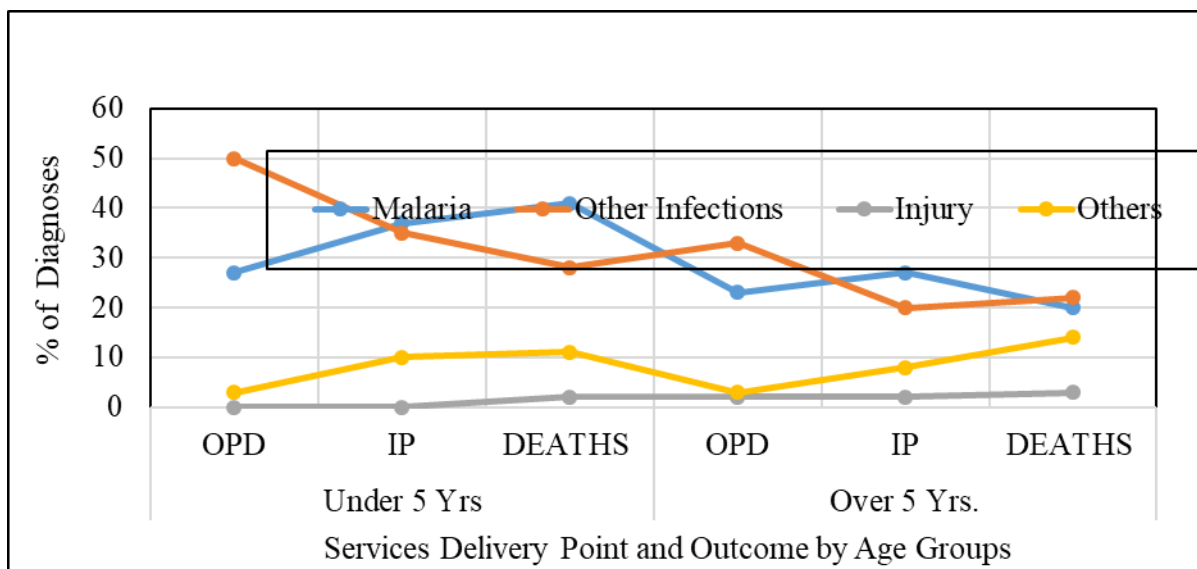
Figure 5: Percent of OPD and IPD diagnoses and deaths at health facilities in Tanzania, 2014 (Source: Tanzania Annual Health Sector Performance Profile 2014/15)

Malaria was leading diagnosis accounting for (20%-41%) of all OPD outpatient departments, In-patient admission conditions and the cause of deaths for all age groups. Other infection accounted for (20%-50%) of all diagnoses or all service delivery departments and cause of deaths for all age groups; with injury taking less than 3% and all other conditions 3% -14%). The range of malaria and other infections diagnoses for under and above five years at OPD, IP and cause of deaths is (77%-56%), (72%-47%) and (69% -42%) respectively. Malaria was the leading condition for IP diagnoses and deaths at health facilities for all age groups and other infection are top illnesses at OPD. Malaria and other infection constitute neatly 90% of OPD and IP diagnoses and Death for all age groups at health facilities and renaming 10 percent is accounted for by injure and other diseases conditions. The percentage of population expressing dissatisfaction with health services and their reasons during (2010-2015) in Tanzania (Figure 6).
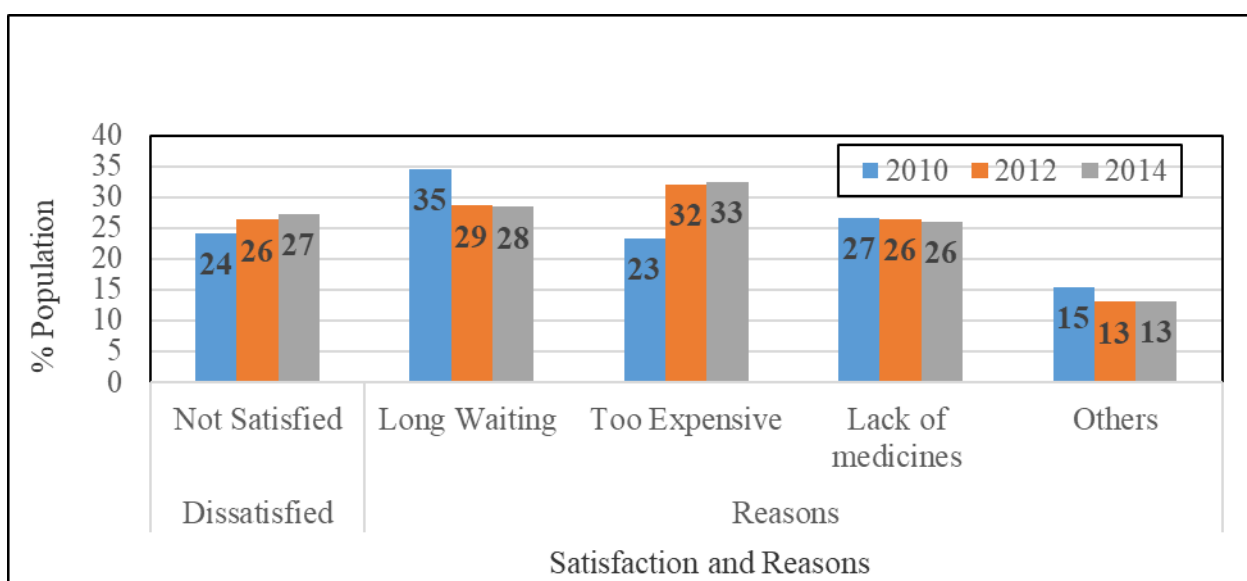

Figure 6: Percentage of population expressing dissatisfaction with health services (Source: National Bureau of Standards, 2016)

The level of population dissatisfaction with health services increased from (24-27%) over the three-year period. The main reasons for dissatisfaction were long waiting time (28-33%) followed by too expensive (23-33%), lack of medicines (26-27%) and other (13-15%). The reason of too expensive has been on the increasing during the survey period. The Primary Health Care (PHC) Organizational Structures and decision-making bodies of Tanzania (Figure 6).
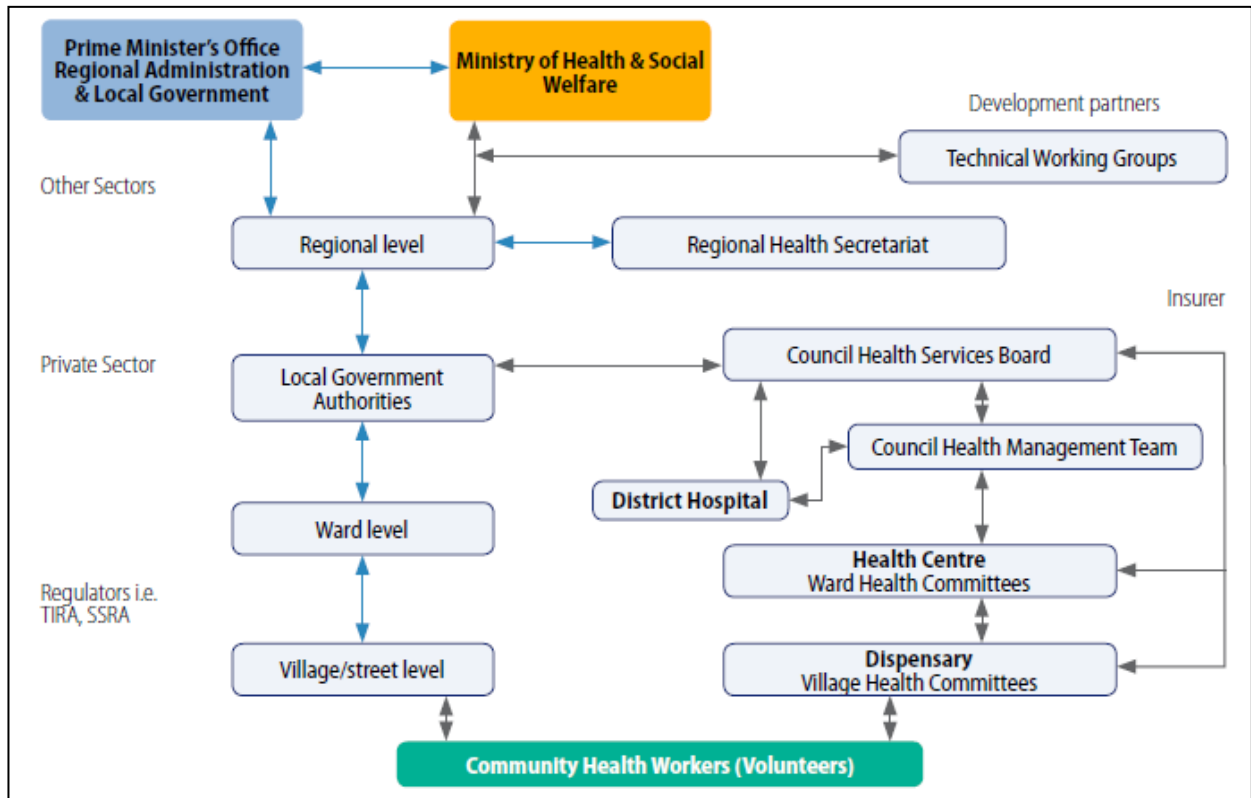

Figure 7: Primary Health Care (PHC} Organizational Structures, United Republic of Tanzania (Source: World Health Organization)

Service Delivery
The Universal Health Coverage (UHC) - Services Coverage Index (SCI) for Access and Capacity of 47 Counties in WHO AFRO Region during 2015 and 2017 (Figure 8).
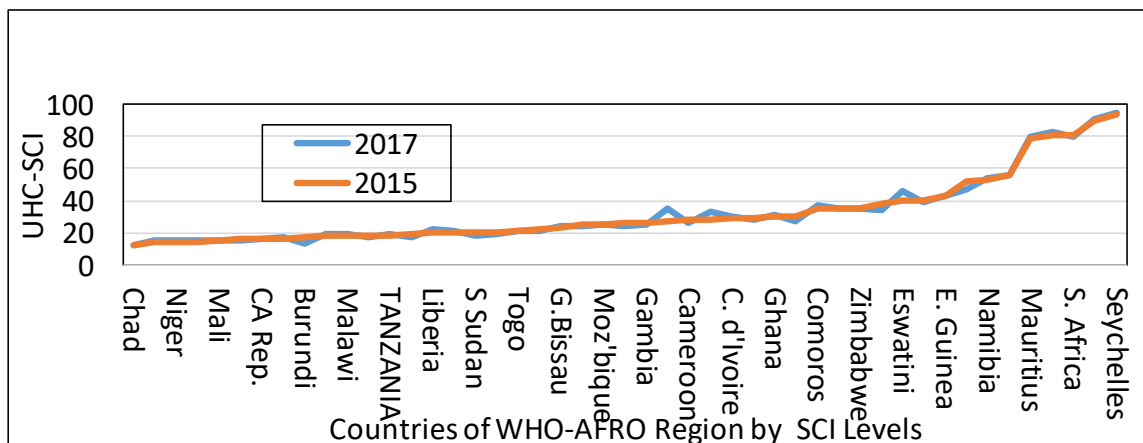
Figure 8: UHC-SCI for access and capacity of countries in the WHO Africa Region, 2015-2017 (Source: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/uhc-index-of-service coverage)

UHC-SCI of access and capacity in the WHO AFRO Region in 2017 range from (12 -95) with about more than three quarters of the countries being below 50; Tanzania had a figure of 19. There was overall a very slight change (-4 to +5) of SCI access and capacity from 2015 to 2017 among the countries; the change for Tanzania was (+1). The Universal Health Coverage (UHC)-Services Coverage Index (SCI) for Reproductive, Maternal, New-born and Child Health (RMNCH), Infectious diseases and Non-communicable diseases (NCD) of 47 Counties in WHO AFRO Region in 2017 (Figure 9).
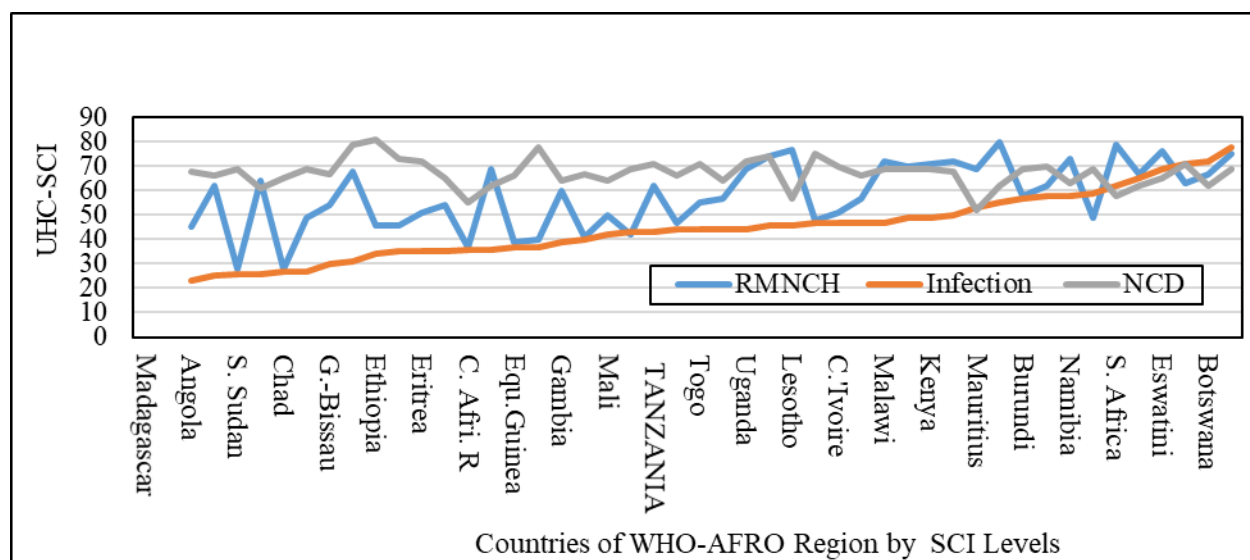

Figure 9: UHC-SCI of RMNCH, infection and non-communicable diseases in the WHO Africa Region (Source: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/uhc-index-of-service coverage)

UHC-SCI of RMNCH, Infection and NCD ranged from (10-80). SCI profile among countries in the WHO AFRO Region shows a parallel trend with Infection being at the bottom; RMNCH more less the middle and NCD on the top especially for countries below SCI level of 50. Tanzania UHC-SCI for RMNCH, Infection and NCD was 62, 43, and 77 respectively. The cumulative (Cum.) total and percentage (%) of Consultations for individual at household by Healthcare Providers/: Traditional (Trad.), Pharmacy (Pharm.), Others, Dispensary (Disp.), Health Centre (H.C), District Hospital (Dst. Hosp.), Regional Hospital (Reg. Hosp.) and National. Hospitals (Nat. Hosp.) and Cumulative Total (Cum. Total) (Figure 10).

Regional and National healthcare providers account for 5% and 3% respectively of individual household member's consultation and the remaining 92% taking place at Districts health system of hospitals (22%), health centre (34%), dispensaries (33%) and other: pharmacies (17%), traditional healers (4%) and others (1%).
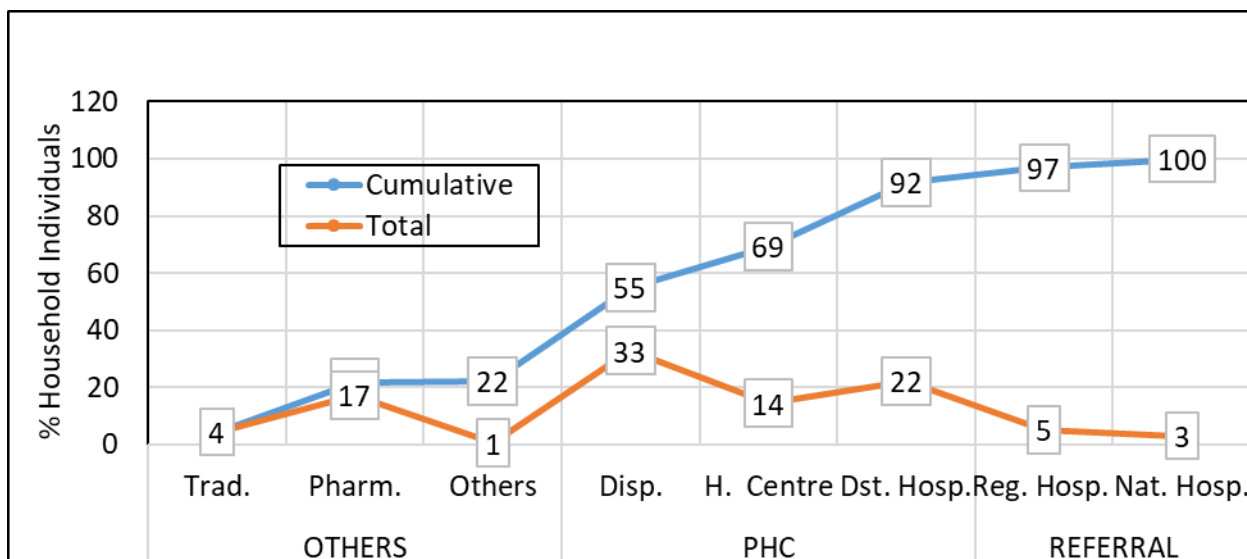
Figure 10: Cumulative and percentages of consultations for individual at household by health care provider in Tanzania, 2011/2012 (Source: Household Budget Survey, 2011/12, National Bureau of Statistics)

Essential medical products and technologies

The Availability of essential medical products (number of items in brackets): Outpatient department (OPD) diagnostics, Infection, prevention and control (IPC) equipment, medicines and Basic laboratory equipment at Health Facilities in 2014/15 in Tanzania (Figure 11).
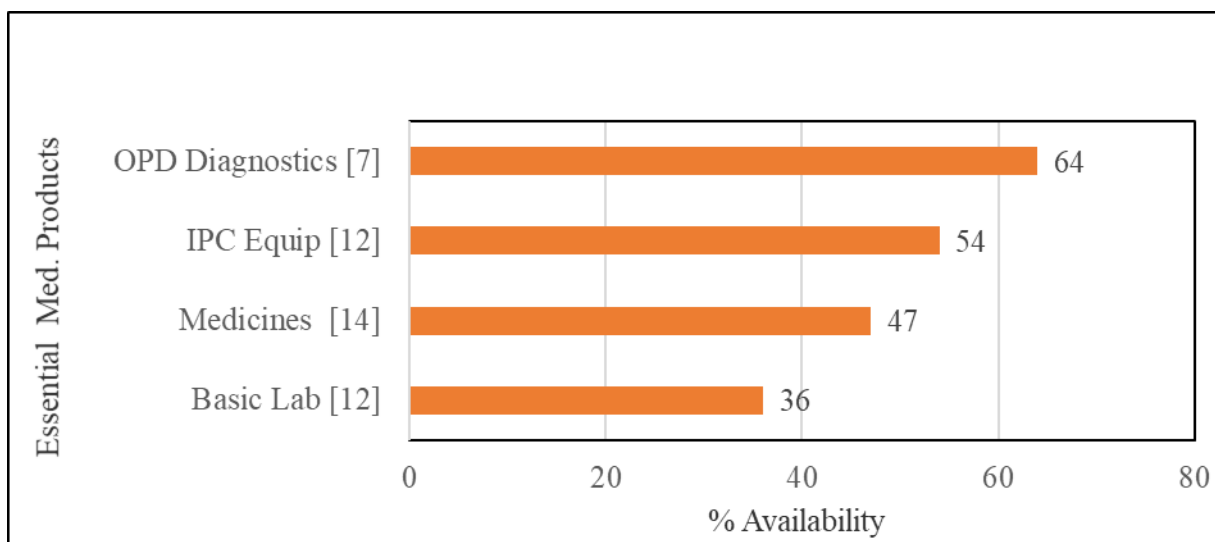
Figure 11: Availability of essential medical products at health facility in Tanzania, 2015 (Source: Tanzania Service Provision Assessment Survey, 2014-15)

The availability of the medical products at health facilities ranged from (36-64%) being highest for Outpatient diagnostic items and least for the basic laboratory products with medicines (47%) and PIC (54%) in the middle.

