Determinants of the Perceived Quality of Malaria Diagnostic Services in Dar es Salaam, Tanzania

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Abstract

This study explores the determinants of perceived quality of malaria diagnostic services in Dar es Salaam, Tanzania using a logit model. The study uses exit interview data from 600 people who had tested for malaria in 30 health facilities in Dar es Salaam in the year 2020. The estimated results show that age of diagnosticians, type of response to suspected malaria illness, and time of testing for malaria influence perceived quality of malaria diagnostic services. Perception of malaria diagnostic services differ significantly by gender with males being influenced by reliability factors while females are influenced more by accessibility factors. Furthermore, youth were more likely to have a lower perception of quality of malaria diagnostic services. The policy implications are threefold. First, enhancing awareness of importance of testing prior to taking medication via coordinated health education initiatives. Second, emphasis of in-service training to maintain competence of diagnosticians is strongly advocated. Third, perpetual monitoring of diagnostician work hours in order to maintain productivity is required.

Key words: Healthcare Quality, Logit, Malaria, Tanzania

JEL Classification codes: I12, I19

1. Introduction

Malaria is a major public health concern in Tanzania where it is the leading cause of morbidity and mortality accounting for 17 percent and 15 percent of outpatient illness for under-fives and those aged above five respectively (MoHCDGEC, 2020). It also accounts for 29 percent and 23 percent of inpatient illness for under-fives and those aged above five respectively and 9 percent and 5 percent of under-five deaths and over five deaths respectively (MoHCDGEC, 2020). As malaria is the leading cause of morbidity and mortality in Tanzania it affects many people economically in one way or another via the direct labour productivity effect on the labour force and an indirect incentive effect on education (Finlay, 2007).

Malaria affects the economy in diverse ways ranging from its direct effect on physical condition resulting in loss of labour productivity and earnings, as well as its indirect incentive effect on education emanating from loss of school time and depletion of scarce resources devoted to tackling it at the expense of other health issues. Since malaria affects the economy, there is a need to address it through prevention, treatment and control is imperative. Adequate prevention, treatment, and control of malaria entail effective and affordable treatment for all cases of malaria within 24 hours since the onset of illness (Amexo *et al*., 2004). Adequate malaria prevention, treatment and control however require adequate malaria diagnosis as confirmation of malaria parasites is the first step in malaria management.

Malaria diagnosis is a crucial element of malaria management as it avails information on the presence or non-presence of malaria illness. Malaria diagnosis is a crucial element of malaria management as it avails information on the presence or non-presence of malaria illness. Such information facilitates allocative efficiency by availing physicians with the necessary information required to prescribe accurate treatments that enhance malaria treatment effectiveness and reduce the time an individual spends being sick (sick time) which increases utility. Diagnosis is however crucial for malaria management only if it leads to accurate results that are an input to the next stage of malaria management which is treatment. Malaria diagnosis is about demonstrating the presence or non-presence of malaria parasites before embarking on a course of treatment for malaria or other febrile disease and is undertaken through microscopy which is based on detection of malaria parasites and by rapid diagnostic tests (RDTs) that are based on the detection of parasite specific antigens.

The high prevalence of malaria in Tanzania has led to accumulation of significant knowledge on malaria over the past years. As a result, people may have an idea or suspect they have malaria which some may use as a basis for judging the accuracy of laboratory malaria diagnosis prior to attending health facilities. Judgement of accuracy of malaria diagnosis pertains to healthcare quality. Healthcare quality is categorized into actual quality and perceived quality with the latter corresponding to quality as perceived from the patient's perspective and the former corresponding to the actual level of quality embodied in a healthcare service (Barnum and Kutzin, 1993; Donabedian, 1980a; Bitran, 1992). Donabedian (1980a; 1980b; 1986; and 1988) propose three dimensions for measurement of the quality of healthcare namely structure, process and outcome. Judgment of accuracy of malaria diagnosis is based on perceived healthcare quality. Such judgement may or may not be justified depending on whether it coincides with actual quality or

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not. Most studies in Tanzania have however analysed malaria diagnostic quality from an actual quality perspective rather than from a health consumer behaviour perspective (Williams *et al*., 2008; Reyburn *et al*., 2007; Nicastri *et al*.,2009; Ngasala and Bashukatale, 2019; Hoffman *et al*., 2019). Such judgement can however be incomprehensive as consumers tend to make decisions based more on perceptions on effectiveness of healthcare services rather than on actual effectiveness. Results of studies focusing on actual quality may thus inadequately explain utilization or non-utilization of malaria diagnostic services as they ignore perceived quality that plays a greater role in influencing utilization of malaria diagnostic services than actual quality.

