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Utilization and Accessibility of Healthcare on Pemba Island, Tanzania: Implications for Health Outcomes and Disease Surveillance for Typhoid Fever

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Abstract. *Salmonella enterica* serotype Typhi (*S.* Typhi) was estimated to cause over 200,000 deaths and more than 21 million illnesses worldwide, including over 400,000 illnesses in Africa. The current study was conducted in four villages on Pemba Island, Zanzibar, in 2010. We present data on policy makers', health administrators', and village residents' and leaders' perceptions of typhoid fever, and hypothetical and actual health care use among village residents for typhoid fever. Qualitative data provided descriptions of home-based treatment practices and use of western pharmaceuticals, and actual healthcare use for culture-confirmed typhoid fever. Survey data indicate health facility use was associated with gender, education, residency, and perceptions of severity for symptoms associated with typhoid fever. Data have implications for education of policy makers and health administrators, design and implementation of surveillance studies, and community-based interventions to prevent disease outbreaks, decrease risks of complications, and provide information about disease recognition, diagnosis, and treatment.

INTRODUCTION

Salmonella enterica serotype Typhi (*S.* Typhi) was estimated to cause more than 21 million illnesses and over 200,000 deaths worldwide in 2000. Over 400,000 of these illnesses occurred in Africa.[1] From 10 global population-based studies with blood culture confirmation, crude incidence rates varied from 13 to 976 cases per 100,000. A study conducted in South Africa during 1985 to 1988 reported a rate of 845/100,000 among 5 to 15 year olds.[2] In addition, four hospital-based studies were conducted in South Africa, Gabon, and Zimbabwe between the late 1970s and mid-1990s and reported 858 cases and 18 deaths.[3] In a recent review focused on the prevalence of bloodstream infections in Africa and based on 22 studies and 58,296 patients, *Salmonella enterica* was found to be the leading pathogen in febrile patients admitted to the hospital. In adults and children, 42% and 21%, respectively, of the isolated bacteria were identified as *Salmonella enterica*.[4] Surveillance in Kenya suggests that invasive non-Typhi serotypes of *S. enterica* (NTS) are also major causes of morbidity and mortality among hospitalized adults and children in sub-Saharan Africa.[5,6] The MDR strains of both *S.* Typhi and NTS have been documented.[7,8] Salmonellosis is likely emerging as a significant invasive bacterial disease throughout sub-Saharan Africa.

Typhoid fever may present as sustained fever, headache, abdominal pain, nausea, loss of appetite, and constipation or sometimes diarrhea. However, typhoid fever may be difficult to confirm if the diagnosis is based only on the clinical presentation. Hospitalization for typhoid fever occurs in 10–40% of cases. Complications include gastrointestinal bleeding and intestinal perforation. These complications occur in 1–4% of cases. Even where blood culture facilities and appropriate antibiotics are available, case fatality rates from these invasive *Salmonella* infections are high, particularly with the emergence of multidrug-resistant strains.

Limited data exist regarding actual or hypothetical use of health facilities for typhoid fever and/or associated symptoms. In a study of use of Community Health Extension Workers in Nigeria, ~7% of over 1,000 clients seen during a 6-month period were diagnosed with typhoid fever.[9] In another study in Ghana on the use of surgical hospital services, perforation caused by *S.* Typhi was one of the major indicators for surgery among adults and the primary indicator for children < 10 years of age.[10] As part of the current study, in 2009–2010 a hospital-based surveillance was conducted on Pemba Island, Tanzania to determine the primary causes of bloodstream infections. Blood cultures were performed on 2,209 febrile patients older than 2 months of age. Results indicate that of the 79 (4%) samples positive for pathogenic bacterial growth, 46 (58%) had *Salmonella* Typhi. Multidrug resistance (MDR) against ampicillin, chloramphenicol, and cotrimoxazole were detected in 42% of *S.* Typhi isolates.[11]

For most low- and middle-income countries accurate incidence data are limited caused by a lack of rapid and sensitive diagnostic tools and poor reporting systems.[12] Surveillance is the primary means through which infectious disease patterns can be identified and used to report on disease-specific incidence, morbidity, and mortality rates. Facility-based or passive surveillance is most commonly used; however, the method can be hampered by varied healthcare utilization patterns of the local population(s), and inaccurate diagnoses and disease recording and reporting. Active surveillance entails health providers seeking cases outside of health facilities, however it is more labor intensive and costly.[13]

The primary research questions addressed in the presented work are 1) How do policy makers, local leaders, and residents of Pemba Island perceive their vulnerability, prevalence, and severity of typhoid fever? 2) What are the patterns of general and hypothetical symptom-specific (sustained fever and abdominal pain) healthcare utilization among residents? 3) What is the sequencing of healthcare utilization among residents with culture-confirmed typhoid fever? 4) What are the implications of healthcare utilization patterns and perceptions

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of typhoid fever for disease outcome? and, 5) What are the implications of healthcare utilization patterns and perceptions of typhoid fever for disease burden surveillance and subsequent interventions for typhoid fever?

MATERIALS AND METHODS

Data were collected in two phases. The first phase included qualitative one-on-one interviews with policy makers, healthcare administrators, local village leaders (shehas), and residents. These qualitative interviews were designed to explore participants' experiences and perceptions regarding typhoid fever, other infectious disease, and use of treatments and health facilities. The qualitative interviews provided contextual data, which was used independently and a supplement to the survey data. The second phase included a randomized household survey focused on healthcare utilization and accessibility, engagement in safe water and sanitation practices, knowledge of typhoid fever, and vaccine desirability. The survey provided more generalizable data, and the ability to determine potential associations between variables, e.g., demographics and perceptions of typhoid fever and healthcare utilization.