Health information systems/ Timely intelligence

The challenges of Tanzania health information system in 2017 are summarised in Box 1.

Box 1: Challenges of Tanzania health information system.

Weak governance mechanisms to guide partners' efforts; and fragmentation and uncoordinated efforts to solve health data collection problems
Lack of standard indicators to guide data collection efforts and proliferation of siloed systems stemming from emerging health issues (e.g., climate change and preparedness)
Lack of analysis of data from surveys, constraining decision making processes; weak dissemination and use of survey data
Multiple digital health information systems for different vertical programmes, regions and partners;
Lack of enforcement of data collection systems standards to allow for interoperability;
Lack of policy guidelines on data analysis and health information sharing; inadequate capacity to utilize facility and district-level data
Limited access to birth and death registration data; Inadequate mechanism for gathering and using feedback from community and users,

Source: Tanzania Data Collaborative, Country Case Study, 2017

Human resources for Health

The distribution of Health Workers (Clinicians and Nurses) at Healthcare Facilities in Tanzania during 2020 is as shown in Table 1. PHC facilities in Tanzania Referral Hospitals: National (5), Zonal (5) Regional (28); District based hospitals (298); Health Centres (908), Dispensaries/Clinics (7,247)

Table 1: The distribution of health workers (clinicians and nurses) at healthcare facilities during 2020 in Tanzania

Detail/Unit	Number	Population/Unit	Ratio health worker per facility
Population	55,986,542	NA	NA
Households	11,912,030	4.7	NA
Healthcare Facilities	8,804	6,358	NA
Clinicians	9,476	5,908	1.5
Nurse	18,667	2,999	3.2

Source: Tanzania National Health Portal: https://hmisportal.moh.go.tz/hmisportal/

There are 55.9 million persons Tanzania entitled to get care at health facilities (8,804) by clinical (9,476), nurses (18, 667) and other providers. There are about 6,358 persons per health facility; the number of clinicians and nurses being 1.5 and 3.2 respectively. The distribution of clinicians and nurses per health facility at regions based in Tanzania Mainland in 2020 (Figure 12). The distribution of trained providers per health facility (HF) vary considerably among the regions for clinicians (0.6-1.8) and nurses (1.3-2.8). All regions in the country except seven have more nurses than clinicians.
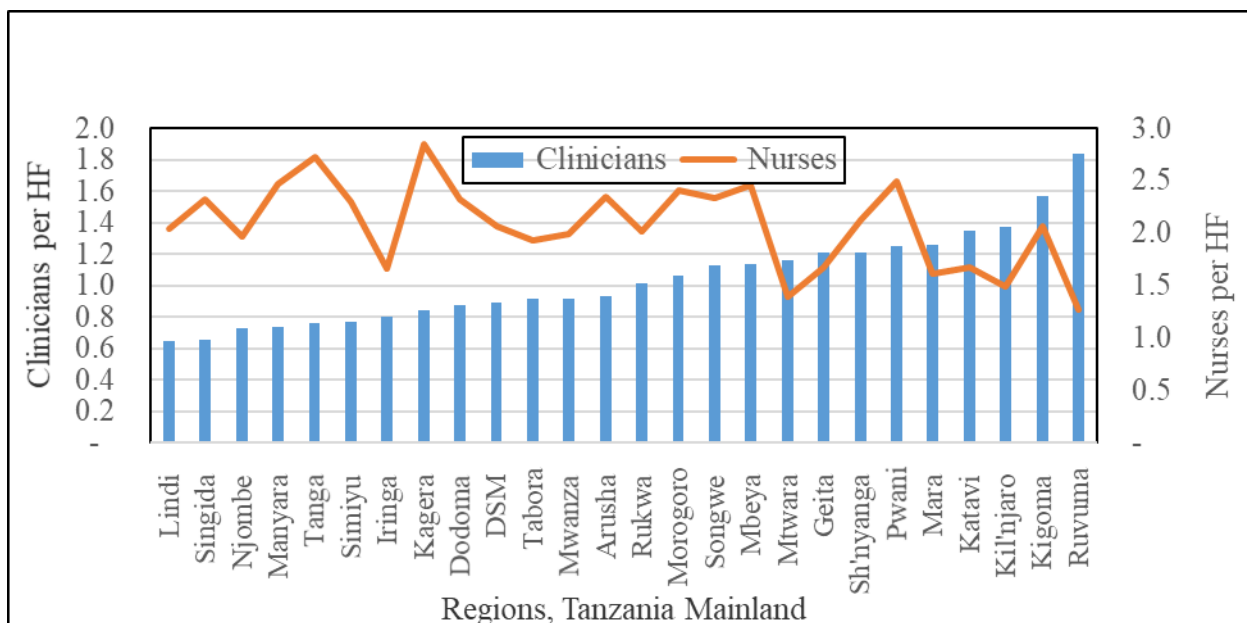
Figure 12: Distribution of trained clinicians and nurses per health facility by regions, Tanzania (Source: https://hmisportal.moh.go.tz/hmisportal/)

Health financing

The total and funding sources of per capita health spending (US$) in Tanzania during 2010 to 2017 (Figure 13).
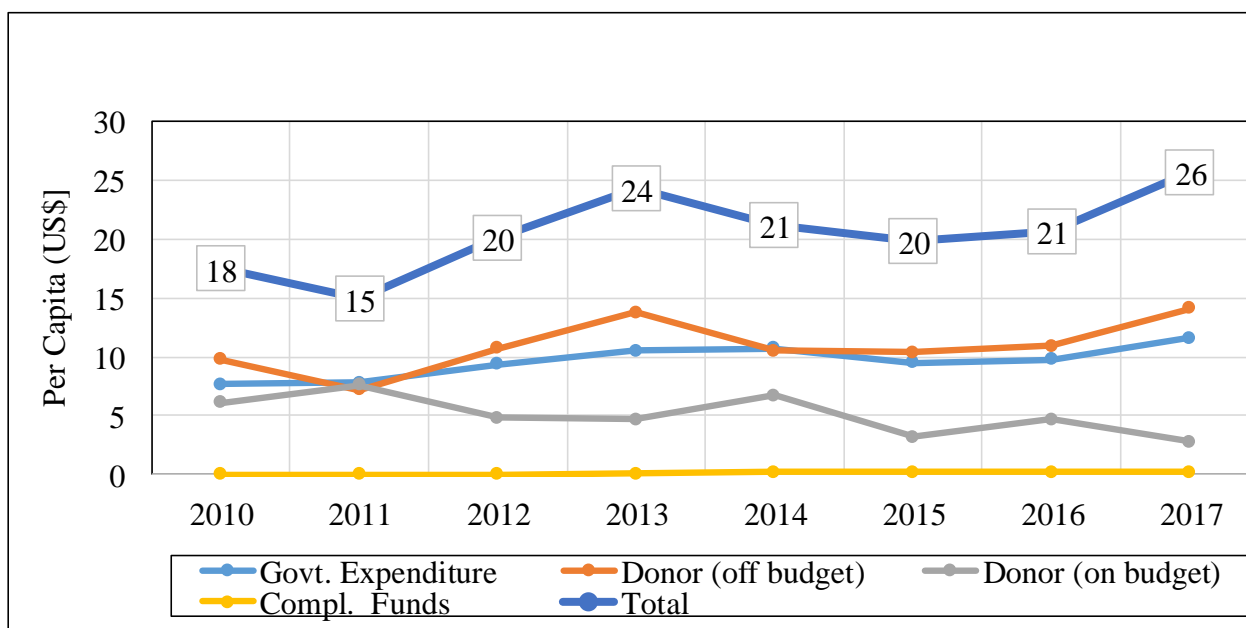
Figure 13: Total funding and sources of per capita health spending in Tanzania, 2010-2017 (Source: World Bank, 2020)

The total per capita health spending in Tanzania during (2010-2017) ranged from (18-26) US$ with a decrease in 2011 (15 US$), rising to US$ 24 in 2013 and decreasing US$ 20 in 2015. Donor off budget was top source of per capita funding throughout the period; followed by government and donor off budget and border line complementary funding (National Health Insurance Fund -NHIF, Community Health Fund-CHF, and User Fees). The

distribution of total health spending across levels of Government: Central Government (Centr. Govt.), Regional Administration and Hospitals (Reg. Adm. & Hosp.) and Local Government Authority (Local Govt. Auth.) from 2013 to 2017 in Tanzania (Figure 14).
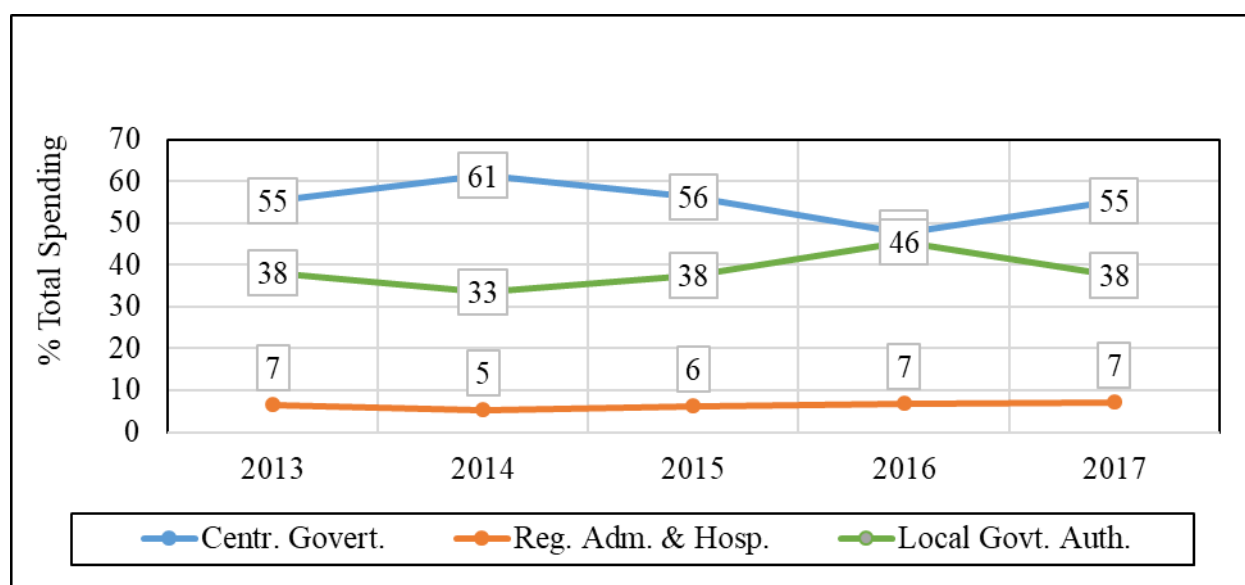
Figure 14: Distribution of total health spending across levels of Government in Tanzania, 2013-2017 (Source: World Bank, 2020)

More than 50% of the healthcare spending during the reporting period was by the Central Government except in 2016; followed by Local Government Authority with a range of (33-46%) and less than 10% for Regional Administration and Hospitals. The per capita health expenditure in US$ for selected District Council in Tanzania in 2015 (Figure 15).

Figure 15: Per capita health expenditure of selected district in Tanzania, 2015 (Source: Jamie Boex et.al, Urban; www.urban.org)

The per capita health expenditure (US$) among the selected District Council (DC) in Tanzania in 2015 least for Nkasi DC (US$ 2.6) and more than twice in Mkuranga DC (US$ 6.5). The average per Capita health expenditure (US$) by Cost Centre (Council Health

Management Team-CHMT; Hospital(s) Services, Health Centres, Dispensaries and Community Health) in the selected District Councils in 2015 (Figure 16).
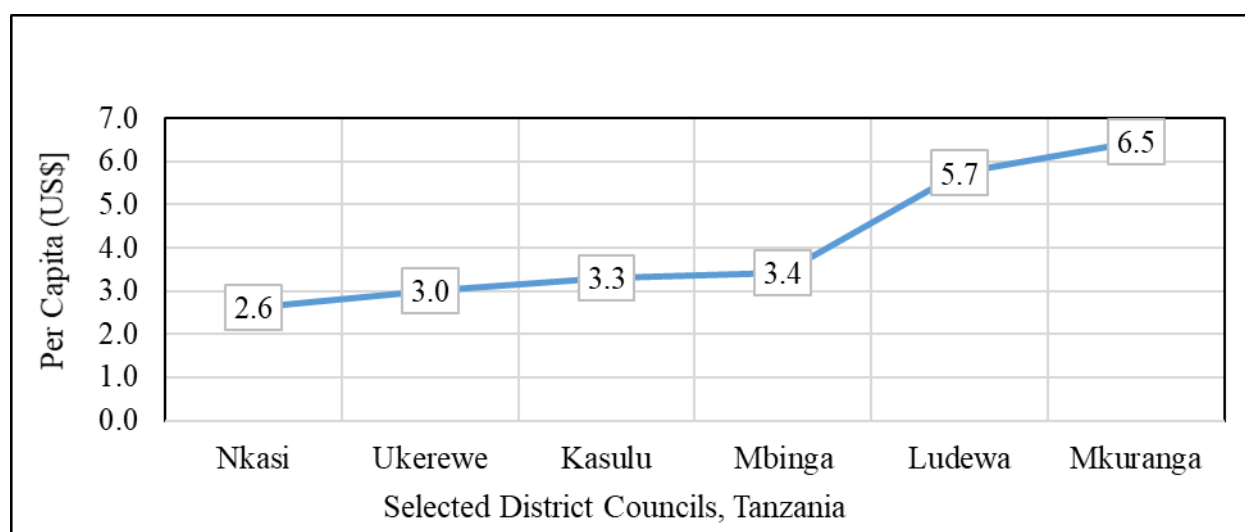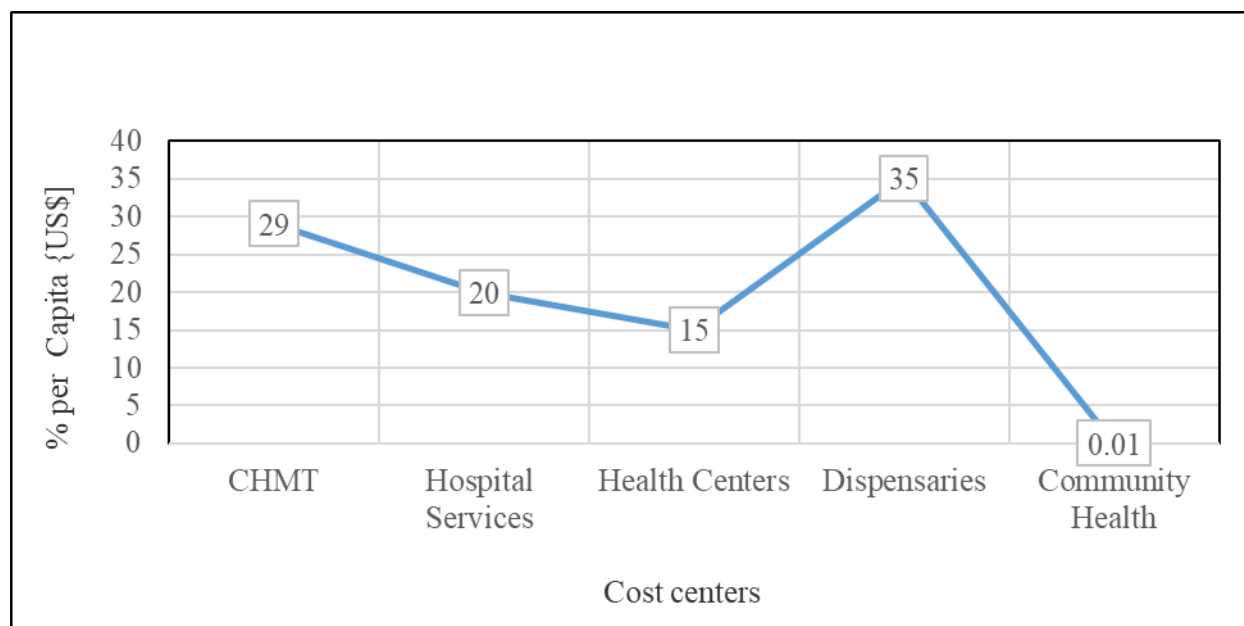

Figure 16: Percent per capita cost centre expenditure in selected districts, Tanzania, 2015 (Source: Jamie Boex et.al, Urban; www.urban.org

The per capita cost centre expenditure is highest at Dispensaries (35%) followed by CHMTs (29%), Hospitals (20), Health Centres (15%) and insignificant (0.01%) for Community Health. The Scores of Healthcare System Components for Universal Health Coverage (UHC) under Tanzania Health Sector Strategic Plan IV (HSSP) and Family Health Practice (FHP) Model (Table 2).