Most studies have analysed quality of malaria diagnostic services from an actual healthcare quality perspective that hinge on the assumption of healthcare consumers possessing adequate information to make optimal healthcare utilization decisions. Such an assumption does not always hold as consumers tend to make decisions based more on perceptions of effectiveness of healthcare services rather than on actual effectiveness resulting in inadequate explanation of utilization or non-utilization of malaria diagnostic services. This study contributes to the existing literature by considering perceived quality of malaria diagnostic services as important in complementing actual healthcare quality in explaining health care utilization. This study achieves this by examining factors determining healthcare consumer perception of the malaria diagnostic services based on outcomes obtained and costs incurred.

The remainder of the paper is organized as follows. Section 2 provides a synthesis of literature; Section 3 describes the study methodology and Section 4 presents results. Section 5 provides concluding remarks.

2. Literature

2.1 Theoretical Framework

The individual derives utility $U(s(t), Z(t))$ from consumption goods and sick time which is non-negative during each period t and falls with increasing health stock where $s = s(H(t))$ is sick time, $H(t)$ is the stock of health capital and $Z(t)$ is consumption good. The individual derives utility from consumption goods and disutility from sick time. The individual seeks to maximize welfare,

$$W = \int_0^T e^{-\rho t} U\{s(t), Z(t)\}dt \ , \ \frac{\partial U}{\partial s(t)} \leq 0 \, , \ \frac{\partial U}{\partial Z(t)} \geq 0 \, , \ \frac{\partial s(t)}{\partial H(t)} < 0 \, , \quad \forall t \tag{1}$$

where W is welfare of an individual, ρ is the rate of time preference. Health stock, $H(t)$ affects an individual's welfare by impacting sick time which effects utility making it a crucial component of individual welfare warranting closer analysis. An individual inherits a stock of health H_0 in period zero which afterwards evolves following the law of motion of health.

$$\dot{H}(t) = I(t) - \delta\{t, Z(t\}H(t) \tag{2}$$

where $\dot{H}$ is change in health stock, I is gross investment in health, δ is the rate of depreciation of health stock and H and Z are as previously defined.

Health stock depreciates at rate δ leading to the need to invest in health through consumption of healthcare services like malaria diagnostic services to keep health stock in an optimal trajectory. Health investment and cost are related by the condition:

$$\left(\frac{\partial U/s(t)}{\lambda(0)}e^{-(\rho-r)t}+\frac{\partial Y(t)}{\partial s(t)}\right)\frac{\partial s(t)}{\partial H(t)}=\left(r+\delta(t)-\frac{\dot{c(t)}}{c(t)}\right) \quad (3)$$

where Y is labour income, c is net price of healthcare per unit and r is interest rate. Equation (3) requires marginal utility of investment in health to equal its marginal cost. Since $\P s(t)/\P H(t)<0$ and $\P Y(t)/\P s(t)<0,$ and sick time, $s(t)$ leads to disutility, the left-hand side of (3) has a positive value implying positive marginal utility. Increase in health stock, H is an important aspect in reducing sick time. One way of increasing health stock is through consumption of healthcare services such as malaria diagnostic services. Healthcare services must however possess high marginal productivity to be meaningful in raising health stock. One of the determinants of healthcare service productivity is the quality of the healthcare services whereby high healthcare quality leads to large magnitude of $\P s(t)/\P H(t)$ and hence larger marginal utility and vice-versa for poor levels of healthcare quality.

Apart from affecting an individual's utility, healthcare quality also affects change in health stock by determining the productivity of gross investment in health, $I(t)$ in (3). High healthcare quality leads to high productivity of gross investment in health and faster development of health stock which increases the consumer's utility and vice-versa for poor healthcare quality. Perception of the quality of malaria diagnostic services will impact the utilization of such services and thus impact health outcome and utility.

2.2 Empirical Literature

Inaccurate malaria diagnosis leads to distrust in diagnostic services and may increase presumptive treatment that tends to exacerbate the negative impacts of malaria on health and the economy by increasing disutility of sick time (Wijesinghe *et al*., 2011). Malaria misdiagnosis also leads to overestimation or underestimation of the burden of malaria (Hume *et al*., 2008) resulting in misallocation of resources because of directing resources to those who do not actually need them while withholding resources to those who do. This tends to lower healthcare consumer utility by increasing sick time which raises disutility. Factors such as experience and training of microscopists, the quality of the slide preparation, staining, reading, quality of the equipment, availability of electricity, and necessary reagents can affect the quality of microscopic and RDT diagnosis. These factors can frequently render microscopy and RDT inadequate for ensuring good health outcomes and optimal use of resources as its accuracy is only 70 -75 percent (El Nageh, 1996; WHO, 2016; RDT Info, 2011).