Table 2: Scores of healthcare system components for universal health coverage (UHC) under Tanzania Health Sector Strategic Plan IV (HSSP) and Family Health Practice (FHP) Model

Components of Healthcare System	Score for UHC (Minimum: + ; Maximum: ++)	
	TZ-HSSP-IV/	FHP Model
Governance and Leadership		
Responsibility for steering the entire health sector at all times including disaster	+	++
Transparent and inclusive processes, national health policies, strategy and plan	+	++
Service delivery		
Comprehensive primary care system with integration, people –centeredness and referral, and continuity	+	++
Standards, norms and guidance to ensure access quality performance with accountability on performance	+	++
Essential medical products and technologies		
Access to affordable essential medicines, vaccines,		

Components of Healthcare System	Score for UHC (Minimum: + ; Maximum: ++)	
	TZ-HSSP-IV/	FHP Model
diagnostics and health technologies of assured quality, which are used in a scientifically sound and cost-effective	+	+
Health information systems		
Timely intelligence on health challenges, on the broader environment in which the health system operates, and on the performance of the health system.	+	++
Human resources for Health		
Workforce responsive to the needs and expectations of people, is fair and efficient to achieve the best outcomes possible given available resources and circumstances.	+	++
Health financing		
System to raise sufficient funds for health fairly including pool financial resources across population groups to share financial risks	+	++
Financing governance system with transparency and accountability	+	++

Sources: WHO, 2010

Discussion

Family Health Practice (FHP), the second generation of Western Medical Practice after centuries of Hippocratic practice (HP), has been adopted very slowly especially in developing countries in Africa region with high burden of household illnesses and injuries. FHP approach guarantees lifelong universal coverage for comprehensive PHC to all members of households / families; and accordingly, the community and the country. Treatment seeking behaviour under HP approach by some individuals at households limits its potential for attaining UHC. UHC-SCI observed in Tanzania and other countries is low with slow growth despite decades of commitments to PHC, MDGs and currently SDG-UHC.

The Global and regional UHC-SCI seems to increase with higher health expenditure per capita (HE/cP) to a certain optimal level beyond which the higher values of the index are not obtained. Similar pattern is also seen in WHO AFRO Region countries which have least UHC-SCI and HE/cP indicating differences in optimisation country health systems. Tanzania health system of treatment seeking behaviour for illnesses and injuries of household members; mainly due to preventable malaria and infection results in over three quarters of cases at outpatient attendance, inpatient admissions and deaths; with dissatisfaction and being too expensive. Tanzania SCI of 43 and the expenditures of 35 US$ also attainable for less US$ 30 (Gambia) or much more US$114 (Angola). Optimisation of health system and accountability be constrained by complicated organisational structure of the two responsible central ministries in Tanzania.

The very low and very high UHC-SCI figures for access and capacity in WHO- AFRO Region indicate the potential of optimising services delivery component of Health system to meet household health needs as in FHP approach. The UHC-SCI for RMNCH, Infectious diseases and NCDs of countries with low levels is irregular but becomes gradually consolidated with higher levels of HS opsonisation. In Tanzania health system, services delivery to health seeking individual from household at frontline health facility (dispensary) is one third, close to UHC-SCI for access of 2017; higher levels can be netted by FHP which will include the one third of ill and injures who stay at home and the other third who overstep the referral imperatives; resulting in overcrowding of secondary and tertiary hospitals, abuse and apparent shortage of resources.

The availability of essential medical products at health facilities for the known illness and injury under treatment seeking behaviour of household individuals at frontline and referral level is unpredictable; with out of stock, expiry etc. FHP provide coverage, real time health need of households and solution on demand of essential medical products and technology. The specific and general challenges of HIS in Tanzania results from health system and components dealing with sporadic events of treatment seeking behaviour at one type and level of health facilities among numerous in the country. Health information systems (HIS) for FHP demands electronic health records (EHR) system for individual and households over their entire life span with local, with community, sub national and national linkages district, one ICT solution for the Health System

Tanzania needs of human resources for health at households are not realistic given health seeking behaviour practice (Hippocratic) the erratic referral system, the central vertical programme and two central ministry decentralising services to district councils. This accounts also for the erratic distribution of clinicians and nurses at regions in the country. The available resource of health facilities, clinicians and nurses can transform the health system to FHP. The high health expenditure at central level for national and council budgets with erratic levels at districts leaves very little for frontline dispensaries and the demand for household illnesses and injuries. The source of system intelligence and financing is from few individuals at household who are seeking treatment at health facilities. Health financing under FHP will be founded knowledge on dynamics of illnesses and injury at households in real time for UHC and SCI of 100 by 2030.

The higher score of FHP model for health systems components indicate its inherent potential for attainment of UHC compared to the traditional Hippocratic model of individual treatment seeking behaviour at households under HSSP IV. The FHP approach involves transformation of health systems components towards comprehensive PHC for individuals and members of households.

Conclusion

Tanzania major health problem are preventable through PHC framework. The current top down donor dependent health system for treatment seeking behaviour of clients at health facilities and the numerous vertical programs have intrinsic limitations and are inadequate for attainment of respectable UHC-SCI. Transformation of the current health

system towards Family Health Practice and Principles will position and fast track implementing of affordable comprehensive PHC on sustainable basis for ultimate attainment of UHC by 2030. Therefore, Tanzania and countries in the Africa region should seize this opportunity by actively promoting the evidence based FHP and principles as the ultimate solution compressive PHC, foundation for community health insurance schemes and timely realization of UHC. Pioneering FHP models in countries can be initiated in districts and regions with least UHC-SCI, scaled up in the Country, WHO-Afro region and elsewhere.

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Situational analysis in responding to emerging and re-emerging epidemics: a case study of Dodoma City in Tanzania

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Abstract

Background: Epidemics in poor resource communities pose public health phenomenon since they are the most vulnerable population. In addition, the community health care providers are not exempted into such occasions. The community health workers are poised to act a major role in managing such epidemics. For every epidemic strategy should prioritise into protect the public and health workers, interrupt the outbreak and shield the most vulnerable communities. It is apparently important the situation prevailing in the country health are analysed on their preparedness to handle such epidemics especially in the developing countries like Tanzania. This study aimed to analyse the preparedness of the health facilities on handling of epidemics in human population in Dodoma city, Tanzania.

Methods: A cross-sectional study was carried in Dodoma city council using semi-structured questionnaire. The questionnaire was administered to health care providers who were either working in or outside health facilities. The enumerators were trained before administering the questionnaire as well the questionnaires were pre-tested so as to observe normality of the data. The data were presented as descriptive statistics (frequencies and distribution) but were further analysed to determine the awareness of handling epidemics among health care providers. The p value of *0.05* was regarded as statistically significant different among factors.

Results: The study involved 84 participants (Male: 52.4% and Female: 47.6%) who were working in (83.3%) or outside health facilities (16.7%). The description of the epidemic among respondents: 61.9% mentioned an epidemic to be a disease which is emerging and 38.1% as re-emerging while 76.2% characterised epidemic as a disease occurring for the first time and 23.8% as a disease with high incidence rate. 73.8%, 92.9%, 70.2% of the participants were aware that simulation, biosafety measures and team preparedness could contain epidemics, respectively. The analysis of data through multivariate analysis showed that simulation of the epidemics could be significant is practised effectively among health workers (p = 0.007), team formulation (0.004) and the chain of communication in case of an outbreaks.

Conclusion: The Health Systems and the Capacity to Respond to Epidemics in Dodoma City is in place however it needs to strengthened and capacity of the health personnel to be improved. That is to say that there is a need for periodic simulations for health personnel to improve their capacity to handle epidemics. Also, their quantity needs to be improved. Maintaining the availability of adequate supply is another factor. In addition, knowledge and skills of the population on epidemic is to be addressed too.

Background

The emergence and re-emergence of epidemics of infectious diseases are globally increasing. These diseases are endangering the public health since they affect the health

systems, social life and create enormous economic turmoil especially in the low-medium income countries (WHO, 2014.). In addition, the diseases are associated with high morbidities, mortalities, panic, disruption of trade and political instability. These outbreaks are associated with several factors including poverty, overpopulation, poor zoo-sanitary practices and lack of access to clean and safe potable water in poor communities (Choi, 2009).

The occurrence of infectious diseases both in human or animals has been constantly emerging and re-emerging in the human history due to pathogen evolution and environmental changes (Morse, 1995). Due to re-occurrence of the pathogens; most diseases which cause epidemics are categorised as newly emerging and re-emerging. Morse (1995) and Morens & Fauci (2013) defined emerging diseases as diseases occurring for the first time in the population they can be due to a new pathogen or an evolved known pathogen. The authors also define re-emerging as diseases which previously existed but re-occur even after apparent control or elimination. Such diseases are characterised by high incidence rate, morbidity, mortality and wide geographical distribution.

The occurrence of emerging infectious diseases in Tanzania has been relatively moderate as compared to her neighbouring countries, although their significant can't be ignored. Several authors have established the occurrence of such epidemics in the past decades through epidemiological evidences. Karimuribo et al. (2011); Chipwaza et al. (2014) and Kajeguka et al. (2016) identified evidences of viral infectious disease of public health importance which were rift valley fever, influenza H1N1, Rubella, dengue and Chikungunya. Furthermore, sero-prevalence conducted in various places confirmed sero-conversion of life-threatening viral disease such as Chikunganya, yellow fever, dengue, hepatitis and different forms of influenza (Heinrich et al. 2012; Chipwaza et al., 2014; Kagejuka et al. 2016). These diseases are described to increase in the human population due to various reasons such as: level of urbanisation and human demographic changes (Morse, 1995; Mboera et al. 2016), booming international travel and trade (Fidler, 1996; Tatem, 2006; Suleiman, 2014), biological warfare and bioterrorism (Gibbs, 2005; CDC, 2013), deficiencies in public health infrastructure and surveillance (Thompson & Zwi, 2011; Scholz et al. 2015), increased demand of animal proteins (Gibbs, 2005; FAO, 2013, MALF, 2016) and genetic mutation and adaptations of the pathogens "antigenic drift" (Morens et al. 2008; Trifonov et al. 2009)

Due to the unpredicted occurrence of epidemics globally; the government of Tanzania has put in place strategies to handle such epidemics. It has established the National referral laboratory to test for infection diseases, National Influenza Laboratory so that to initiate viral and epidemiologic influenza sentinel of Rift Valley fever and dengue fever, respectively. Meanwhile the country is currently handling the testing and reporting of the COVID-19 infection using the modern technology under the National Laboratory. Despite all measures considered reasonable to handle the epidemics however the level of preparedness differs among health facilities. Thus, this study attempt to analyse the situation in one of the cities in Tanzania so as to establish the trend of emerging infectious disease (EID) occurrence especially in human health set up, to establish the efforts made by the authorities so as to cope with occurrence of such diseases.

Furthermore, the study was undertaken to evaluate the capability, opportunities, behavioural change and motivation of the health workers to handle epidemic outbreaks

Methods

Study area and design
This study was carried using a cross sectional study design where structured question was used as research tool to collect the required data. The study was carried in Dodoma city council to determine the level of preparedness to handle emerging and re-emerging epidemics.

Data collection
A structured question was administered to health professionals who were randomly assigned for a scheduled interview. All data collectors were trained on interviewing the participants before starting the exercise and the questionnaire for pre-tested to acquire normality. The study aimed at evaluating the working force available, the channels of communication in case an outbreak, working gears and protocol for biosafety and biosecurity to contain such outbreaks.

Data analysis
The data were processed using Microsoft excel and later on analysed using SPSS. In this study the key outcome considered were chain of command among health facility workers, infrastructures and the contribution of the community to respond epidemics. Descriptive statistics including means, standard deviation, frequencies and distribution were calculated while Chi-square was used to determine the association among factors where p – value of 0.05 was considered as significant.

Results

This study was conducted to evaluate the preparedness of the health facilities on handling outbreaks of emerging and re-emerging diseases at different level. The participants in the study were either working at a health facility or outside the health facility although they were all public health workers. In addition, the study was conducted to analyse such preparedness in terms of human resource and health facility infrastructures. The study was conducted through structured questions involving 84 participants with different level of education, health facility and academic background in the field of biomedical and medical training. The demographic presentation of the participants showed that most of the interviewees were male (52.4%) who were mostly diploma holder and below (64.3%) (Table 1).

The participants were also asked on their knowledge and skills pertaining to the definition of epidemics. The results present that most of the respondents defined an epidemic as a disease which is emerging to their routine work in a health facility (61.9%). On the other hand, the participants anticipated that an epidemic should be presented with high incidence rate and morbidities of the affected population; under this consideration 76.2% of the participant agreed that a disease which diagnosed for the first time qualifies more to be an epidemic.

Table 1: Demographic presentation of the study participants

Category	Subject	Frequency	Percentage (%)
Gender	Female	40	47.6
	Male	44	52.4
Level of education	Diploma and below	54	64.3
	Biomedical degree	30	35.7
Place of working	Health Facility	70	83.3
	Out of Health Facility	14	16.7

Table 2: Participants definition of an epidemic in the study area

Category	Subject	Frequency	Percentage (%)
Defining an Epidemic	Emerging	52	61.9
	Re-emerging	32	38.1
Characteristics of epidemics	First time appearance	64	76.2
	High incidence	20	23.8
Cholera	Yes	83	98.8
	No	1	1.2
Ebola	Yes	38	45.2
	No	46	54.8
HIV/AIDS	Yes	30	35.7
	No	54	64.3
COVID-19	Yes	76	90.5
	No	8	9.5
Other types of epidemics	Yes	49	58.3
	No	35	41.7

The study also required the participants to present their level of preparedness so as to handle such outbreaks (Table 3). It was observed that simulation was the common method to demonstrate preparedness to combat an epidemic (73.8%), most of the participants were as well aware of the guidelines for biosafety and biosecurity (92.9%). Concurrently most of the participants agreed that working in a team is better approach to handle epidemics (70.2%).

Table 3: Awareness of the participants on the preparedness to handle epidemics

Category	Subject	Frequency	Percentage (%)
Simulation	Yes	62	73.8
	No	22	26.2
Biosafety guidelines	Yes	78	92.9
	No	6	7.1
Preparedness Team	Yes	59	70.2
	No	25	29.8

Another parameter to assess such awareness requested the participants to provide the form of chain of command (Table 4); that is in case of an epidemic which level of administration should be notified as early as possible. The findings present that most of

the health workers who work outside the health facility communicate with the community leader (88.1%) such as Street or hamlet (kitongoji) chairpersons, health facility in-charge (66.7%) and few report to the district commissioner (26.2%).

Table 4: Chain of command when reporting epidemics

Category	Subject	Frequency	Percentage (%)
Hamlet/Community Leaders	Yes	74	88.1
	No	10	11.9
Health Facility In-charge	Yes	56	66.7
	No	28	33.3
District commissioner office	Yes	22	26.2
	No	62	73.8

The participants were also requested to provide information on how do they handle the patients in epidemics (Table 5). It was found that 83.3% of the participants argued against treating patients with epidemics, some suggested traditional healing, placement of patients in treatment camps with special facilities (100%) and provision of preventive education (94.0%).

Table 5: Treatment of patients in areas where there is an epidemic

Category	Subject	Frequency (n)	Percentage (%)
Health Facility	Yes	14	16.7
	No	70	83.3
Traditional Healing	Yes	03	3.6
	No	81	96.4
Placing in Treatment camps	Yes	84	100.0
	No	0	0.0
Preventive education	Yes	79	94.0
	No	05	6.0

The participants were also requested to rank disease outbreaks as per their understanding and experience. The results present that cholera was the highest ranked epidemic (98.8%), COVID-19 (90.5%), Ebola (45.2%) and HIV/AIDS (35.7%). It was also noted that some of the participants could present more epidemics (58.3%) while other could not mention other epidemics (41.7%).

In order to quantify the association of the factors to either management or occurrence of epidemics statistical analysis of the results was undertaken so to establish the inference as well the causal relation of the factors. The factors were categorised basing on the level of education of the participants, place or status of work either at the health facility or outside the health facility and the chain of command once an epidemic occurs in the community. Table 6 shows that level of education was not statistically significant different among participant on matter related to preparedness and describing epidemics.

Table 6: Level of education with respect to epidemic handling

Category #1	Education level	Yes (n, %)	No (n, %)	*p-value*
Simulation	Diploma and below	39 (46.4%)	15 (17.9%)	0.431
	Biomedical degree	23 (27.4%)	07 (8.3%)	
Guideline for managing epidemics	Diploma and below	49 (58.3%)	05 (6.0%)	0.297
	Biomedical degree	29 (34.5%)	01 (1.2%)	
Categorising epidemics	Diploma and below	39 (46.4%)	15 (17.9%)	0.191
	Biomedical degree	25 (29.8%)	5 (6.0%)	
Team formulation	Diploma and below	40 (47.6%)	14 (16.7%)	0.216
	Biomedical degree	19 (22.6%)	11 (13.1%)	

There was a statistically significant difference (p = 0.006) among health care who are working at the health facility compared to those who are working (Table 7). There is also significant difference (p = 0.004) on the understanding the importance of team formulation in epidemic management among health workers.

Table 7: Working status of the respondents with respect to handling epidemics

Category #2	Status of working	Yes (n, %)	No (n, %)	*p-value*
Simulation	Health Facility	54 (64.3%)	16 (19.0%)	0.006
	Out of Health Facility	08 (9.5%)	06 (7.1%)	
Guideline for managing epidemics	Health Facility	68 (81.0%)	02 (2.4%)	0.438
	Out of Health Facility	10 (11.9%)	04 (4.8%)	
Categorising epidemics	Health Facility	54 (64.3%)	16 (19.0%)	0.113
	Out of Health Facility	10 (11.9%)	04 (4.8%)	
Team formulation	Health Facility	45 (53.5%)	25 (29.8%)	0.004
	Out of Health Facility	14 (16.7%)	0 (0.0%)	

Reporting of the epidemics was statistically significant among health workers who are working at health facility as compared to those working outside the healthy facility (Table 8).

Table 8: Chain of communication among health workers in and outside health facility

Category #3 - Reporting chain	Status of working	Yes (n, %)	No (n, %)	*p-value*
Hamlet/Community Leaders	Health Facility	62 (73.8%)	08 (9.5%)	0.527
	Out of Health Facility	12 (14.3%)	02 (2.4%)	
Health Facility In-charge	Health Facility	50 (59.5%)	20 (23.8%)	0.042
	Out of Health Facility	06 (7.1%)	08 (9.5%)	
District Administration	Health Facility	15 (17.9%)	55 (65.5%)	0.034
	Out of Health Facility	07 (8.3%)	07 (8.3%)	

Discussion

A rapid situational analysis was undertaken in Dodoma city for a period of October – November, 2020 to determine the preparedness of the human resource in combating epidemics in the city. The study involved respondents with different education level in the health sector, those working in or outside health facilities. The study intended as well

to assess their knowledge and skills on categorising forms epidemics as compared to the routine disease they encounter in their practices. The mainly analysed the competence of the health workers basing on their level of education, health facility working status and possible chain of communication once an epidemic occurs.

Basing on the general understanding of the participants it appears that most of the respondents could differentiate an epidemic from a pandemic, could categorise the nature of an epidemic and provide relevant examples such as COVID-19, cholera, Ebola, Zika, severe respiratory influenza and others. Therefore, having the proper knowledge of epidemics is one step to manage such disease outbreaks. Similar findings have been reported by Ballard et al. (2020) who cemented on the need to invest in train the community health workers as they are poised to play a pivotal role in fighting epidemics at different levels especially in poor resource communities. Boyce & Katz (2019) commented highly on the continuous training of the community health workers so that they can promote epidemic preparedness prior to massive loss of human life. Furthermore, the health care providers act as community level educators and mobilizers, contribute to surveillance systems and filling service gaps. There is a knowledge gap of the health workers on the management of the epidemics. All respondents fully endorsed that during epidemics all patients should be treated in specialized camps. The inclusion of One Health Approach that also addresses zoonotic diseases was not mentioned.

In this study the respondents presented concern on the ways are prepared to handle disease outbreaks with their area of jurisdiction. Such preparedness is sensitised among health care providers by simulating the handling of outbreaks, available protocols and teams for handling epidemics at different levels. This is in accordance with the National Action Plan for Health Security (NAPHS) 2017-2021 of Tanzania which provides the guidance on handling outbreaks. This aspect is also in accordance with the World Health Organisation (WHO, 2013) guidelines on handling epidemics; CDC (2013) described almost similar guidelines which could be simulated to protect the public against bioterrorism and FAO (2013). However, this finding was not in favour of those presented by Koka et al. (2018) who noted several gaps in the disaster and epidemic preparedness in various health facility settings. The authors noted that the few highly skilled workers were assigned more administrative positions in such health facilities; thus, when an epidemic breaks the teams to respond to such scenario are mainly made of junior clinical and nursing staff.

It was also noted by this study that the chain of command among workers in the health sectors differs in the aspect of their understanding. The health workers at a health facility mentioned that epidemics are always reported to the community leaders. This difference in understanding on the chain of command may affect the effectiveness of campaigns to contain an epidemic. It can be noted that disease outbreaks are capable of spreading fast such that they can cause public panic, thus lack of proper chain of communication of mentioned be the respondents could exacerbate the disease outcome. This finding concurs with Abubakar et al. (2013) who elaborated that communication between the health care providers and the community is vital for prevention and social mobilisation leading to containing of the diseases. The authors further described that containment of an outbreak is largely through integrated disease surveillance and response strategy in

local and central government. Mangu et al. (2014) insisted that rapid response to an outbreak involves well organised processes of communication, team development and supplies so as to manage the outbreak in a minimum time possible. While Froeschel et al. (2016) justified the need for integrated local, National and International stakeholders to contain epidemics. Despite the relatively low number of respondents in this study; the authors are adamant to report the results are worth reporting due to the facts that epidemics are part and parcel of human and animal health. They frequently occur and case of life, finance and socio-economic disintegration especially in the low-medium-income countries.

This study was limited by the lack of accommodating the personnel in the livestock sector because animals are the major reservoirs of most human pathogens. In addition, data collection was based on personnel working in health facilities. Moreover, there was no verifying of the infrastructures and supplies present.

Conclusion

The Health Systems and the Capacity to Respond to Epidemics in Dodoma City is in place. However, it needs to be strengthened and capacity of the health personnel to be improved. That is to say that there is a need for periodic simulations for health personnel to improve their capacity to handle epidemics. Also, their quantity needs to be improved. Maintaining the availability of adequate supply is another factor. In addition, knowledge and skills of the population on epidemic is to be addressed too.

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Mercury exposure and associated reported menstrual disorders among women in artisanal and small-scale gold mining in Nyang'hwale District, Geita, Tanzania

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Abstract
Background: Out of the workers involved in small scale mining activities in Tanzania, women are 30-50%. Normally use mercury to recover gold from the ores. This practice may cause a wide range of health impacts including reproductive defects in reproductive hormone and an ovulation which may result to menstrual disorders in women working in artisanal and small-scale gold mining. This study aimed to assess occupational exposure to mercury and associated menstrual disorders among women working in artisanal and small scale gold mining in Nyang'hwale District, Geita.
Materials and methods: The study was descriptive cross-sectional study design. Simple random sampling technique was used to obtain 170 of women working in ASGM and 99 of women who were teaching primary schools. Data on the proportion of menstrual disorder were collected using face to face administered questionnaire and analysed using descriptive statistics. The Chi square test and Binary logistic regression were performed for association between mercury exposure and menstrual disorders. 95% confidence Interval expressed in P = 0.05 or P<0.05 was used. CVAAS was used to analyse mercury concentration level in urine.
Results: The mean Age of the participants was 33.6 ± SD and the mean of menarche age was 15.26 ± SD. The proportion of menstrual disorders in the exposed group was significantly higher than that in the non-exposed group (OR 1.5; 95% CI 1.160 – 1. 876 and P= 0.001). The proportion of menstrual disorders in exposed group was (67%) and non-exposed group (46%). The proportion of dysmenorrhea in the exposed group was found statistically significantly higher than that in the non-exposed group (OR 2.7; 95% CI 1.579 – 4.489 and P= 0.0001) and the proportion was (38%). The mean mercury levels in urine were 41.3ug/L for exposed group and 2.04ug/l for non-exposed group respectively. Out of 21 urine samples, 6 (28.6%) exceeded the Maximum World Health Organization (WHO) acceptable level of 50 ug/L.
Conclusions: The findings generalized that women who are exposed to occupational mercury have higher risk to report the problems of menstrual disorders. The district council stakeholders should create awareness to mining community, that mercury used for amalgamation process to extract gold may be associated with menstrual disorders and other reproductive health defects among the women working or living nearby the mining areas.

Key words: mercury, exposure, menstrual disorders, women, artisanal, gold mining, Tanzania

Introduction

Artisanal and small-scale gold mining (ASGM) is undertaken by individuals or groups with limited equipment and often informally without mineral right (1). ASGM is increasingly common in many parts of the world with more than 30 million active artisanal miners in more than 55 countries (2). It is estimated that over 30% of all ASGM activity worldwide is undertaken by women but depending on the region this may be much greater (3). In Africa, ASGM workforce comprises not less than 40-50% women (4). Female miners can take part in all aspects of mining, digging, crushing, transporting, sorting, processing and trading (5).

In Tanzania alone, is estimated 0.5 to 1.5 million of informal miners, of whom 30-50% are women (2) were involved in mining activity they normally use mercury to recover gold from the ore. In gold smelting or amalgam they use their bare hands when handling mercury, which expose them to risk both from mercury vapour and direct contact through skin. In fact, the number of artisanal mining sites is expanding in many regions of Tanzania, particularly around Lake Victoria and in the central and southwestern regions of the country (2). Artisanal and small scale mining activities are largely concentrated in rural areas that have very little infrastructure, and the individuals undertaking informal mining generally lack education, training, management skills and essential equipment for safe mining practices (2). In mining process, mercury is used to extract gold from ore in artisanal and small-scale gold mining. Approximately 40% of this mercury is lost during the initial concentration of amalgamation stages of the gold mining process and the remaining 60% is released directly into the atmosphere when the Hg amalgam is burned at the end of the purification process, exposing miners to inorganic-mercury poisoning either via the respiratory tract as vapor or through the skin by contact (6). Thus resulting into millions of small scale miners, infants, children, women of child bearing age (potentially pregnant), and breast-feeding women who are working or living in ASGM communities be at risk of mercury exposure (7).

Chronic mercury exposure may seriously result to menstrual cycle disorders, arising from interference with the part of the brain which controls reproduction (hypothalamo-pituitary-gonadal axis) (19). Epidemiological studies have shown the harmful effects of mercury vapour on the central nervous system. The excess of ovulatory troubles in a group of occupationally exposed women has been interpreted as an indirect consequence of this effect on the pituitary hypothalamic axis (8). Mercury is poorly absorbed through the skin and gastrointestinal tract by less than 1%, also is efficiently absorbed through the lung by 80% to 85% (9). The dissolved vapour remains in the blood long enough to cross the blood brain barrier where it is oxidized and eliminated only very slowly (10).

Necropsy studies of occupationally exposed to mercury have found high concentrations of mercury in the pituitary, thyroid, and brain. There are evidences that mercury persists in these tissues for many years, hence the mercury that accumulates is biologically active able to interfere with endocrine or reproductive function (10). The occurrence of these hormonal problems may lead to the development of various chronic health problems, including menstrual cycle irregularities and the continually occurring over a long periods

may result in early onset of menopause (11). But the evidence shows that the women exposed to mercury are reported to have the highest prevalence of menstrual cycle disorders, compared to non-mercury exposed group according to some studies done in China, Italy and Colombia (17%, 47% and 59% respectively) (8,12,13).

In European and North American studies, it was found that over one-half of the women of reproductive age and about 30 to 90% of menstruating women report lower abdominal and lower back pain associated with the menstrual cycle due to mercury vapour exposure (12). The findings suggest that globally there is high prevalence of menstrual disorders such as dysmenorrhea, prolonged menstrual periods, irregular periods, heavy flow periods and premenstrual syndrome (14). The World Health Organization reported that 18 million women of reproductive aged perceive their menstrual bleeding to be excessive. Such disorders have economic consequences in terms of health care costs due to the consumption of expensive hormonal drugs and laboratory tests (15). In developing countries approximately 4 to 8% of women report having menstrual periods longer than 7 to 8 days and excessive, profuse or heavy bleeding 4 to 9% and prevalence of excessive bleeding was reported to be higher, increasing from 8% to 27% (16). Nigeria and Ethiopia also reported the prevalence of menstrual cycle disorders among the women in reproductive age to be 19% and 46% respectively (17).

Although the menstrual disorder is associated with psychosocial problem, life style, health status; also may be associated with mercury exposure (18,19). Studies done in Tanzania on mercury exposure and associated health effects among ASGM focused on mercury intoxication and neurological symptoms, tremors, stomatitis, gingivitis memory loss, vision impairment, insomnia, emotional instability and other health symptoms (2,20,21). So far, little has been documented on mercury exposure and associated menstrual disorders in women working in artisanal and small scale gold mining. This study based on, determined the proportion of women with menstrual disorders, determined the concentration of mercury level in urine and associated menstrual disorders among women in artisanal and small scale gold mining in Nyang'hwale District.

Material and Methods

Study design and setting
This cross-sectional study design was used for assessed exposure to mercury and associated menstrual disorders among women in artisanal and small scale gold mining in Nyang'hwale District, Geita, Tanzania. Nyang'hwale District is one of the five Districts in Geita region in Tanzania, where intensive artisanal and small scale gold mining activities are conducted and most of women are self-employed in gold mining activities, directly exposed to elemental mercury vapour.

Selection of participants
We recruited 269 women of age group between 18 – 44 years old. Whereby 170 were women selected in artisanal and small scale gold mining as exposed group, currently working in artisanal and small scale gold mining for at least one year in amalgamation process and those who carry out other activity around the mining area like heating gold

ores were included in the study; and 99 participants were women selected from primary schools (Teachers) as non-exposed group who were selected 5km away from the village where artisanal and small scale gold mining was being conducted. Women who were pregnant, any type of diagnosed pelvic pathology (fibroids, pelvic inflammatory disease), and lactating mothers were excluded to participate in this study.

Four study wards were selected purposively out of twelve wards due to availability of the villages where women were working intensively in artisanal and small scale gold mining in all mining stages. Then one village from each ward was selected purposively due to criteria of the elements included in the study as predefined to obtain 4 villages. Then the women who were working in artisanal and small scale gold mining whose fulfil the inclusion criteria were selected using simple random sampling technique using lottery method; and the same sampling technique was used to select non exposed group (Primary teachers) to obtain the total number of sample size 99 from 16 primary schools.

Data collection

Data on the proportions of menstrual disorders was collected using semi structured questions which were adapted from Modified gynaecologist questionnaire for assessing Menstrual cycle disorders (22,24). The questionnaire includes questions about demographic and occupational data, history of exposure to mercury or other chemicals, history of gynaecological and disease, the approximate interval of days (menstrual length) between first to next menstrual cycles (include Oligomenorrhea, Amenorrhea, Polymenorrhea, Hypomenorrhea) the average days of the menstrual bleeding, menstrual flow as slight or excessive bleeding (Menorrhagia,) than usual by assessing the approximate number of sanitary napkins used daily, prolonged menstrual bleeding, shortened menstrual bleeding, intermenstrual bleeding and on symptoms of menstrual cycle disorders the questionnaire included the questions on physical symptoms like excessive abdominal pains, severe menstrual cramps. The questionnaire contained the questions on assessing other factors contribute to menstrual disorders like consumption of alcohol, smoking habit, post exposure to pesticide and habit of performing physical exercises.

We recruited three research assistants who had a post health professional background and were serving as health workers in Nyang'hwale district. The assistants were oriented to research concept, protocol, data collection tools (questionnaire) and procedures of urine collection.

Procedures for urine collection and analysis

First morning urine samples were collected as recommended by World Health Organization guideline for mercury analysis in urine sample (23). From 21 respondents who were selected by random systematic sampling strategy by skipping 12 respondents after each sampled participants. Fifteen and 6 urine samples were collected from exposed and non-exposed groups respectively. The urine sample was collected in sterile plastic containers (100 ml size) and 50ml of urine were collected and the containers were kept closed until ready for analysis. Participants were asked to open the container at the time of urine collection and close it immediately after urine collection to avoid touching inside the container or cap to avoid contamination (25,26,27). Urine samples were stored

in cold box at collection site and transported to the District hospital laboratory where they were refrigerated (4°C) until transport to Government Chemist Laboratory for analysis.

Analysis of urine was performed by Flow Injection Cold Vapour Atomic Absorption Spectrometry (CVAAS) (28). The digestion of urine was carried out then the sample solutions were subjected to CVAAS for mercury determination. The mercury levels in the urine from analytical results were compared with World Health Organization (WHO) standards. Analysis was performed for three weeks by Government chemistry Laboratory Authority at Lake Zone.

Data analysis
Descriptive statistics was done for demographic characteristics of the participants, menstrual disorders among the women who were exposed to mercury and non-exposed to mercury the data presented in tables. The difference in mean of mercury level between two groups were determine using Mann Whitney U test. Multivariate logistic regression and bivariate analysis using chi square test were used to find the association between mercury exposure and menstrual disorders; P value equal to 0.05 or less (P<0.05) was considered statistically significant to show the association between exposure to mercury and menstrual disorders among the women in ASGM. The prevalence odds ratio (OR) which was used to measure the association between mercury exposure and menstrual disorders.

Ethical considerations
Ethical clearance was provided by the Muhimbili University of Health and Allied Sciences Ethical Committee, issued on 30th May 2019. Permission to conduct the study at the field was requested and provided by the Nyang'hwale district medical officer. Written informed consents were obtained from the participants after being informed on the operation and application of the study findings. Confidentiality of the respondents was ensured at all stages of the study.

Results

Social demographic characteristics of the study participants
The study had 269 respondents who were in the age group between 18 – 44 years with mean age of 34 (SD=7.476) whereby the mean age of the exposed group was 35 (SD=7.868) and non-exposed group 31 (SD=6.117). The overall mean body weight was 65.3(SD=12.6) kg, for the exposed and non-exposed were 63.3(SD=12.6) and 65.2 (SD=12.7) kg, respectively. According to occupation, (63%) of the women working in artisanal and small scale mining as exposed group and (37%) were primary school teachers as non-exposed group, these groups were very energetic and productive. With regard to marital status (56%) of non-exposed group were married and the difference was statistical significance. Regard to education level, the majority of exposed group had no education by (54%) followed by (42%) who had primary education level, whereby (100%) of primary school teachers had a tertiary education level (Table 1).

Table 1: Socio-demographic characteristics of women working as ASGM and Primary School Teachers in Nyang'hwale District (N= 269)

Variable		No. (%) Overall	No. (%) Exposed	No. (%) No-exposed	P-value
Age (years	Mean	34.6	35	31.4	
Weight (kg)	Mean	65.3	65.3	65.2	
Marital status	Single	70 (26.0)	39 (22.9)	31 (31.3)	
	Married	105 (39.0)	50 (29.4)	6 (6.1)	
	Co-habit	27 (10.0)	21 (12.4)	6 (6.1)	
	Divorced	45 (16.7)	42 (24.7)	3 (3.0)	
	Widow	22 (8.2)	18 (10.6)	4 (4.0)	0.0001
Education	None	92 (34.2)	92 (54.1)	0	
	Primary	72 (26.8)	72 (54.1)	0	
	Secondary	6 (2.2)	6 (42.4)	0	
	Tertiary	99 (36.8)	0 (0)	99 (100)	0.0001
Occupation	Exposed	170 (63.2)	170 (100)	0 (0)	
	Non-exposed	99 (36.8)	0 (0)	0 (0)	

Occupational exposure to mercury

Table 2: Occupational exposure to mercury among the women in ASGM and non-exposed group (Primary school teachers) in Nyang'hwale District

Variables	Variable categories	Frequency	%
Work category	Amalgamation	160	59.5
	Heating gold ores	10	3.7
	Teaching	99	36.8
Not used PPE	Miners	170	63.2
Storage of Mercury	Special room	22	8.2
	Inside the house	88	32.7
	Others place	4	1.5
	Don't know	56	20.8
Disposal of empty containers	Damp site	2	0.7
	Burning around the mining site	140	52.0
	Disposal haphazardly	28	10.4

The proportion of menstrual disorders among women

Table 3: The menstrual disorders among the women in artisanal and small scale gold mining and women teaching primary schools in Nyang'hwale District

	Exposed (N=170)		Non exposed N=99		
Variables	Frequency	%	Frequency	%	P -Value
Amenorrhea	61	35.9	21	21.2	0.01
Oligomenorrhea	47	27.6	1	1	0.0001
Polymenorrhea	24	14.1	7	7.1	0.05
Dysmenorrhea	64	37.6	14	14.1	0.0001
Menorrhagia	52	30.6	14	14.1	0.003
Bleeding spot before and after the menstrual period	31	18.2	20	20.2	0.75
Blood spot after sexual intercourse	15	8.8	7	7.1	0.65

Slight Bleeding	3	1.8	0	0	0.001
Prolonged duration	32	18.8	7	7.1	0.001
Hypomenorrhea	15	8.8	2	2.0	0.001

Exception for bleeding spotting before and after menstrual period or after sexual intercourse, proportion of women with menstrual disorders was found to be statistically significant higher in exposed group as compared to non-exposed group. (Table 3).

Mercury level in urine

Table 4.: Urine Mercury levels (ug/L) in selected participants N=21

		Mean (SD)	N	Mean Rank	Sum of Rank	P-value
All Participants occupation		30.06 ug/l				
	Miners	41.33 ug/l	15	14	210.00	
	Non-miners	2.04ug/l	6	3.5	21.00	<0.001

Mann Whitney U Test for difference in means between two independent groups was used

Mean mercury level in urine of the participants was (30.06µg/L), and the range was 72.883ug/l to 0.247ug/l. The mean mercury level in urine for exposed group was statistically significantly higher (41.33ug/L) compared to non-exposed group (2.04 ug/L) and P = 0.0001.

Table 5: Distribution of mercury level in urine measurements in comparison to WHO standards

Levels (µg/L)	Mercury level in Urine (µg/L) Exposed N = 15		Mercury level in Urine (µg/L) non-exposed N =6		Status WHO standards
	Frequency	Percentage	Frequency	Percentage	
Less than 5ug/l	0	0	5	83.3	Normal
5- 19 ug/l	3	20	1	16.7	Alert level
20 – 49ug/l	6	40	0	0	Action level
Greater than 50ug/l	6	40	0	0	Maximum Acceptable level

About (40%) of the miners group had mercury level above the maximum acceptable level and (40%) of them were at action level who were tested for mercury levels in urine, exceed the maximum acceptable level provided by WHO as shown in Table 5 above. Amongst the non-exposed group who tested for mercury levels in urine, (83%) were at normal level (less than 5ug/l) (Table 5).