Various studies have found quality of equipment significantly affect diagnosis quality (Williams *et al*.,2008; Iwuafor *et al*., 2018; Hoffman *et al*., 2019;Bosco *et al*., 2020). Reyburn *et al*. (2007) however found quality of equipment did not affect malaria diagnosis much. Although malaria diagnosis is undertaken using scientific equipment, diagnostician characteristics and practices can

significantly influence the quality of diagnosis as they may influence the value judgment of diagnosticians and can sometimes lead them to draw diagnostic conclusions in a priori fashion. Diagnostician characteristics such as location, age, experience have been found to affect quality of diagnosis (Reyburn, 2004; Mwanziva *et al*., 2008; Nicastri, 2009; Plucinski *et al*., 2017; Ngasala and Bashukatale, 2019). Diagnostician characteristics and practices tend to affect their a priori expectations which can subsequently influence diagnosis quality.

Malaria does not affect a population in equal measure but can differ based on various factors such age groups, intensity of transmission, severity of illness and so on. Diagnosticians perform differently in the face of such factors leading to the factors influencing diagnosis quality. Mosha *et al.* (2010), Plucinski *et al*., 2017 and Iwuafor *et al.* (2018) find factors such as age, illness severity, and transmission intensity affect diagnostician expectations and performance as well as well as consumer perceptions on diagnosis quality.

Since malaria is the leading cause of morbidity and mortality in Tanzania, it significantly costs the economy. MOHCDGEC (2016) estimates 17 percent of health expenditure in Tanzania was devoted to malaria services in 2012 while Jowett and Miller (2005) estimate over 1 percent of GDP is devoted to the disease, representing US$ 2.2 per capita, and 39 percent of total health expenditure nationally with government facilities devoting almost a third of their resources to the disease while private expenditure, primarily on drugs, coils, sprays and bed-nets represents 71 percent of total expenditures.

In an analysis of economic burden of malaria in rural Tanzania, Somi *et al*. (2007) finds poorer households bear a greater burden from malaria relative to their consumption than better off households and that households were more vulnerable in the rainy season when malaria prevalence was high, and liquidity was low. In a malaria expenditure analysis in Tanzania, Jowett *et al*. (2000) found malaria expenditure to account for 39 percent of all health expenditures with household expenditure accounting for about three-quarters of this expenditure of which a third was spent on antimalarials and almost half on bed nets, insecticides and coils.

The literature reveals malaria misdiagnosis to be common in Tanzania and other countries hinting to low productivity of malaria diagnostic services that may lead to less-than-optimal impact on sick time and subsequently healthcare consumer utility. Most studies however analyzed quality of malaria diagnostic services from an actual quality perspective based on the assumption of healthcare consumers possessing adequate information to make optimal healthcare utilization decisions which is incomprehensive as consumers tend to make decisions based more on perceptions on effectiveness of healthcare services than on actual effectiveness. Considering the importance of perceived quality on utilization of malaria diagnostic services, we seek to identify factors influencing perceived quality of malaria diagnostic services.

3. Methodology

3.1 The Model

The demand for health in this framework is based on the concept of utility maximization where utility is derived from consumption of health and non-health goods. The health good in this case is malaria diagnostic services. Assuming suspected malaria illness, the respective utility of receiving good quality malaria diagnosis (g) and poor-quality malaria diagnosis (p) is,

$$U^g = U(h_g, x_g, \varepsilon_g; \phi_g) \quad \text{and} \quad U^p = U(h_p, x_p, \varepsilon_p; \phi_p) \tag{4}$$

where h is health status, x is non-health consumption, ε is a random error term, and ϕ is a parameter vector. Health status emanating from good malaria diagnosis (h_g) and health status resulting from poor malaria diagnosis (h_p) are represented as health production functions

$$h_g = h(z; \beta_g) \text{ and } h_p = h(z; \beta_p) \tag{5}$$

where z is a vector of individual, household, community, and health care provider characteristics. The health care choice is represented by the indicator function

$$S = 1(U_g > U_p)$$

A person chooses diagnostic services that he or she perceives will lead to accurate malaria diagnosis. The model is characterized by a trade-off between good quality and poor-quality diagnostic services where malaria diagnostic services should lead to better health and consequently less non- health consumption i.e., $x_g < x_p$ and $h_g > h_p$. The next sub-section specifies the model empirically.

3.2 Empirical Specification

The empirical specification is based on a linear utility and production functions (Mwabu, 1986; Akin *et al*., 1986; Lindelow, 2005). A linear utility function is adopted because it can consider the fact that income can have different coefficients across choices and health improvements differ across choices (Dow, 1995).

$$U^g = \phi_{g1} h_s + \phi_{g2} x_g + \varepsilon_g \text{ and } U^p = \phi_{p1} h_p + \phi_{p2} x_p + \varepsilon_p \tag{6}$$

where $h_g = \beta_g^z{}' z$ and $h_p = \beta_p^z{}' z$

z is a vector of individual, household, socio-economic, and provider characteristics. Non-health consumption (x) is a function of exogenous income (y) and travel time (T) and is given as

$$x_g = \gamma_{g1} y - \gamma_{g2} T \text{ and } x_p = \gamma_{p1} y - \gamma_{p2} T \tag{7}$$

Using the linear functions for h and x, and with an appropriate reparametrization, the indirect utility function can be written as

$$V^g = V(\alpha_g' w + \varepsilon_g) \text{ and } V^p = V(\alpha_p' w + \varepsilon_p) \tag{8}$$

where $w = \begin{bmatrix} z \\ y \\ T \end{bmatrix}$

The probability of using good quality malaria diagnostic service is,

$$\Pr[g=1|w]=\Pr[V^g>V^p]=\Pr[(\alpha_g-\alpha_p)w>\varepsilon_p-\varepsilon_g]=\Pr[\alpha w>\varepsilon] \quad (9)$$

Where $(\alpha=\alpha_g-\alpha_p$ and $\varepsilon=\varepsilon_p-\varepsilon_g)$

Under the assumption that $\varepsilon \sim (\mu, \frac{(\pi\sigma)^2}{3})$

$$\Pr[g=1|w]=\Pr[\alpha' w>\varepsilon]=\Pr[\alpha' w<\varepsilon]=\frac{e^{(w,\alpha)}}{1+e^{(w,\alpha)}} \quad (10)$$

This is the logit model whose parameter vector α can be estimated consistently using maximum likelihood techniques. The estimated equation is,

$$qd=\alpha_0+\alpha_1 hf+\alpha_2 age+\alpha_3 sex+\alpha_4 frq+\alpha_5 fct+\alpha_6 pay+\alpha_7 td+\alpha_8 dage+\varepsilon \quad (11)$$

where, qd is quality of malaria diagnostic services (dummy variable consisting of good quality = 1; poor quality = 0); hf is health facility respondent attends (captures structural quality); age is age of respondent in years; sex is sex of respondent (male = 1; female = 0); frq is response to suspected malaria illness which captures information aspects (always testing = 1; not always testing = 0); fct is type of facility malaria is tested and captures process quality (hospital = 1; non-hospital = 0); pay is price paid for malaria diagnostic service; td is time of testing malaria which captures process quality (14 hours; between 9 am and 10 pm), dage is age of the diagnostician. td and fct are related to process quality because it is assumed that the time of delivering diagnostic services and the setting in which such service is delivered impact the method or process of delivering the service.

3.3 Data

Data for the study was obtained through interviewing people who had tested for malaria in 30 health facilities selected randomly in Kinondoni, Ilala and Temeke districts of Dar es Salaam from a total of 477 health facilities in Dar es Salaam. Of the 477 health facilities, 209 were in Kinondoni district, 156 in Ilala district, and 112 in Temeke district. The random selection of health facilities resulted in selection of 13 health facilities from Kinondoni, 10 health facilities from Ilala, and 7 health facilities from Temeke based on a district's proportionate share in Dar es Salaam region's health facilities. Dar es Salaam was chosen as its large population offers a wide range of respondent and service provider characteristics necessary for undertaking a comprehensive analysis of factors influencing perceived quality of malaria diagnostic services. The focus of the interview was to obtain the perception of people who tested for malaria on the quality of malaria diagnostic services. Perception is important in health outcome because it is perception that determines whether an individual seeks healthcare or not and the type of healthcare pursued (Mugisha, 2002; Howlader *et al*., 2019).

Once the 30 health facilities were randomly selected, purposive sampling was used to select people to participate in an exit interview based on having gone to a health facility to test for malaria which is strongly correlated with having had malaria in the past. A total of 600 people were afterwards

selected in a systematic random manner with every third person being interviewed by health laboratory personnel. The study used systematic selection of respondents to give the people going to health facilities for malaria testing an equal chance of participating in the exit interview as well as to minimize bias on part of the health laboratory personnel in administering the exit interview. Of the 600 people who participated in the exit interview, 263 were in Kinondoni, 196 in Ilala, and 141 in Temeke. Ten health facilities in Kinondoni interviewed 20 people each while three health facilities interviewed 21 people each; eight health facilities in Ilala interviewed 20 people each while two health facilities interviewed 18 people each; and six health facilities in Temeke interviewed 20 people each while one health facility interviewed 21 people.