Association between mercury exposure and menstrual disorders

Table 6: Association between mercury exposure and menstrual disorders among women working in ASGM in Nyang'hwale Geita

Variables	Exposed (N=170)		Non-exposed N=99		P -Value	OR	95% CI
	Frequency	**%**	**Frequency**	**%**	**P -Value**	**OR**	**95% CI**
Amenorrhea	61	35.9	21	21.2	0.01	1.7	1.101 - 2.599
Dysmenorrhea	64	37.6	14	14.1	0.0001	2.7	1.579 – 4.489
Menorrhagia	52	30.6	14	14.1	0.003	2.2	1.266 -3.695
Polymenorrhea	24	14.1	7	7.1	0.005	2.0	0.893-4.464

Chi-square test (x^2); P< 0.05; OR is odds ratio, and 95% CI is 95% confidence interval

The menstrual disorders were more likely among the women who were in exposed group compared to non-exposed group; and there was statistically significant association between mercury exposure and menstrual disorder; for example, dysmenorrhea was more likely among women exposed to mercury (OR 2.7; 95% CI 1.579 – 4.489 of and P= 0.0001) (Table 6).

The result from binary logistic regression shows that mercury level in urine was the most predictor for menstrual disorders after adjusted with other predictors as shown in table 7. The results indicate that the increase in mercury exposure there is an increase the probability of menstrual disorders problem. This mean that mercury in urine is statistically significant associated with menstrual disorders compared to other predictors (OR 4.787; 95% CI 1.213-25.106 and P = 0.05) (Table 7).

Table 7: Logistic regression shows the association between mercury level in urine and menstrual disorders among women working in ASGM in Nyang'hwale District

Variables	β	SE	Wald	P value	OR (CI of 95%)
Menstrual disorders					
Uses of family planning	-0.751	1.504	0.249	0.6	0.472(0.025 -9.000)
Body physical exercise	-3.905	2.441	2.560	0.1	0.020(0.000 -2.408)
Exposed to pesticide	-0.399	1.819	0.048	0.8	0.671(.019 -23.700)
BW decreases	-0.576	2.067	0.078	0.8	0.562(.01 -32.310)
BW increases	0.397	1.871	0.045	0.8	1.487(.038-58.241)
Hg level urine	1.566	.845	3.431	0.05	4.787(1.213-25.106)

OR= odds ratio; CI=confidence interval

Discussion

This study demonstrates that the proportion of menstrual disorders among the exposed group who were exposed to mercury was statistically significant compared to non-exposed group. These findings were consistent to the studies on mercury exposure and menstrual disorders in China, Italy and Colombia, which show that women who were exposed to mercury have the higher prevalence of menstrual disorders 17%, 47%, and 59% respectively (8,12,13). However, the proportion of menstrual disorders in this study was found to be slightly higher than those in Colombia. These could be contributed by following factors; longer working hours per day, longer working duration, all of which may result to increase mercury dose intake. Due to most of exposed group were not using personal protective equipment to protect themselves from direct exposure to mercury and last improper storage and disposal of empty mercury containers were

stored inside the living house, and about half of the empty containers of mercury were burned around the mining area thus may lead to increase the concentration of mercury exposure. These factors might have contributed to the increase dose response relationship toward the menstrual disorders among the exposed group.

In this study the menstrual disorders were found to be statistically significant higher in exposed group as compared to non-exposed except for bleeding spot before and after the menstrual period and blood spot after sexual intercourse was found not statistically significant different between the exposed group and to the non-exposed group. The proportion of dysmenorrhea was found to be statistically significantly higher among the exposed group than to the non-exposed group as compared to other menstrual disorders. This findings was consistent to the study conducted in China among the women working in lump factory and exposed to metallic mercury also found the prevalence of dysmenorrhea to be higher in exposed group than that in the non-exposed group compared to other menstrual disorders (12). Also the higher proportion of Polymenorrhea and oligomenorrhea were found statistically significant higher among exposed group compared to non-exposed group in the study conducted in Italy among women worked in lamp factory (8). The mercury vapour which is normally produced in any industrial process it was found to have effect in reproductive hormones which may result to menstrual disorders and other reproductive outcome in women working with elemental mercury. Also according to the study conducted in Colombia among the women in artisanal gold mining; the findings shows that the exposure to elemental mercury during the process of gold mining has an association with a higher prevalence of menstrual cycle irregularity (13). The findings also was supported by the experimental study of all chemical forms of Hg administered to animals has shown that the result in disturbances in menstrual cycle and inhibition of ovulation (29). The study conducted on occupational exposure to mercury in female dentist in United State of America also found the evidence that mercury accumulates in the brain, pituitary, and thyroid, that it disrupts ovulation in animals, and that women exposed to mercury tend to experience abnormal menstrual cycles (10). The results generalized that women who are exposed to mercury have higher risk of reporting the problem of menstrual disorders compared to non-exposed women.

Amenorrhea, dysmenorrhea and menorrhagia were found statistically significantly higher among the exposed group compared to non-exposed group. This result is supported by the study conducted in China among the females exposed to mercury vapour found the prevalence of dysmenorrhea was significantly higher than that to the control group. The prevalence of an abnormal menstrual cycle, abnormal duration of menstrual bleeding, and abnormal of menstrual bleeding in the exposed group was higher than that in the control group (12). The menstrual disorders like dysmenorrhea was found to be statistically significant higher to mercury exposure, hence from the result, there is an association between exposure to mercury and the menstrual disorders. This result also was supported by the study conducted in China among the females exposed to mercury vapour found that Dysmenorrhea may be a useful biomarker for assessing female exposure to mercury occupationally (12). The findings shows that the mean mercury level in the urine (was lower than that found in the study conducted in Handeni and Chunya respectively (20,21). It can be explained that the mean of mercury level in the urine were

found from the lower level among the non-exposed group and the highest level was among the exposed group. This may be due to the difference in frequency of mercury used in the amalgamation process because women in mining area were not involved in amalgamation process as their daily activity.

Despite the fact that, mercury use in this study area is low, there were women who were found with mercury levels exceeding the allowable levels. In this study we found that the maximum urinary mercury level of 72.88µg/L to a woman who was 44 years old used to store the mercury at home and involved in the amalgamation process for 5 years. While comparing to the study conducted in Handeni (21), the exposed miners with maximum urinary mercury levels (74.7µg/L) who had worked in extraction, amalgamation process and burning amalgam for 7 years. The exposed group in this study was found with the urine mercury levels above (World Health Organization) WHO maximum allowable levels 40% of the urine samples tested by CVAAS exceeded WHO standard; and 40% of tested sample were found to the action level (Table 4.4.1). This results is slightly similar to the study conducted in Handeni Tanga found 47.6% of the urine samples tested by CVAAS exceeded WHO standard (21). The mean of mercury level in exposed group was statistically significant difference from the non-exposed group. This results is consistence to the study conducted in Chunya which found the Urinary mercury concentrations for exposed group were higher than the referent group (17).

The result from binary logistic regression shows that mercury level in urine was the most predictor for menstrual disorders compared to the other predictors like the uses of modern family planning, body physical exercise, post exposure to pesticide, body weight increased and body weight decreased. When β value (coefficient value) is positive, OR>1 this indicates that the increase of mercury exposure is an increase for the probability of reporting menstrual disorders problem among women working in artisanal and small scale gold mining. This means that mercury in urine is statistically significant associated with menstrual disorders. This finding was consistence to the study conducted in China among the females exposed to mercury vapour also observed a trend of increase prevalence of menstrual abnormality with the increase level of mercury exposure

This study has some limitations. Information bias, is one of the limitations due to the nature of the study the respondent were more likely to provide wrong information for different reasons like fear of disclosing the information. Lead to spending more time to explain clearly to them on the aims and benefits of the study. Hence it was easy for them to understand before a respondent was given the consent. Since the study was a cross sectional study design, it involved collection of information at a single point in time to assess the exposure and the outcome; it could not determine the causal-effect relationship between exposure to mercury and menstrual disorders.

Conclusion

The findings generalized that women who are exposed to occupational mercury have higher risk to report the problems of menstrual disorders compared women who are not exposed to occupational mercury. The cohort study should be conducted in order to establish the causal effect relationship between mercury exposure and menstrual

disorders, because there is still limited scientific information on mercury exposure and reproductive health effects in women occupationally exposed to mercury.

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Authors' contributions

SCK designed the study, conducted data collection, did data analysis and interpretation of findings, wrote and approved the manuscript. SM and JM provided technical inputs to improve designing the study, supported data analysis, read improved and approved the final manuscript write up.

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Patterns and causes of speech sounds disorder among patients attending speech and language therapy clinic at Muhimbili National Hospital, Tanzania

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Abstract

Background: Speech Sound Disorders (SSD) is a communication disorder in which a person has persistent difficulty saying words or sounds correctly, difficulties with perception, motor production and phonological representation of speech sounds and speech segments. This study aimed to determine the patterns and causes of speech sound disorders among patients attending speech and language therapy clinic at MNH.

Methods: A cross sectional descriptive study was conducted and included individuals attending at Muhimbili National Hospital in Tanzania. A structural questionnaire was used to collect data from patients who had SSD attending speech and language therapy clinic at MNH. Data entry and analysis handled using software, SPSS version 23, quantitative variables, analysed using median and percentages, result presented in frequency and cross tabulation tables and figures.

Results: This study recruited 114 participants with SSD among them males were 75 (65.8%) while females were 39 (34.2%) with M: F of 1.9:1. Most of the study population were in the age group of < 5 years 40 (35.1%), age range from 2-80 years with median age of 8.5 years. In this study 70 (61.4%) had functional SSD while 44 (38.5%) had organic type. Aphasia and dysarthria were common among males by 70.8% and 18% while dysphonia was common among females by 35%. Patients with more than 60 years (93.3%) were more affected by aphasia, followed by age group 5-17 years (66.7%) while dysarthria was predominant in the age group of <5 years. Dysphonia and aphasia equally occurred in the age group of 18-45 years by 50% each. Substitution was seen to affect more in the age group of <5 years by 38.2%. Traumatic brain injury (100%) and stroke (81.5%) were the major causes of Aphasia.

Conclusion: This study has brought to light the fact that speech sound disorders affect mostly school-aged children with male predominance. Types of speech sound disorders were functional and organic. Functional occurring more in children and the cause being idiopathic while organic was more common in adults with stroke and traumatic brain injury.

Background

Speech sound disorder is a communication disorder characterized by persistent difficulties in producing speech sound. It can be characterized by phonological problems

which involve difficulties in producing particular sound or difficulties with speech such as stuttering. Speech sound disorders can be organic or functional in nature (1–3). Organic Speech Sound Disorders include those resulting from motor or neurological disorders such as childhood apraxia of speech, dysarthria and structural abnormalities for example cleft lip/palate and sensory perceptual disorder such as hearing impairments. Functional speech sound disorders include those related to the motor production of speech sounds and those related to linguistic aspect of speech production. These disorders are referred as articulation and phonological disorders. Articulation disorder focus on errors e.g. distortions and substitutions in production of individual speech sounds. Phonological disorder is inability to produce sound normally e.g. fronting, stopping and final consonant deletion that affect more than one sound and influence of accent (4–8).

Motor speech disorders (MSDs) are a group of speech disorders resulting from deficits in the central or peripheral nervous system that involve the sensorimotor planning and programming of speech movement as well as those processes that execute, control and regulate that movement. Apraxia of speech (AOS) and dysarthria are the two major categories of MSDs. AOS is a neurologic speech disorder characterized by distorted substitutions, vowel and consonant distortions, distorted sound additions, syllable and word segregation and use of equal stress and voicing errors. It occurs most frequently as a result of stroke but is also seen as the initial sign of progressive neurologic disease, either in conjunction with progressive aphasia or as the only sign of the degenerative disease. Speech impairments especially aphasia are among the most serious cognitive deficits in post-stroke patients. Patients with aphasia have higher mortality and poorer long term functional recovery, resuming their previous occupational and other activities to a considerably lower extent than patients without speech disorders (9–14).

Speech sound disorders (SSD) are the most common paediatric communication disorders, affecting between 10% and 15% of pre-schoolers and 6% of school-aged children. The minority of SSD cases are attributable to a known cause, such as a cognitive impairment, sensorial-neural hearing loss, cleft lip and/or palate or cerebral palsy. For most children, the cause of their speech impairment is unknown. Children with SSD of unknown origin are typically diagnosed between 2 and 4 years of age and present with restricted speech sound systems without any apparent sensory, structural, neurological or psychological impairment. Moreover SSD of unknown origin can persist beyond the preschool years, placing some children at risk academically, socially and vocationally(20–23).

Causes of SSD depends on age of the patient. Acquired Motor SSD such as dysarthria and apraxia of speech reported as cause of SSD in Adults followed severe concussion or intracranial bleeding as well as brain stem and peripheral nerve damage. Dysarthria may occur more commonly than AOS and may be associated with traumatic brain injury while apraxia of speech may be associated with open head injury or following stroke(14). Patients with severe to profound sensorineural hearing loss (SNHL) have high rates of SSD. This may be suspected based on the pattern of the child's understanding and speech production. A child may present with non-developmental error pattern, initial consonant deletion or vowel substitution. Therefore, this study aimed to establish the

patterns of speech sound disorder and causes of organic speech sound disorder among patients attending Muhimbili National Hospital (MNH) in Dar es Salaam, Tanzania

Methods

Study design and data collection
This was a prospective descriptive cross –sectional study conducted for a period of 6 months from September 2019 to February 2020, at Muhimbili National Hospital in Speech and Language clinic in Otorhinolaryngology (ORL) department. This study included consented patients aged between 2 and 80 years who had SSDs. Structured questionnaire was used to collect data from all patients who met inclusion criteria Patients who were found with SSDs were evaluated for types and causes. Independent variables comprised of age, sex and causes of organic speech sound disorders. The causes of organic speech sound disorders that were assessed in this study included, traumatic brain injury, severe to profound hearing loss, stroke and cleft lip/palate. Dependent variables were types of speech sound disorders. Confounding variables were age and sex of a patient with speech sound disorders.

Data analysis
This was done using SPSS software version 23 and data was managed electronically in computerized software program. Result are presented in frequency, cross tabulation and figures. The relationship between the independent variable and the dependent variable was established using Chi-square test of association. Any variable with p-value less than or equal to 0.05 was considered to be statistically significant.

Ethical considerations
This study was approved by the Research and Publication Committee of the Muhimbili University of Health and Allied Sciences (MUHAS). Participants were provided with an informed consent and then asked to provide written consent to participate in the study. A written informed consent for children participation in the study was obtained from parents /care takers before enrolment.

Results

Age and sex distribution of patients with speech sound disorders
A total of 114 patients with SSD were recruited, 75(65.8%) were males while females were 39(34.2%) with M: F of 1.9:1. Most (35.1%; n=40) of the study population were in the age group of <5 years. Their ages range was 2-80 years with median age of 8.5 years (Table 1).

Table 1: Age and Sex distribution of patients with SSD N=114

Age group	Sex N (%)		Total	
	Male	Female		
<5	25 (33.3)	15 (38.5)	40	(35.1)
5-17	25 (33.3)	6 (15.4)	31	(27.1)
18-45	2 (2.7)	5 (12.8)	7	(6.1)
46-60	11 (14.7)	8 (20.5)	19	(16.7)
>60	12 (16)	5 (12.8)	17	(14.9)
Total	75 (65.8)	39 (34.2)	114	(100)

Distribution of types of speech sound disorders
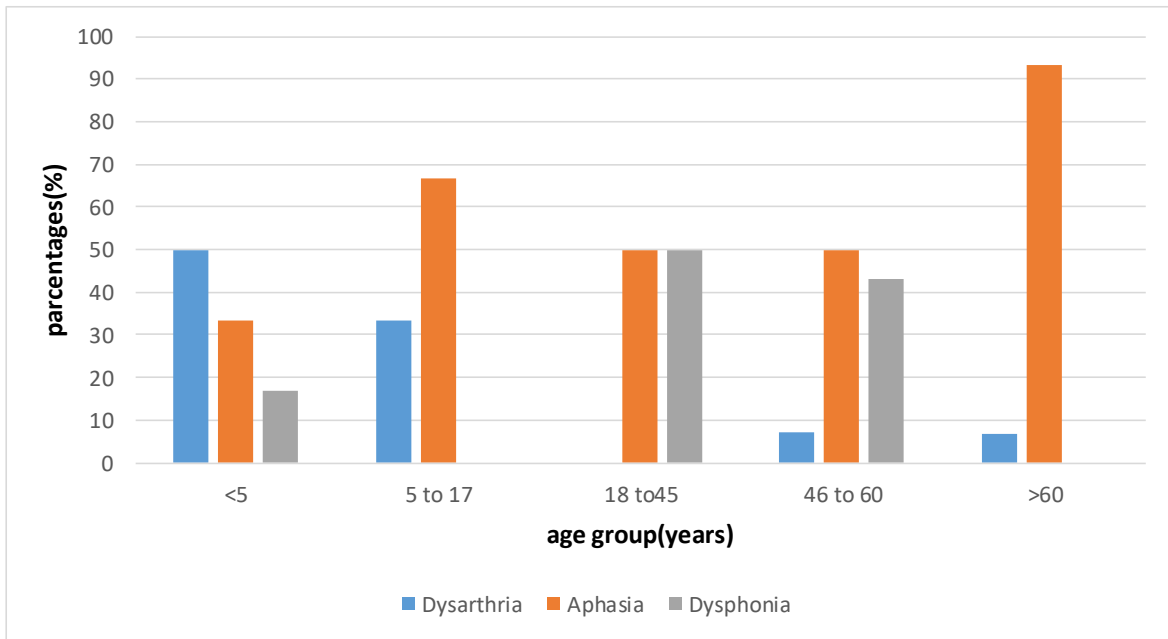Among 114 patients with SSD, majority had functional type 70(61.4%) (Figure 1).