Demand for diagnostic services is driven by various socioeconomic factors and healthcare quality factors which do not vary much across similar populations. Moreover, the facts that diagnostic services like most health goods is a necessity which most people do not consume often and have no incentive to over consume makes its consumption behaviour among people more or less uniform. This similarity in patterns of consuming diagnostic services makes our sample size adequate in providing representative results.

4. Results

4.1 Descriptive Statistics

It is necessary to discuss features characterizing the data used for the study before discussing the empirical results. Table 1 shows summary statistics of the explanatory variables.

Table 1: Summary Statistics

Variable	Mean (Standard Deviation)
Health facility respondent attends (hf)	15.9 (9.545238)
Age of respondent (age)	28.89833 (16.67037)
Age of diagnostician (dage)	35.67833 (9.299767)
Sex of respondent (sex)	0.4983333 (0.5004144)
Response to suspected malaria illness (frq)	0.79 (0.4076481)
Type of facility malaria is tested in (fct)	0.8633333 (0.3437817)
Price paid for malaria diagnostic service (pay)	2664.167 (966.9666)
Time of testing malaria (td)	5.303333 (3.201834)

600 people who tested for malaria at health facilities were interviewed. The average age of people testing for malaria was 29 years and slightly above half of respondents were female. The average cost for testing for malaria was 2,664 shillings. There was low variation in cost of malaria diagnostic services. Majority of people tested for malaria in a hospital, dispensary or health center although almost a third of people do not always test for malaria prior to taking drugs. Finally, most respondents tended to test for malaria in the afternoon onwards rather than in the morning which is an indication of being concerned about the opportunity cost of going for testing in the morning during work hours.

4.2 Diagnostic Service Estimations

Since the outcome variable, quality of malaria diagnosis has two categories; we use a binary logit regression to analyze how the independent variables influence it. However, some explanatory variables may be endogenous because of correlation with the error term which can lead to biased parameter estimates. Endogeneity can be dealt with in a logit model using the control function approach, which is based on the concept that the part of an endogenous variable that cannot be explained by observed attributes contains information about the value of the unobserved attributes. This approach involves the inclusion of a new control variable in a regression to condition out the part of the error that is correlated with an endogenous regressor (Villas-Boas and Winer, 1999; Blundell and Powell, 2001; Petrin and Train, 2002; Kim and Petrin, 2010).

Considering the possibility of endogeneity, the first task before undertaking any estimation is to examine the correlation of the error term and the independent variables. The correlation matrix shows time of diagnosis (*td*) is significantly correlated with the residual while the other variables are not. Inclusion of time of diagnosis in the model without dealing with endogeneity will lead to biased estimates implying we must deal with it before proceeding.

Expressing the endogenous variable, time of diagnosis (td) as a function of observed variables that are independent of the error term carries out the control function approach. The observed variables are residence of respondent and type of health facility an individual uses for testing malaria (*fct*).Time of diagnosis (*td*) is expressed as,

$$td_j = g(j, z) + \mu_j \quad (12)$$

where td_j is time of diagnosis; z is the observed attribute of the service and other variables; j is the service; μ_j is the error incorporating factors that affect facility chosen for testing but are not captured by z. Once (11) is estimated we obtain the residuals as

$$\mu_j = td_j - g(j, z) \quad (13)$$

μ_j is expressed with a parameter λ i.e., $\mathrm{CF}(\mu_j : \lambda)$ which is the control function with parameters λ.

The control function is specified linearly in μ_j where the control function is $\mathrm{CF}(\mu_j : \lambda) = \lambda\mu_j$ where λ is a scalar (Petrin and Train, 2010). The control function is included in the original regression as an explanatory variable. The purpose of the control function is to absorb the part of the unobserved regressand that is correlated with the endogenous regressor; once this part of unobserved regressand is included, the remaining part of unobserved regressand is not correlated with the exogenous regressor implying the control function can be interpreted as a proxy for omitted attributes (Petrin and Train, 2002). After implementing (11) and obtaining the residual from (13), it is included in the model. Table 2 shows estimation results.