Figure 1: Distribution of organic speech sound disorders by age

Distribution of organic SSD by age and sex
Patients with more than 60 years of age were more affected by aphasia (93.3%) followed by age group 5-17 years (66.7%). Dysarthria was predominant in age group of less than 5 years, dysphonia and aphasia equally occurred (50% each) in the age group of 18-45 years. In the age group 46 to 60 years aphasia was 50% while dysphonia was 42.9% with the p value of 0.01 which was statically significant. Aphasia and dysarthria were common in males, 70.8% and 18% respectively while dysphonia was common in females, 35% .This difference was not statistically significant (p=0.2).
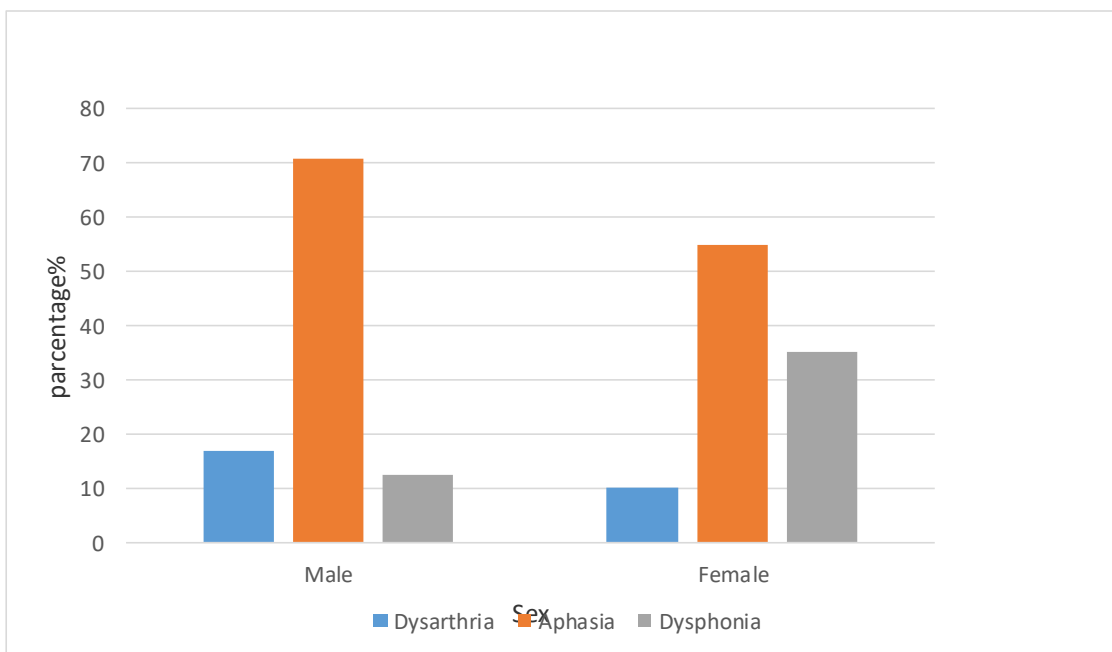

Figure 2: Distribution of organic speech sound disorder by sex

Distribution of functional Speech Sound Disorder by age

Substitution (38.2%) and distortion (17.6%) were commonly seen among the under five children which was statistically significant for substitution but not distortion. Repetition and addition were significantly predominant in patients who were 5 years and above (p< 0.05).

Table 2: Distribution of functional speech sound disorder by age (N=70)

| Type of SSD | Age group (years) | | | | | P value |
	<5 (N=34)	5-17 (N=28)	18-45 (N=1)	46-60 (N=5)	>60 (N=2)	
Substitution	13 (38.2)	2 (7.1)	0	1 (20)	0	0.05
Distortion	6(17.6)	4 (14.3)	0	0	0	0.80
Repetition	14 (41.2)	16 (57.1)	1 (100)	0	2(100)	0.05
Addition	3 (8.8)	2 (7.1)	0	1 (20)	0	0.88
Omission	8 (23.5)	7 (25)	0	0	0	0.64

Distribution of functional SSD by sex

Females were more affected with functional SSD which were distortion (15.8%), substitution (21.3%), omission (26.3) and repetition (47.4) (Table 3). However, additional (9.8%) disorder was observed more in males than females, though not statistically significant.

Table 3: Distribution of functional SSD by sex (N=70)

| Type of SSD | Sex | | P value |
	Male (N=51)	Female (N= 19)	
Distortion	7(13.7)	3(15.8)	0.82
Substitution	11(21.6)	5(26.3)	0.67
Omission	10(19.6)	5(26.3)	0.54
Addition	5(9.8)	1(5.3)	0.55
Repetition	24(47.1)	9(47.4)	0.98

Causes of organic speech sound disorders

Traumatic brain injury (100%) and stroke (81.5%) were seen as dominant causes of aphasia which was statistically significant in stroke (p value 0.00) but not in traumatic brain injury.
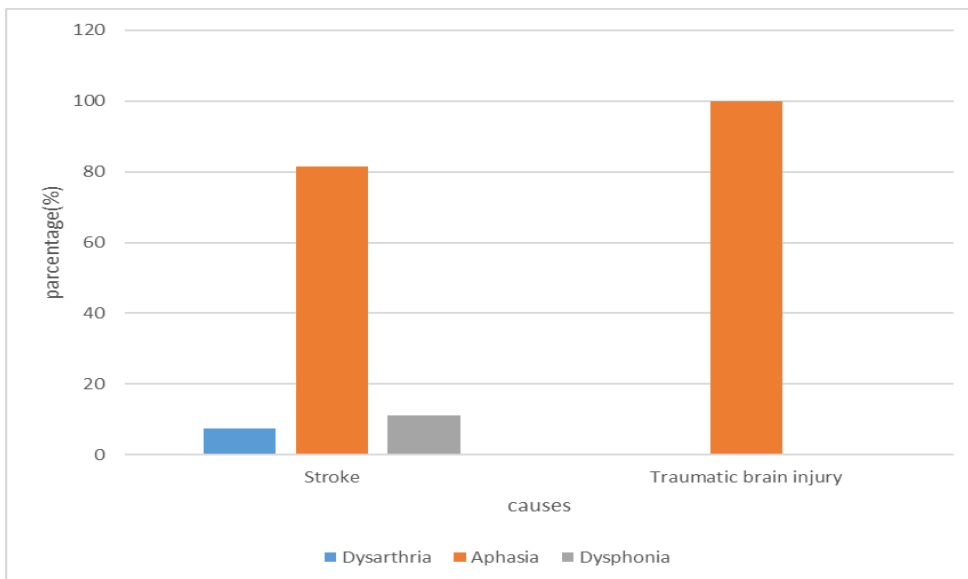
Figure 3: Causes of organic speech sound disorders

Discussion

Speech sound disorders is reported to be common in early childhood. The term speech sound disorder consists of both articulation (motor-based production deficits) and phonological deficits. SSD may be associated with poor literacy acquisition and reading mastery resulting in significant implications for school readiness and academic achievements. Pre-schoolers with SSDs have clinically significant impairments in the production of speech sound of the ambient language. Although many of these speech sound errors resolve after several years (with or sometimes without intervention), age-appropriate speech sound production is not always achieved.

In this study, males were more affected than females. Similar findings have been reported in studies elsewhere (33-35). Most of the study population were in the age group of <5 years. This is similar to the findings of studies elsewhere. The reasons why SSD occur more in young age group it can be idiopathic but can be explained by family history of SSD ,hearing impairment ,bilingualism in home (11,27, 33, 35-37).

Among 114 study participants majority had functional SSD and organic type where by functional type was commonly seen in young age group compared to organic which was seen in adult age group. Functional SSD consisted of two types with their subtypes which were articulation (substitution, distortion and omission) and phonological disorder (addition and repetition/stammering). In Articulation disorder, the study revealed that substitution and distortion were commonly seen in preschool <5 years of age while omission was common among 5-17 years. These findings are similar to the study done in university of the United Kingdom which showed that articulation disorder was 17.6% in school going children between age of 8 years to 12 years where by substitution was common seen while study done in Cameroon showed articulation disorder accounting 3.6% in 14.7% patients with SSD. In this study additional (phonological) disorder was seen to be dominant in males while other types such as substitution, repetition, omission and distortion were seen to occur mostly in females. In the contrary, a study Australia

showed that at the age of 4 years SSD was estimated to be 3.4% with phonological disorder affecting 13% of children with male predominance, the difference could be due to different study population (34,38,37).

Organic SSD was observed in over one-third of the study population. Aphasia and dysarthria were common in males while dysphonia was common in females. Patients older than 60 years of age were more affected with aphasia than their counterparts. Similar findings have been reported from elsewhere. Some studies suggest that the differences may exist depending on type of Aphasia while in this study we didn't look on types of Aphasia (13,14,16,39). In this study dysarthria was dominant in age group of less than 5 years while dysphonia and aphasia equally occurred in the age group of 18-45 years.

Among 44 patients with organic SSD two-thirds had the cause of SSD while in functional SSD cause was idiopathic. Traumatic brain injury and stroke were seen as dominant causes of aphasia. These findings are similar to the study done in Korea to elucidate the impact of co-occurring dysarthria and aphasia on functional recovery in post-stroke patients which revealed dysarthria. Also a study done in India to determine speech disorder at tertiary care hospital, whereby patients with acute brain damage due to traumatic brain injury, cerebrovascular accident and postoperative cases of brain tumours were selected , acute brain damage due to various causes manifest with speech abnormality, especially when the left cerebral hemisphere was involved (12,13,16,17,19,40).

Conclusions

This study has brought to light the fact that speech sound disorder is a problem in Tanzania and school age children are the most affected ones where in adults, it is seen to be common in stroke patients who presented with aphasia. The overall SSD was seen more in males compared to females. Functional speech sound disorder was 61.4% which was seen more in children and the cause was idiopathic while organic speech sound disorder was occurred mostly in adult with stroke and traumatic brain injury.

Acknowledgements

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Outpatient malaria cases trends and burden in Morogoro Region, eastern Tanzania, 2020

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Abstract

Background: Morogoro region is classified as a moderate malaria burden region with malaria prevalence of 9.5% far from attaining elimination stage (prevalence < 1%) as per Tanzania National Strategic Plan 2015 – 2020. This study was carried out to determine monthly trends of outpatient (OPD) malaria cases to provide a good understanding of the disease in Morogoro Region of Tanzania.

Methods: Malaria case data was extracted from the District Health Information System 2 (DHIS2) and analysed.

Results: A noticieable decrease in OPD malaria cases was seen from May to September, 2020 compared to same period in the previous two years. Seasonality was seen in OPD malaria cases in all districts of the region with the peak in January, 2020, except for Malinyi (February, 2020). Irregularities were seen to the reported OPD malaria cases monthly trends from some selected faith-based organization and private health facilities. Morogoro Rural and Kilosa districts had the highest malaria cases contributing to 50% of all cases in the region.

Conclusion: Malaria is still a public health problem in the region needing focused, evidence based interventions. A closer follow up, feedbacks and mentorship on data quality and data use to councils/health facilities is necessary in order to have informative public health actions. Seasonality on malaria burden was seen in the region which might guide seasonal strengthening of malaria interventions.

Background

Morogoro region is situated in the eastern part of Tanzania with 70,600 square kilometres and a population of 2,662,468 (NBS, 2020). The region remains a moderate malaria burden region in Tanzania with the malaria prevalence of 9.5% 6 – 59 months children higher than the National prevalence (7.3%) (NBS, 2017). Available statistics from the District Health Information System 2 (DHIS2) indicate stabilization of malaria cases during the period of 2015-2019. This reflects that there has been no significant change in malaria burden in the past five years beside significant resources committed and spent by the region for case management, preventive services (Hellewell *et al.*, 2018; Kitojo *et al.*, 2019). In the fight against malaria beside the current mentioned services, Social and Behavioural Change Communication, integrated vector control, monitoring/evaluation and research are considered as important interventions to fight against malaria.

In March, 2020 Morogoro Region Health Management Team (RHMT) realized the gap that there was insignificant malaria burden reduction in the region during the past five years. The region is far from achieving the elimination strategy the goal of the Tanzania

National Strategic Plan 2015 - 2020 which required the region to have malaria prevalence of less than 1% by the end of 2020 (Tanzania, 2014). The region planned to change the approach in dealing with malaria disease so as to find ways to secure resources for other malaria interventional activities. A key means to achieve this was to start with monthly/quarterly/annual malaria data dissemination to different levels and to different stakeholders in the region and outside the region so as to propose for evidence-based solutions which might secure resources to cover other interventions. Besides, the region also strengthened the existing interventions so that to have focused resources utilization to have improved malaria service and data quality.

The objective of this study was to determine the monthly trends and burden of malaria cases for Morogoro Region. Specifically, to: (i) determine the monthly trends of OPD malaria cases for Morogoro Region for October 2017 – September 2020 and by district council for October 2019 – September 2020; (ii) determine the monthly trends of OPD malaria cases for selected health facilities in Morogoro Region; and (iii) determine the OPD malaria burden by council and HFs in the same period

Methods

District Health Information System 2 (DHIS2) data abstraction, analysis and interpretation was carried out. The Morogoro RHMT files and records were reviewed.

Results and Discussion

Monthly trends of OPD malaria cases from DHIS2
From October 2019 to September 2020, 379,035 cases of outpatient confirmed malaria cases were reported (Figures 1 and 2).
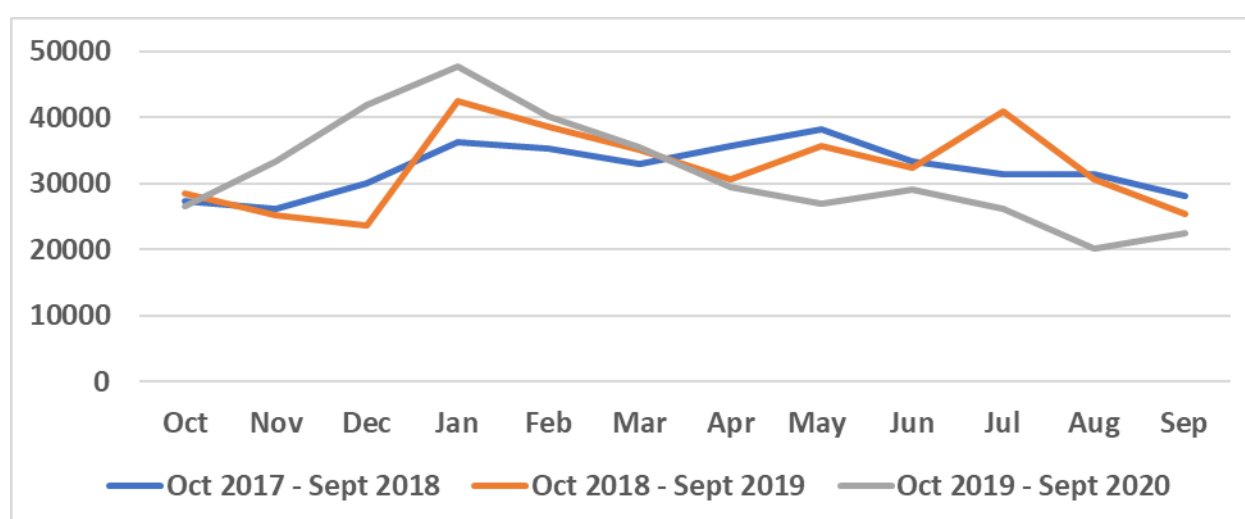

Figure 1: OPD Monthly malaria cases trends in Morogoro Region, October 2017 – September 2020

A noticieable decrease in OPD malaria cases was seen from May to September, 2020 compared to same period/months in the previous two years. Seasonality was seen in OPD malaria cases in the region with the peak of cases in January.
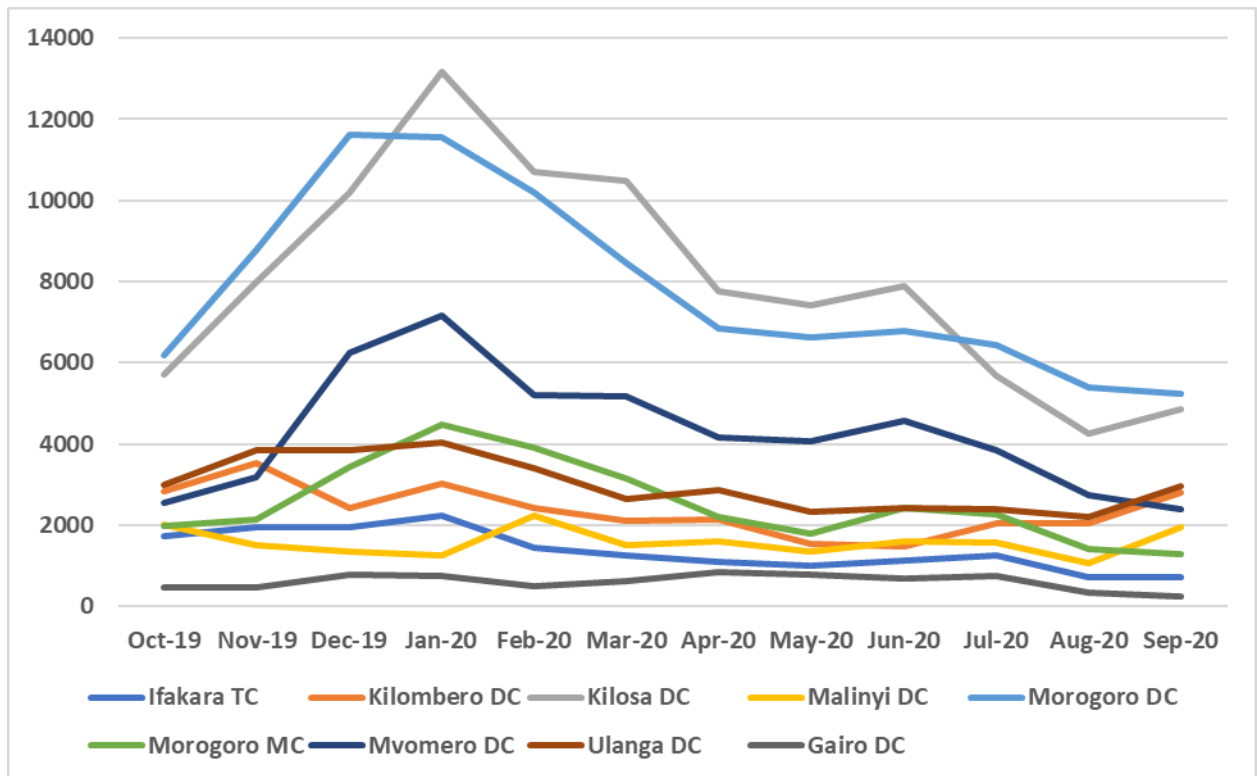
Figure 2: OPD monthly malaria cases trend by council, October 2019 – September 2020

A peak of OPD malaria cases was seen in January 2020 for all of the councils with the exception Malinyi DC whose peak was at February, 2020.
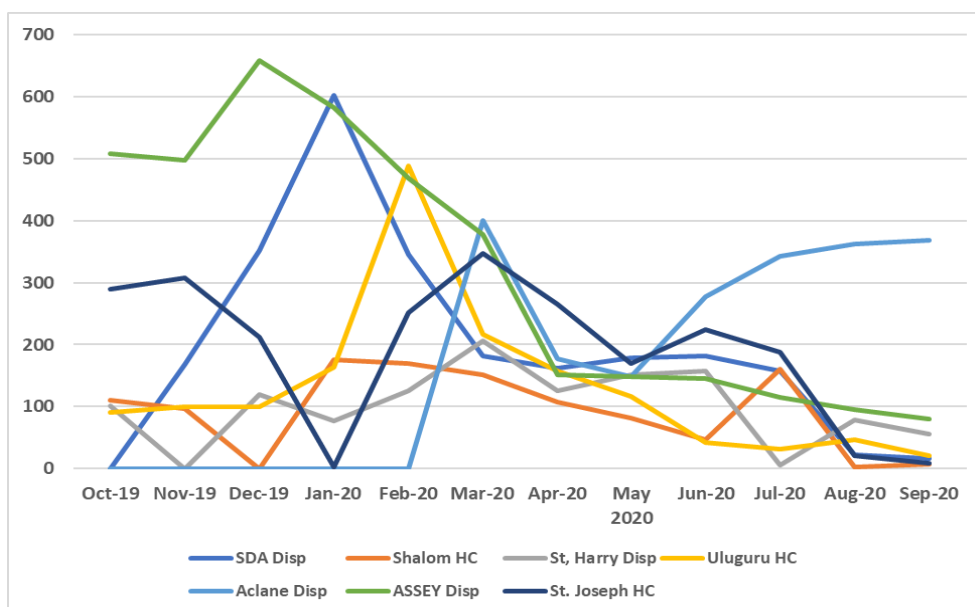
Monthly trends of OPD malaria cases for selected HFs

Figure 3: OPD monthly malaria cases trend by health facility, October 2019 – September 2020

Irregularities were seen to reported OPD malaria cases monthly trends from the selected health facilities mainly Faith Based Organizations (FBO) and private HFs. Some of the health facilities using malaria microscopy slides did not adhere to quality control procedures where the used slides were not stored and some were re-used.