Table 2: Logistic Estimation Results of Malaria Diagnosis

Variables	Coefficient	Std. Err.	Z-Value	dy/dx
hf	-0.01751	0.014716	-1.19	-0.00308
age	0.003045	0.006543	0.47	0.000536
dage	0.034422	0.012396	2.78	0.006061
sex	0.024917	0.213463	0.12	0.004387
frq	0.65868	0.260741	2.53	0.127442
fct	-0.07936	0.412643	-0.19	-0.01375
pay	-0.0001	0.000111	-0.72	-0.00001
td	-1.10771	0.53563	-2.07	-0.19505
CF	0.744886	0.532521	1.40	0.131162
Number of observations = 600				
LR chi2(9) = 161.36				
Prob > chi2 = 0.0000				
Pseudo R2 = 0.2268				
Log likelihood = -275.08965				

Of the eight explanatory variables only age of diagnostician, type of response to suspected malaria in terms of always testing or not prior to taking any antimalarial, and the time of diagnosis significantly impact the quality of malaria diagnostic services.

Response to suspected malaria illness in terms of whether a person always tests for malaria prior to taking antimalarials or not affects the quality of malaria diagnosis. This is because always testing for malaria prior to taking any antimalarial decreases the chance of a person having poor perception of malaria diagnostic services by 13 percent. Knowledge of malaria is enhanced by a tendency to always undertake malaria testing in response to suspected malaria illness prior to taking any treatment decision

Enhanced knowledge of malaria is an important input in shaping an individual's perception on quality of malaria diagnostic services as increased exposure to malaria knowledge obtained through testing for malaria leads to an accumulation of knowledge through experience. Such knowledge aids in determining where to find good quality diagnostic services in terms of where to go, conditions for good diagnosis and avoidance of facilities that are more likely to have poor quality diagnoses consistent with various studies (Corno, 2014; Danso- Appiah *et al.*, 2010; Leonard *et al.*, 2009; Ugwu and Zewotir (2018).

Information acquired because of consistently testing for malaria prior to taking antimalarials enable healthcare consumers to better grasp the illness in terms of diagnosis, control and management. This leads to building of more informed perceptions on quality which ultimately leads to better healthcare decisions that result in higher marginal productivity of healthcare in relation to sick time. Reduction of sick time because of increased marginal productivity of malaria diagnostic services reduces the disutility caused by sick time and thus increases utility from utilization of malaria diagnostic services.

Time of diagnosis in terms of undertaking malaria testing in the morning or afternoon to evening significantly impacts the perceived quality of malaria diagnosis as being tested in the afternoon to evening tends to increase the chances of perceiving malaria diagnostic services to be of poor quality by about 20

percent. Testing for malaria in the morning tends to positively influence perception of malaria diagnostic services probably because laboratory technicians are more productive in the early hours of the day than later hours especially when the work entails examining microscopes which can be straining for the eyes (Payne, 1988).

Diagnosticians tend to be less focused on reading slides and at times may even decide presumptively on the results a priori based on transmission intensity. This is like findings by Reyburn *et al.* (2007) and Mwanziva *et al.* (2008). Working long hours ultimately leads to exhaustion and eventually reduced emphasis on quality control issues ultimately leading to reduced labour productivity (Donald *et al.*, 2005) which lowers output either in quantity or quality terms. Reduced productivity in the case of healthcare personnel tends to manifest itself in reduced emphasis on process which is crucial for maintenance of healthcare quality. Reduced productivity of laboratory technicians due to working long hours leads to increased malaria misdiagnosis resulting in increased rather than decreased sick time. Increased sick time is a source of disutility and thus leads to the overall decline of an individual's utility as well as loss in productivity due to decreased working days.

Age of diagnosticians significantly affect perceived quality of malaria diagnostic services by increasing positive perception of malaria diagnostic services. Since diagnostician age is a proxy for competence, its direct relationship with positive perception of malaria diagnostic results indicates diagnostician competence enhances positive consumer perception of malaria diagnostic services This is consistent with findings from various studies (Ngasala and Bashukatale, 2019; Jemere *et al.*, 2018; Sori *et al.*, 2018). Diagnostician age affects perception of quality of malaria diagnostic services as older diagnosticians tend to have more in-service training and experience that improve sample staining, smearing and reading that are important for malaria diagnostic service quality.

Age, sex, type of health facility at which malaria is tested, and cost of malaria testing are insignificant in determining perception of malaria diagnosis quality. Age and sex do not influence an individual's perception of malaria diagnosis quality probably because the intensity of transmission of malaria is more or less the same across the sample regardless of age or sex thereby making them a non-factor in shaping peoples' perceptions on the quality of malaria diagnosis. The reason cost of malaria testing does not influence an individual's perception of malaria diagnostic services may have to do with the fact that that the average cost of malaria diagnostic services of 2,664 shillings per diagnosis is relatively affordable compared to diagnosis of other illnesses and is thus unlikely to determine perception of diagnosis quality which is rather influenced more by non-price factors.