OPD malaria burden by council and HFs, October 2019 – September 2020
In the region, 379,035 OPD malaria cases were reported and this was about 17% of the total OPD clients attendance. Some of the councils and health facilities contributed the highest OPD malaria cases burden (Figures 4 and 5).
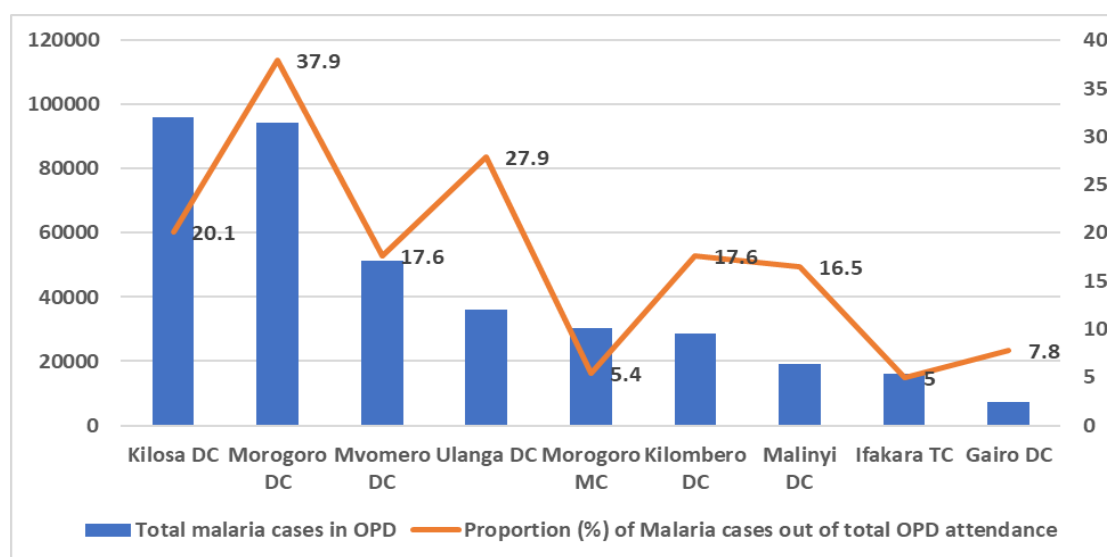
Figure 4: OPD malaria burden by council, October 2019 – September 2020

Morogoro DC and Kilosa DC had the highest number of OPD malaria cases and the two councils contributes about 50% of all cases in the region; Morogoro DC, Ulanga and Kilosa had the highest OPD malaria proportion 37.9%, 27.9% and 20.1% respectively out of total OPD attendance for October 2019 to September 2020. Gairo reported the lowest annual number (7,203) of OPD malaria cases; Ifakara and Morogoro MC had the lowest proportion of OPD cases out of total OPD attendance (5% and 5.4% respectively). The distribution of OPD malaria cases number and proportion out of total OPD attendance was also seen to be heterogenous across the health facilities and some of the healh facilities contributed a significant number and proportion of cases as seen from the graph below for the 20 health facilities.
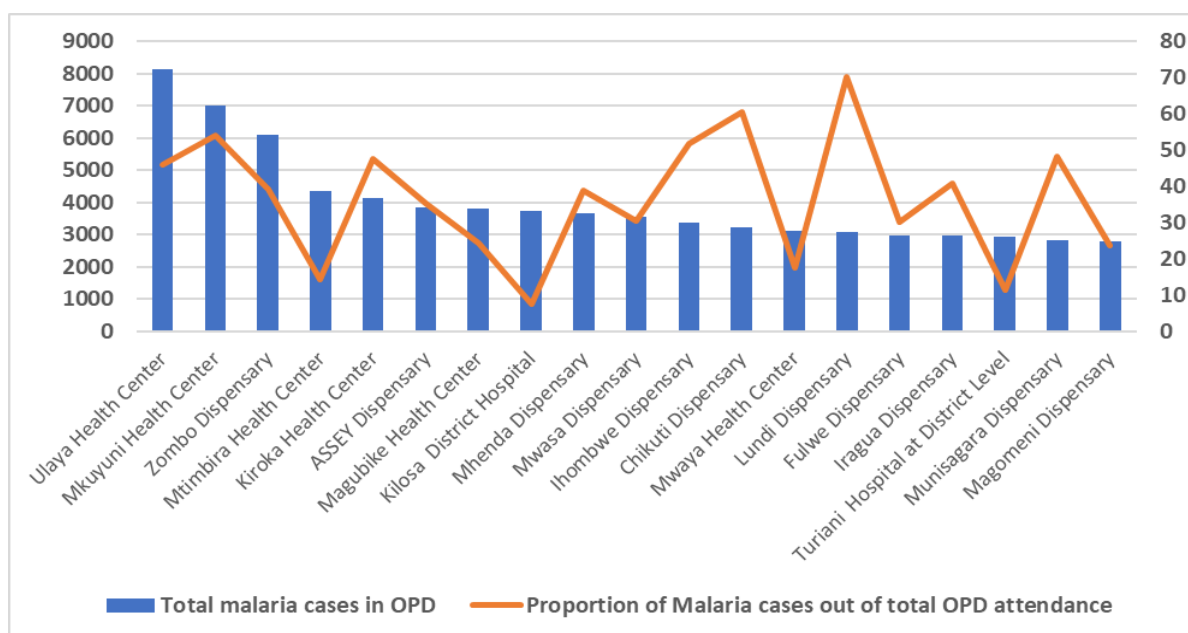
Figure 5: OPD Malaria burden by facility, October 2019 – September 2020

The 20 health facilities with the highest number of OPD malaria cases contributed about 20% of all the OPD reported malaria cases in the region for Oct 2019 to Sept 2020.

Conclusions

Malaria is still a public health problem in the region. A closer follow up, feedbacks and mentorship on data quality and data use to councils/health facilities is necessary in order to have informative public health actions. Seasonality on malaria OPD burden was seen in the region which might guide seasonal strengthening of malaria interventions including SBCC, vector control interventions and resources mobilization at all levels. Special strategies are needed to fasten malaria burden reduction in the region especially on high burden councils/health facilities and their surrounding communities. SBCC, integrated vector control, monitoring/evaluation and research are key tools to be used by the region/councils and other key stakeholders including regional Implementing Partners beside case management and malaria services quality check at regional, council and facility level in malaria burden reduction in the region. Nevertheless, data use, dissemination for all malaria indicators is needed and more studies including community level studies so as to produce more evidence and engage more stakeholders to reduce OPD malaria burden in the region.

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teams, health facilities in charges/health care workers and other leaders/experts at all levels who had played a big role to make the team have the above findings.

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Partnership and multi-sector engagement for outbreak responses: the relevance of one health approach in Tanzania

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Abstract

Background: Partnership between humans, animals, and environmental health professionals plus understanding the consequences of humans, animals and environment interactions on health is required for optimal health to be attained. This study was conducted to investigate the effectiveness of one health strategic plan towards facilitating partnership and multi-sector engagement (P&MSE) for outbreak responses in selected wards in Morogoro, Tanzania.

Methods: Data were collected in Morogoro region using a questionnaire from 1440 respondents obtained through multistage sampling procedure, 80 focus group discussion participants and 16 key informant interviewees. IBM-SPSS v.20 analysed quantitative data while qualitative data were organized into themes on specific objectives.

Results: Only 3.8% (CI:95%, 2.8 to 4.8) identified P&MSE in the study area, 30% (22.9 to 35.8) of the respondents indicated that the reported PMSEs to be effective in outbreak responses. The study further revealed that 32.3% (95% CI:30.3 to 35.3) had adequate OH knowledge. Only 5% (95% CI:4.0 to 6.1) were aware of OH approach (OHA) related practices and 2.5% (CI 95%, CI:1.7 to 3.4). Despite the efforts in the OH Strategic Plan to promote OHA, little has been observed on P&MSE for outbreak responses. Though both low awareness and insignificant PMSE have been observed, 39.2% confirmed the relevance of OHA towards PMSE.

Conclusion: Schools, hospitals and non-governmental organizations were identified to facilitate P&MSE for outbreak responses. This indicates that efforts established through the plan have not significantly reflected at the community level. This study recommends strengthening efforts towards the execution of OH Strategic Plan focusing on creation of effective P&MSE for outbreak responses.

Keywords: One health, partnership, community, outbreak response, Tanzania

Background

Quality population is a parameter for economic development (URT, 2007a; URT, 2007b). *Inter alia,* health determines the quality of a population (URT, 2003b; URT, 2007a; Lutz, 2014; Muhanga, 2019a). Evidently, partnership and multi sector engagement (P&MSE) between humans, animals, and environmental health professionals stand as a necessary attribute towards attaining optimal health for humans, animals, and environmental health. Together with this, there is an obvious need for community members to understand the consequences of humans, animals and environment interactions on health. To that effect, then, the need for multi-disciplinary approaches to effectively

manage these risks requires stronger partnerships at the community level and government engagement.

In realization of this, among others, the government in Tanzania has put numerous initiatives to in improvising delivery of health services and educating people to become health literate. Despite these efforts, there has been notable health impairing behaviours (HIBs) (URT, 2007a; URT, 2007b), some resulting in zoonotic diseases (Cleaveland et al., 2002; Minja, 2002), and varying preferences among Tanzanians in terms of health-seeking sources (McCombie, 2002; URT, 2003b; Muhanga and Mapoma, 2019; Muhanga, 2020).

Several cases of interaction between humans and animals which have been resulting into diseases which are reported and some undetected, unreported and underreported (Kambarage et al, 2003). Scholz et al., (2008), among other factors, partly attribute the undetected, underreported and unreported cases /incidences to low awareness. Low awareness by itself indicates apart from other factors lack of information on the interaction between animals and humans and how such interactions impact on health amongst the community members. The need for valid, timely and complete health and related information is an important aspect towards public health surveillance and early detection of outbreaks (Vandersmissen & Welburn, 2012).

Lack of a holistic systems approach towards understanding certain health aspects cutting across various species, failure to recognize that there is extricable link between human, environment and animal health (Schwabe, 1984; Rweyemamu et al., 2012) are reported to have a proportionate influence to the incidences. Absence of working cooperation between physicians and veterinarians (Rweyemamu et al., 2013) is reported among others to have its contribution on the same. Karimuribo et al., (2007) also report on the incidences of human brucellosis in northern Tanzania. The study has been concerned with the need for public health information awareness creation to arrest the situation, among others, the study recommended for an exigent need to establish programs on public health education, together with enhancement of capacities on diseases diagnostic. It is obvious that there is a gap on awareness on human and animals' interaction plus its consequences and lack of public health education together with limited working cooperation between physicians and veterinarians. These are aspects of P&MSE. There is an obvious indication that despite the efforts there are challenges towards attainment of good health (Ratzan and Parker, 2000; Byrne, 2004; Mamdani and Bangser, 2004; Kaseje, 2006; Sanders and Chopra, 2006; Kaale and Muhanga, 2017; Muhanga and Malungo, 2018, 2019; Muhanga, 2019b).

Undeniably, health-related challenges that require One Health approach (OHA) to manage have grown in frequency, dynamics and manifestation globally. This has then necessitated the need for strengthened efforts to address emerging and re-emerging zoonotic diseases. The need for multi-disciplinary approaches to effectively manage these risks requires stronger partnerships at the community level and government engagement (Kambarage et al., 2003). To optimize full advantage of OHA, definitely, higher level of consultation and support from numerous sectors and various industries which have significant input in governing health, which has to include inputs from the environment sector is emphasized. Cognizant of this, the Government in Tanzania

introduced One Health Strategic Plan (2015–2020), while this plan outlines very well operations and activities amongst diverse stakeholders. It also emphasizes close collaboration between the sectors towards preventing and controlling diseases of zoonotic nature. The plan further intends to guarantee the presence of appropriate preparedness, consistent and coordinated response in case of a zoonotic event (URT-PMO, 2015). Muhanga *et al.*, (2019) have reported how this plan has facilitated the enhancement of knowledge, awareness, attitudes, and practices (KAPs) under OHA insignificantly. One Health offers prospects for institutions and individuals to work across sectors and networks, hence creation of PMSE, resulting into stronger systems at national level for addressing emerging diseases also regional bonds. OH Strategic Plan (2015–2020) has been expected to facilitate this.

However, little is empirically known on how effective this plan has been towards facilitating partnership and multi-sector engagement (P&MSE) for outbreak responses in Tanzania. Existing literature has scantly documented on related studies in Tanzania. There is no evidence in the literature on having community engagement and partnerships towards effectively managing these risks researched and documented adequately in Tanzania. It is against this background that this study investigated on the effectiveness of OH Strategic plan towards facilitating P&MSE for outbreak responses in selected wards in Morogoro, Tanzania.

Definitely, the core causes of poor health and well-being will not significantly be dealt without focusing on their basic determinants. For sure, most of the identified determinants have been observed to cut across sectors beyond the health sector, in the view of that, to address them necessitates close working and partnerships with various sectors. Intersectoral and multisectoral action remains vital towards dealing with plenty of today's persistent challenges, generally on well-being and health. This study reflects on the Health 2020 Policy Framework which underlines the significance of intersectoral and multisectoral action, focusing on the whole-of-government and whole-of-society approaches, in tackling challenges on health (WHO, 2013; WHO, 2018).

Methods

Both qualitative and quantitative data were collected in Morogoro municipality and Mvomero districts in Morogoro, Tanzania, through a study which was cross-sectional in design. The area where this study was conducted is reported by Tanzania-NBS (2013) to be inhabited by 315,866 (Morogoro municipality) and 312,109 (Mvomero district) people respectively. A structured questionnaire guide using a Computer Assisted Personal Interviewing (CAPI) electronic platform was employed to collect data. The population for the study included all households with livestock species at Mvomero district plus the medical, veterinary and environmental Officers. In Morogoro district, the population included all the households and medical, veterinary and environmental officers in the study area.

The multi-stage sampling procedure was used in selecting study units, involving four (4) stages (in choosing districts, wards, villages/streets, and HHs). Identification of the districts, wards and villages/streets for the study was made through purposive sampling,

whereas respondents from the study areas were selected using simple random sampling. The inclusion criteria for the wards at Mvomero were those wards that pastoralists were mostly residing, and for the households are those having animals being kept and selling of livestock products to Morogoro urban. Those wards which were included in the study from Morogoro were those from areas products from Mvomero districts were sold, these are the wards where meat (particularly *offal; utumbo* in *Kiswahili*) and milk vending by Maasai from Mvomero district has been taking place[1]. Four wards were purposely selected to participate in the study, two from each district after meeting the criterion. The selected wards were Doma and Melela wards in Mvomero districts also Mazimbu and Kihonda Maghorofani in Morogoro municipality. Thereafter two villages/streets were purposively selected from the four wards making a total of eight villages/streets. The reconnaissance visits identified these vendors mostly in Reli and Mazimbu Darajani streets in the Mazimbu ward also at Msamvu B and Maghorofani in Kihonda Maghorofani. Patton (2002: 230) posits that "The logic and power of purposeful sampling lies in selecting information-rich cases for study in-depth, which have the potential to yield insights and in-depth understanding rather than empirical generalizations. This form of participant selection focuses on selecting information-rich cases whose study will clarify the questions under study. "

In order to estimate size of the sample, a 95% confidence interval (CI), a margin of error of 5%, and a design effect of 1.5 were assumed. Since this study employed multistage sampling method then design effect was used. The statistical estimation method by Kelsey *et al.* (1996) was used to calculate a minimum adequate sample size. A total of 1440 respondents were obtained by employing the formulae:-

$s = X^2 NP (1- P) \div d^2 (N-1) + X^2 P (1- P)$.

Where:-
s = sample size required
X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).
N = size of the population
P = the proportion of the population (assumed to be .50 since this would provide the maximum sample size).
d = the degree of accuracy expressed as a proportion (0.05).

The sample size was calculated from the total population of each 2 purposive selected streets/ villages from a ward. After obtaining the total sample for each ward, the proportions of each street/village from the total sample was calculated. The sample size was then distributed in the identified study streets/ villages. In this study, the sample size allocated for each village/ street was considered adequate. Bailey (1994) and Field (2009) argue that where a statistical data analysis has to be conducted bare minimum of 30 respondents is the requirement, whatsoever the population size. In preparation of sampling frame for the study, the local leaders had to be involved. IBM-SPSS v20 was used for computing frequencies, percentages, mean and maximum scores.

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[1] These traders are popular in the area as *Wang'ombe* and *Baba Yeyo*

Results and Discussions

Socio-demographic profile of the respondents
The profile of the study participants is presented in Table 1. Results reveal that the highest group 29.2% (95% CI: 23.3% to 35.0%) were between 30 to 39 years and the lowest group which formed 3.8% (95% CI: 1.7% to 6.2%) had who were 70 years and above. The mean age was 43.7 years (95% CI: 42.1 to 45.3 years), and the highest age being 72 years and the lowest age reported at 21 years. It is indicated that 47.9% of the respondents were men (95% CI: 41.3% to 53.7%) and 52.1 % were women (95% CI: 46.3% to 58.8%). Slightly more than one-third (39.2%; 95% CI: 32.9% to 44.6%) had no formal education, and 30.0% (95% CI: 25.0% to 36.2%) completed primary school education. Of the interviewed respondents, the majority 57.5% (95% CI: 50.9% to 63.8%) of the respondents were married. The average household size was 5 (95% CI: 4.9% to 5.4%) members, a household with the lowest size (minimum) was found to have 1 member and a household with 10 members was the one with the highest size (maximum). About 62.9% of the interviewed households had 1 to 5 members.