The insignificance of the type of health facility at which malaria is tested in terms of whether it is a hospital or non-hospital laboratory implies both hospital and non-hospital laboratories are considered by consumers of malaria diagnostic services to be the same as far as quality of malaria diagnosis is concerned. The perceived quality of laboratories in malaria diagnosis in the context of hospital and non-hospital laboratories thus differs from Bates *et al.* (2004) and Bamberg *et al.* (2008) who noted non-hospital laboratories had an actual quality advantage over hospital laboratories because of having more leeway in improving services and showing commitment to employees that resulted in increased efficiency.

The type of health facility at which malaria is tested may not influence perception of quality of malaria diagnosis because of two reasons. First, it could be that non-hospital laboratories in Dar es Salaam have failed to make use of the advantages they have over hospital laboratories due to attitude or management

which has led them to become more or less similar to hospital laboratories. Second, it could be that although there may be a difference in actual quality between hospital and non-hospital laboratories, people who test for malaria at such laboratories cannot recognize such differences as their assessment of quality is based on perceptions rather than actual information.

We also estimate results for specific groups to obtain further insights on the perceived quality of malaria diagnostic services in Dar es Salaam. We run separate estimations for males, females, and youth (18-35). Table 3 shows estimation results for males whhile Table 4 shows estimation results for females.

Table 3: Logistic Estimation Results of Malaria Diagnosis for Males

Variables	Coefficient	Std. Err.	Z-Value	dy/dx
hf	-0.03021	0.02098	-1.44	-0.00502
age	-0.01195	0.008899	-1.34	-0.00199
dage	0.036974	0.017288	2.14	0.006145
frq	0.428057	0.375721	1.14	0.076246
fct	-0.83967	0.579372	-1.45	-0.1165
pay	-0.0001	0.000148	-0.62	-0.00002
td	-1.70943	0.78728	-2.17	-0.28409
CF	1.357189	0.783119	1.73	0.225555
Number of observations = 299				
LR chi2(8) = 81.58				
Prob > chi2 = 0.0000				
Pseudo R2 = 0.2349				
Log likelihood = -132.8717				

Table 4: Logistic Estimation Results of Malaria Diagnosis for Females

Variables	Coefficient	Std. Err.	Z-Value	dy/dx
hf	-0.0022017	0.020927	-0.11	-0.0004
age	0.0230658	0.010274	2.25	0.004164
dage	0.0356827	0.018689	1.91	0.006442
frq	0.8880755	0.377633	2.35	0.17984
fct	0.8250088	0.616638	1.34	0.170865
pay	-0.0001	0.000169	-0.57	-0.00002
td	-0.5146336	0.758619	-0.68	-0.09291
CF	0.1335179	0.75424	0.18	0.024105
Number of observations = 301				
LR chi2(8) = 91.29				
Prob > chi2 = 0.0000				
Pseudo R2 = 0.2510				
Log likelihood = -136.23654				

Results from Table 3 and Table 4 shows marked difference in factors influencing perceived quality of malaria diagnostic services between males and females. Factors influencing perceived quality of malaria diagnostic services in males are diagnostician age and time of diagnosis while respondent age and response

to suspected malaria illness are the factors influencing perceived quality of malaria diagnosis services in females with always testing for malaria prior to taking drugs increasing positive perception of malaria diagnostic services by 18 percent.

Diagnostician age and time of diagnosis which influence males perception of quality of malaria diagnostic services pertain to reliability (the ability to effectively deliver the service) while respondent age and response to suspected malaria illness which influence females perception of quality of malaria diagnostic services pertain to accessibility (increased utilization).

Males perception of quality of malaria diagnostic services are influenced by reliability factors while female perceptions are influenced by accessibility factors as the latter are more concerned about receiving the service while the former are more concerned about the capacity of providers to avail effective services. This is consistent with Rumi *et al.* (2021) and Abu-Salim *et al.* (2019) that found empathy (provision of individualized attention) influenced female perception of quality of healthcare than it did for males. Accessibility is a necessary condition for empathy hence empathy tends to influence female perceptions of quality more than it does for males who are influenced by reliability factors. Table 5 shows estimation results for youth.

Table 5: Logistic Estimation Results of Malaria Diagnosis for Youth (age 18-35)

Variables	Coefficient	Std. Err.	Z-Value	dy/dx
hf	-0.03369	0.020275	-1.66	-0.0055126
dage	0.020632	0.017443	1.18	0.0033761
sex	-0.11882	0.314354	-0.38	-0.0194882
frq	0.650455	0.40695	1.6	0.1194094
fct	-0.1307	0.575069	-0.23	-0.0207842
pay	-0.00022	0.000161	-1.36	-0.0000358
td	-1.79163	0.764546	-2.34	-0.2931788
CF	1.391596	0.755552	1.84	0.2277182
Number of observations = 304				
LR chi2(8) = 87.09				
Prob > chi2 = 0.0000				
Pseudo R2 = 0.2471				
Log likelihood = -132.68303				

The only variable that significantly influences youths perception of quality of malaria diagnostic services is the time of diagnosis with being tested in the afternoon to evening increasing the chances of perceiving malaria diagnostic services to be of poor quality by 29 percent which is signififantly higher than for the estimation for the disaggregated sample. This indicates that the youth percieve time of diagnosis influence quality of malaria diagnostic services more than the general population. This finding is consistent with DeVoe *et al.* (2009) that found younger healthcare consumers were less likely to report being satisfied with healthcare services.

5. Conclusion

The study had the objective of assessing and quantifying the perceived quality of malaria diagnostic services in Dar es Salaam. The study found 27 percent of respondents perceived malaria diagnostic services in Dar es Salaam to be of poor quality based on not being satisfied with their initial malaria diagnostic results. Perceived quality of malaria diagnostic services in Dar es Salaam is significantly affected by the type of response to malaria in terms of always testing for malaria or not prior to taking any other action, time of consuming malaria diagnostic services which influences process quality, and diagnostician age which is a proxy for competence of human resources. Type of response to malaria illness influences acquisition of information which has an impact on perceptions, healthcare decisions and ultimately productivity of healthcare which impacts utility.

Time of diagnosis impacts perception of malaria diagnostic services in the sense that diagnosis made in the afternoon and beyond are undertaken by technicians who have worked long hours leading to exhaustion and eventually reduced emphasis on quality control issues which leads to reduced labour productivity that manifests itself in poor diagnosis and fails to significantly impact sick time. This results in consumers failing to increase utility despite using resources on healthcare eventually leading to poor perception of malaria diagnostic services. Diagnostician age which is a proxy for health personnel competence affects perception of quality of malaria diagnostic services as older diagnosticians tend to have more in-service training and experience that enhance their efficiency in undertaking their work through better process quality emanating from improved sample staining, smearing and reading.

Age, sex, type of health facility at which malaria is tested, and cost of malaria testing do not influence a person's perception of malaria diagnosis quality. Cost of malaria testing does not influence an individual's perception of malaria diagnostic services probably because of the low average cost of malaria diagnostic services which is relatively affordable compared to diagnosis of other illnesses. The insignificance of the type of health facility at which malaria is tested in terms of whether it is a hospital or non-hospital laboratory implies that both hospital and non-hospital laboratories are considered by consumers of malaria diagnostic services to be more or less the same as far as quality of malaria diagnosis is concerned.

The fact that perception of quality of malaria diagnostic services is affected by the type of response to malaria prior to taking antimalarials, diagnostician age, the time of consuming malaria diagnostic services indicates that improvement of perception of the quality of malaria diagnostic services can be undertaken by targeting these factors. There should thus be increased health education efforts geared towards increasing awareness of the importance of testing for malaria prior to taking any action. This is because response to suspected malaria illness is an attitudinal issue necessitating continuous health education efforts through schools and the media aimed at building a culture that considers malaria testing a perquisite for malaria management. Successful health education initiatives however require existence of a strong and well-coordinated health education framework in a country. This necessitates improved coordination of health education efforts in the country.

Factors influencing perception of malaria diagnostic services differ significantly by gender with diagnostician age and time of diagnosis influencing males perception of quality of malaria diagnostic services (these pertain to reliability i.e., the ability to effectively deliver the service) while respondent age and response to suspected malaria illness influencing females perception of quality of malaria diagnostic services (these pertain to accessibility i.e., increased utilization).

Time of diagnosis influences youth's perception of quality of malaria diagnostic services with being tested in the afternoon to evening increasing the chances of perceiving malaria diagnostic services to be of poor quality more than for the general population. The significance of diagnostician age which is a proxy for diagnostician competence in influencing perceived quality of malaria diagnostic services is indicative of the importance of experience in maintaining quality of malaria diagnostic services. It is thus imperative to emphasize in-service training for diagnosticians to maintain malaria diagnostic service quality.

Since the time of consuming malaria diagnostic services affects perception of such services in Dar es Salaam negatively through long working hours which affect productivity, there is a need to address the issue of maintaining productivity of health laboratory personnel at levels conducive to good quality diagnosis of malaria. Productivity of health laboratory personnel can be enhanced by focusing efforts on improving monitoring of work hours of health laboratory personnel through enhanced implementation of regulations governing working hours.

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