Table 1: Socio-demographic profile of the study participants (n=1440)

Variables	Categories	Percentage
Age in Years	21-39	42.1
	40-49	26.3
	50-59	17.1
	60-69	10.7
	> 70	3.8
Level of Education	Not gone to school at all	39.2
	Universal adult education	2.5
	Primary school	30.0
	Secondary school	8.8
	Post-secondary /vocational	10.4
	University	9.2
Sex	Male	47.9
	Female	52.1
Marital Status	Never married/Single	30.4
	Married	57.5
	Separated	1.7
	Widow	5.4
	Widower	2.5
	Cohabitating	0.8
	Too young to marry	1.7
Household Size	1-3	21.7
	4-7	65.9
	> 8	12.4

Partnership and Multi-Sector Engagement for outbreak responses
This study identified and assessed partnership and multi-sector engagement (P&MSE) for outbreak responses existing amongst various professionals including health

professionals from the health, from both medical and veterinary sectors, environmental, economic, social, agricultural, wildlife, and other interested parties towards attainment of optimal health for people, animals and the environment.

The results in Table 2 reveal that only 3.8% (CI 95%, 2.8 to 4.8) identified PMSE, with majority of the respondents (91.3%: CI 95%, 89.7 to 92.7) were not aware on the ways in which these professionals collaborated in the study area, other 5.0% (CI 95%, 3.9 to 6.2) claimed that there were no any collaborations observed within the specified period of time.

Table 2:   Partnership and Multi-Sector Engagement (P&MSE) for outbreak responses   (n=1440)

Responses	Frequency	Percent	95% CI	
			Lower Bound	**Upper Bound**
No PMSE	72	5.0	3.9	6.2
Identified PMSE	54	3.8	2.8	4.8
Unaware of PMSE	1314	91.3	89.7	92.7
Total	1440	100.0		

Table 2 indicates that very few participants to the study managed to identify PMSE involving various professionals towards attainment of optimal health. The results are in line with what 'the whole-of-government approach' has been propagating under the Health 2020 Policy Framework. This is an indication that there is "the diffusion of governance vertically across levels of government and arenas of governance and horizontally throughout sectors" (WHO; 2013). The little of PMSE that is reported in Table 1 conforms with what was found in a study by Mwinyi *et al.,* (2015: 30) who similarly observed that "One Health in terms of collaboration, particularly between human and animal health sectors to prevent and control zoonoses has been low while the sectors have a lot of things in common".

During KII, it was observed that there has been a feeling that has sometimes made it difficult for effective collaboration between medical and veterinary professionals, as one participant claims:-
"It is just the way human health professionals have their views /perceptions on animals health professionals that has always been a hindrance towards effective collaboration. Our colleagues have always been considering themselves superior to us …..That has had a lot of negative influences on collaboration ….."

In presence of such views /perceptions, it will always be difficult to willingly accommodate these collaborations if they have not been institutionalized. OH Strategic Plan is very important as it sets a formal/institutionalized entry towards creating and maintaining active collaboration which are formed from PMSE.

Effectiveness of PMSE in Building Public Health Capacity, and Empowering People to Manage their Health under OHA

The results in Tables 3 indicate that the lowest and highest scores were 14 and 18 respectively with a mean of 17.32 and a Standard deviation of 1.15 on the effectiveness of the PMSE' initiatives in building public health capacity.

Table 3: Scores on Perceived Effectiveness of PMSE in Building Public Health Capacity (n=1440)

Scores	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
14.00	72	5.0	2.5	7.9
15.00	36	2.5	.4	4.6
16.00	252	17.5	12.5	22.1
17.00	72	5.0	2.5	7.9
18.00	1008	70.0	64.6	75.4
Total	1440	100.0		

The results in Table 4 further reveal that 30% (95% CI: 22.9 to 35.8) of the respondents perceived the PMSE' initiatives in building public health capacity, and empowering people to manage their health to be effective while 70% (95% CI: 64.2 to 77.1) perceived it being ineffective.

Table 4: Perceptions on Effectiveness of the PMSE in Building Public Health Capacity (n=1440)

	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Effective	432	30.0	22.9	35.8
Ineffective	1008	70.0	64.2	77.1
Total	1440	100.0		

It can be observed that perceptions on PMSE effectiveness in building public health capacity, and empowering people to manage their health were found to be very ineffective by the majority of the respondents. The same was observed during the FGD, where one participant had this to say: -

"There could be a lot of initiatives that the government may be putting in place related to healthcare, promoting health and preventing diseases in our area. But it is very difficult to us to know them all. It is rarely that common people like us are involved in initiating or even executing such initiatives ….."

PMSE in Building Public Health Capacity on Human and Animals Health
The results in Table 5 reveal that 70 %(95% CI: 67.6 to 72.4) of the respondents identified hospitals, 27.5% (95% CI: 25.1 to 29.7) schools and 2.5% (95% CI: 1.7 to 3.4) NGOs as institutions which facilitate health initiatives in building public health capacity on human in the society.

Table 5: Institutions Facilitating Health Initiatives in Building Public Health Capacity (n=1440)

Institutions	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Schools	396	27.5	25.1	29.7
Hospitals	1008	70.0	67.6	72.4
NGOs	36	2.5	1.7	3.4
Total	1440	100.0		

Similarly, other studies (Mboera *et al.,* 2007; Rains and Ruppel, 2013) report the role played by health care facilities (hospitals) in building public health capacity through dissemination of health information in rural Tanzania. Schools have also been observed to significantly accommodate initiatives towards promotion of public health in various countries (Leger, 2001; Nutbeam, 2001).

Awareness on the Concept and Practices Related to OHA

The findings on Table 6 indicate that only 5% (CI 95%, 4.0 to 6.2) of the respondents who were interviewed were aware on the concept and the practice of OHE.

Table 6: Awareness on OHA Concept and practices

Response	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Not aware	1368	95.0	93.8	96.0
Aware	72	5.0	4.0	6.2
Total	1440	100.0		

In order to confirm individuals' awareness on OHA concept and practices, the respondents were asked what they know on OHA. The results in Table 7 indicate only 2.5% (CI 95%, 1.7 to 3.4) of the respondents managed to correctly describe OHA by saying it is a collaborative effort of multiple disciplines dealing with health issues.

Table 7: Knowledge on OHA (n=1440)

Responses	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Collaborative efforts of multiple disciplines dealing with health issues	36	2.5	1.7	3.4
N/A	1404	97.5	96.6	98.3
Total	1440	100.0		

The study Millerand Olea-Popelka, (2013) report that OHA to be at its infancy in many areas of the world, no wonder that people have little knowledge and awareness on the concept and practices as the results in Table 6 and 7 respectively reveal. Similarly, URT-Prime Minister's Office (2015) recognizes/acknowledges low awareness on OHA, as it is revealed in One Health Strategic Plan 2015 – 2020. Low awareness on OHA is also partly acknowledged by URT-MoHCDGEC (2017: 18) as it reports that: "…..there is limited coordination and collaboration between health sector and other sectors as well as participation of non-state actors in addressing emerging and re-emerging diseases". Low awareness can also be contributed to lack of transparency in the sector; as cited in URT

(2017: 1), which claims that transparency and social accountability is amongst challenges facing Health sector in Tanzania.

During FGDs, it was apparent that individuals despite having little knowledge on OHA, but they were involving themselves with the practices related to OHA but didn't know it when it is being referred to as OHA. This was realized after the researcher had explained what it was meant by OHA:-

"From the explanations you have given us we have really come to understand what is being regarded as One Health Approach. I can see opportunities that are obvious with the approach towards attainment of optimal health for humans, animals and the environment. This is very important aspect if good health has to be maintained in the society ……it is true that sometimes our animals have been a cause of our ill health, I have understood from the explanations you have also given us explanations on how we (human being) could affect animals health …….the environment quality and its effects on health for both humans and animals have been very obvious to me even before I attended this session with you here …… (FGD participant at Doma, Mvomero).

Potential Hindrances towards Effective PMSE

The results in Table 8 indicate that 5% (CI: 95%, 3.9 to 6.2) of the respondents identified lack of good health policies, while 2.5% (CI 95%, 1.7 to 3.3) identified unavailability of veterinary services in their area, another 2.5% (CI 95%, 1.7 to 3.3) identified lack of government support and the remaining 90% (CI 95%, 88.4 to 91.6) were not aware on the factors that have been hindering collaboration between various professionals towards attainment of optimal health.

Table 8: Factors Hindering Effective Collaboration on Health Related Aspects (n=1440)

Responses	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Lack of good health policies	72	5.0	3.9	6.2
Unavailability of veterinary services in rural areas	36	2.5	1.7	3.3
Lack of government support	36	2.5	1.7	3.3
Don't know	1296	90.0	88.4	91.6
Total	1440	100.0		

Policy issues are also reported by Mbugi *et al.,* (2012) to attribute to low awareness on collaboration on diagnosis and surveillance of zoonotic or non-zoonotic diseases. Mbugi *et al.,* (2012) report absence of participatory health policy with a focus on multi-sectoral actions on One Health being a major hurdle, specifically in countries with poor resource base. During a KII, one informant claimed that:-

……….In absence of directives, guidelines or policies on such collaboration it is not possible to expect much from such collaboration …… the government has to put in place such directives, guidelines or policies ….

It is apparent that health policy (policy objectives 2.4.6) does not explicitly insist on the veterinarian's collaboration with human health professionals, despite underlining on promoting awareness amongst employees from the government and members of the

community at large. The policy however insists that health related problems can adequately be solved by employing partnership and multisectoral engagement cutting across sectors such as agriculture, water, education, the private sector, NGOs, and civil society.. This also include other stakeholders such as central ministries "regional administration and local government, and community development, gender and children" (URT, 2003b). Mbugi (2012:2) claims that "despite advocating 'One Health' approaches in infectious disease surveillance in developing countries such as Tanzania, the concept may be challenged and compromised by the existing health policies in the country. The current health policy and the Tanzanian Veterinary Act (the tool that provides guidelines for veterinary practice activities) may not have a common point of intersection. This could be a result of parallel working organs that do not interact or a habitually conservative notion that 'a vet should be a vet' and 'a medic should be a medic". During KII, it was observed that there has been a feeling that has sometimes made it difficult for effective collaboration between medical and veterinary professionals, as one participant claims:-

"It is just the way human health professionals have their views /perceptions on animals health professionals that has always been a hindrance towards effective collaboration. Our colleagues have always been considering themselves superior than us …..That has had a lot of negative influence towards collaboration ….."

Table 9: Relevance of Technical Collaboration between Professionals(n=1440)

	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Irrelevant	564	39.2	36.7	41.8
Relevant	876	60.8	58.2	63.3
Total	1440	100.0		

The relevance of OHA towards facilitating PMSE

The respondents who acknowledged the need for technical cooperation included, their reasons; that technical collaboration between medical professionals, veterinary and environmentalists help to save lives of both humans and animals (7.5%: CI 95%, 6.1 to 8.8), while 2.5 % (CI 95%, 1.7 to 3.3) of the respondents attributed the need for the collaboration to its potentiality to help to conserve environment (Table 10).

Table 10: Relevance of Technical Collaboration between health and related professionals (n=1440)

	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Help to save lives of humans and animals	108	7.5	6.1	8.8
Help to conserve environment	36	2.5	1.7	3.3
Didn't understand whether there is a need	1296	90.0	88.5	91.6
Total	1440	100.0		

Despite having very few people identifying the relevance of technical collaboration between health and related professionals which could have been attributed to low awareness on the concept of OHA, the reasons advanced in Table 10 are supported by

European Union (EU) (2011), which claims that OHA can serve purposes of improving ecosystems management, livelihoods, animal and human health.

Support for the Institutionalization of Technical Collaboration
The respondents were asked whether if they will support the technical collaboration between medical professionals, veterinarians and environmentalists when institutionalized. Table 12 reveals that 94.2% (95% CI, 93.1 to 95.3) of the study participants were in favour of such collaboration if institutionalized.

Table 12: Support for the Institutionalization of Technical Collaboration between Professionals (n=1440)

Response	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Not supporting	84	5.8	4.7	6.9
Supporting	1356	94.2	93.1	95.3
Total	1440	100.0		

Mwinyi *et al.,* (2015) in their study conducted in Zambia determined attitudes of the respondents towards One Health practice. The findings from this study revealed that almost all the respondents (98.5%) said that they would support it to a large extent and 1.5% said that they would just support institutionalization of One Health practice.

By-laws, local policies and directives on health promotion, healthcare and diseases prevention
The results in Table 13 indicate bylaws, local policies and directives on health promotion, healthcare and diseases prevention that were identified by the respondents. It is indicated that10.0%(95% CI: 8.5 to 11.6) of the identified focused on restrictions on certain health behaviours, 12.5% focused on encouraging certain health behaviours, while 10.0% (95% CI: 8.5 to 11.5) were on meat inspection in their area, 27.5% (95% CI: 25.1 to 29.9) on environmental management practices near residential areas, 15.0% (95% CI: 13.1 to 16.9) on where and when pasture and selling outlets businesses can be located, 15.0% (95% CI: 13.2 to 16.9) on water sources use (which, for who, when) and 10.0% (95% CI: 8.5 to 11.7) on village control issues of livestock feed in the area nearby game reserve.

Table 13: By laws, local policies and directives on health promotion, healthcare and diseases prevention (n=1440)

	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Village control on issues of livestock feed in the area nearby the game reserve	144	10.0	8.5	11.7
Water sources use which for who when	216	15.0	13.2	16.9
Where and when pasture selling outlets and businesses can be located	216	15.0	13.1	16.9
Environmental management practices near residential areas	396	27.5	25.1	29.9
restrictions on certain health behaviours	144	10.0	8.5	11.6
Encouraging certain health behaviours	180	12.5	10.8	14.2
Meat inspection	144	10.0	8.5	11.5

Local Government and Public Health

The results in Table 14 indicate the ways through which local government has been dealing with public health and related aspects through its capacity. The findings reveal that 8.8% (95% CI: 5.4 to 13.3) of the respondents identified LGAs involvement in public health through the services it commissions and delivers, whereas 67.4% (95% CI: 61.3 to 73.3) of the respondents identified LGAs involvement in public health through its regulatory powers, the other 8.8% (95% CI:5.4 to 12.9) of the respondents identified LGAs involvement in public health through community leadership and the remaining 15.0 % (95% CI: 10.0 to 20.0) were not in position to identify any ways through which LGAs involved itself in public health.

Table 14: Local government authority involvement in public health through its capacity (n=1440)

Responses	Frequency	Percent	95% CI	
			Lower Bound	Upper Bound
Through the services it commissions and delivers	126	8.8	5.4	13.3
Through its regulatory powers	972	67.4	61.3	73.3
Through community leadership	126	8.8	5.4	12.9
Don't know LGAs involvement in Public health	216	15.0	10.0	20.0
Total	1440	100.0		

These findings indicate that LGAs have been involving themselves to ensure communities are take up their responsibility seriously in their healthcare as stipulated in the National Health policy (URT, 2003a) despite low level of such initiatives. However, it should be noted that the low reported level of such involvement can also be emanating from a number of factors including lack of transparency in the health sector as reported in URT (2017: 1). It is reported by URT (2017: 1, 4) the country to have made impressive gains in various aspects in health sector despite the challenges. The results indicate that the government at the local level to have been engaging in health related activities, this conforms with the whole-of-government approach means "the diffusion of governance vertically across levels of government and arenas of governance and horizontally throughout sectors" (WHO, 2013).

Focus of the Identified PMSEs on Health

Table 15 presents results on the focus of the identified government initiatives on health promotion, healthcare and diseases prevention in the study area.

Table 15: Focus of the Identified PMSE Initiatives on Health

Focus	Diseases prevention		Health promotion		Health care	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Seminars/Workshop	108	7.5	0	0	0	0
Public Announcements	792	55.0	36	2.5	0	0
Village/wards/street meetings	1368	95.0	36	2.5	0	0
Visits by Health Officials from the wards	720	50.0	0	0	0	0

Parents meetings at school	468	32.5	0	0	0	0
Leaflets distribution	792	55.0	0	0	0	0

The results indicate that 7.5% of the respondents identified seminars/workshops on diseases prevention, no seminars /workshops were identified for health promotion and health care. Of the identified public announcements, 55% focused on diseases prevention, whereas only 2.5 % of public announcements on health promotion were identified by the respondents and none on health care. Village/wards/street meetings on diseases prevention accounted for 95% of the identified village/wards/street meetings, and village/wards/street meetings were on health promotion 2.5 % and none were on health care. Visits by Health Officials from the wards on diseases prevention accounted for 50% of the identified visits by Health Officials from the wards, with none on health promotion and health care. For the case of parents' meetings at school, 32.5% were on diseases prevention and none were on health promotion and health care. The findings further reveal that 55% of the leaflets distributed were on diseases prevention and none on health promotion and health care.

Similarly, public meetings and print materials were the most frequently used channels of health information communication as reported by Mboera *et al.,* (2007). In a study by Rains and Ruppel (2013; 2016) it was found that in the cause of seeking health information among other sources also health care service providers and print media were utilized. Freer (2015:16) identifies dissemination of fact-based pamphlets and the placement of posters, among others as source of health information.

Conclusions

Despite all these drawbacks, in Tanzania, an enabling environment towards effective collaboration involving various professionals in attainment optimal health has been created. Tanzania's 5-year *One Health Strategic Plan* (2015–2020) is the first national OH strategic plan which has been developed by employing a multisectoral approach. This plan has made use of expertise from innumerable sectors which reflects a shared commitment in enhancing collaborative working amongst health and related sectors, including humans, animals, and wildlife health sectors to ease the burden from zoonotic diseases (URT- Prime Minister's Office, 2015). Through its capability to provide opportunities to various individuals and also institutions to work across networks and sectors, which have always been expected to result into stronger systems at national level which have managed to combat emerging diseases and regional bonds, One Health, seems to have the potentiality of creating PMSE. It has been observed that through the implementation of OH, partnerships and platforms shall be created which require an obvious linkage between humans and animals' health, ecosystems and the environment, also between livelihoods and policy processes. Since this plan is aimed at summarizes operations and activities among stakeholders, it is important to establish best ways to reach a wider audience. This can be achieved through training, advocacy, and communication; research and development; surveillance; and, preparedness and response. Obviously, once people are aware and knowledgeable on OH issues the burden of zoonotic diseases will be reduced.

Despite the fact that Health 2020 Health Policy Framework has its origin in Europe, what has been found in this study connect to what this frame work had placed its interest through using *whole-of-government* and *whole-of-society* approaches, to deal with most pressing health challenges in the regions. This is the case where it was found in the study that there engagement of the private sector, civil society, communities and individuals in health-related actions.

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