Research site. Zanzibar is located off the coast of Tanzania and includes two main islands, Unguja and Pemba. Although part of the Republic of Tanzania and Zanzibar, Zanzibar remains semi-autonomous with an independent government, including executive and legislative bodies, and various ministries, e.g., Ministry of Health and Social Welfare. Zanzibar's economy is primarily agriculture-based though in recent years tourism has been an increasingly significant component of the local economy.[14]

In the Republic of Tanzania and Zanzibar, the 2009 Gross National Income per capita was US$500. In 2007, over 33% of the population was living below the national poverty line. Average life expectancy is 56 years.[15] The under 5 years of age mortality rate in 2009 was 107.9, which is lower compared with the overall sub-Saharan region (117.7) and other low-income countries (129.6). Fertility rates remain relatively high, with 6.3 children per woman in 2002. In 2008, 45% of the rural population had access to safe water, which is comparable to the general sub-Saharan region (46.8%), but lower than the global average for low income countries (55.6%).[15]

The current research was conducted on Pemba Island. However, qualitative interviews with government policy makers and administrators were conducted on the neighboring island of Unguja. In the 2002 census, Pemba Island's population was ~350,000 with over 80% of the residents living in rural areas. According to the 2002 census, 44% of the population is younger than 15 years of age.[16]

Four research villages in the southern region of Pemba were purposively selected by the local and international research teams. Two villages (Pujini and Uwandani) had recent blood culture-confirmed cases of typhoid fever, whereas two villages (Matale and Umangani) had no confirmed cases. The villages differ in distance and ease of access to the administrative center, Chake Chake. Pujini is the most remote and ~10 km from Chake Chake with a significant portion of travel time off paved roads; Uwandani is situated immediately off the main road. Qualitative interviews were conducted in Pujini and Matale with residents and local leaders (Sheha and assistant Sheha). The household surveys were conducted in all four villages.

Healthcare infrastructure. Healthcare in Zanzibar includes both public and private facilities with oversight through the Ministry of Health and Social Welfare (MOHSW). Private facilities on Pemba Island include over-the-counter shops and pharmacies. Public facilities include first and second line Primary Health Care Units (PHCU) at the village level, Primary Health Care Centers (PHCC) or "cottage hospitals" at 30-bed capacity, and district hospitals. First line PHCU services focus on basic health care, maternal-child care, outreach and health education services, immunization programs, and water sanitation efforts. Second line PHCU also includes laboratory facilities and dental services. PHCC include in-patient basic medical and surgical care, emergency obstetric services, psychiatric assessments, and ambulance services.[17] On Pemba Island there are 58 PHCU, two cottage hospitals (PHCC), and three public district hospitals with capacity of 80–120 beds.[18] One of the three district hospitals is located in Chake Chake.

Research population and sampling strategies. The research population included all residents 16 years of age and older and currently living in the four research villages. Through contact between the local research team members and the village Sheha (leaders), residents were purposively selected for the qualitative interviews based on criteria including experience with typhoid fever and socio-economic status. The Sheha or assistant Sheha were also interviewed in Matale and Pujini.

For the household survey, the research team was able to use lists of assigned household numbers in each village for randomization purposes. These numbers were assigned to and marked on all village housing structures as a part of the Public Health Laboratory-Ivo de Carneri/Johns Hopkins University database. A total of 487 households were selected based on an estimated = 0.05). At completion, 435 (89.3%) households participated in the survey. Primary reasons for not participating were absenteeism during the data collection days, a household number could not be located, or a structure had been abandoned.

Instrument development. Interview guides for policy makers and administrators, and residents and local leaders were developed for the qualitative interviews. The guides for policy makers and administrators included questions about the national and local level health infrastructure, knowledge and perceptions about typhoid fever, issues of water safety and sanitation, health outreach and education, and experiences with the Expanded Program for Immunization (EPI) and other vaccination programs. The guides for residents and local leaders focused on utilization and accessibility to healthcare facilities, water use practices, knowledge, perceptions, and experience of typhoid fever, experience with vaccination programs, and desirability for a typhoid vaccine in the future.

The household survey was developed based on typhoid fever pre-vaccination survey instruments previously used in Hue, Viet Nam, and Kolkata, India.[19,20] Modifications were made to the survey questions and response items based on local socio-cultural context and the qualitative interview data. The final survey included five sections: 1) demographics; 2) general healthcare utilization and accessibility; 3) hypothetical healthcare use for symptoms associated with typhoid fever; 4) knowledge, experience with, and perceptions of typhoid fever (including vulnerability, severity, prevention, treatment); 5) participation in EPI and vaccine desirability.

The survey was field piloted, minor revisions were incorporated, and final checks were conducted to ensure accurate translation of the survey from English to Swahili.

Data collection. Both qualitative and survey data were collected in September and October 2010. Qualitative data were audiotaped. Extensive notes were also taken during all of the interviews to allow more immediate access to the data. Qualitative interviews with policy makers and administrators were conducted primarily in English by one of the U.S. team members, with a translator available to clarify questions and responses. Interviews were conducted in the offices of the respondents. Qualitative interviews with local leaders and residents were conducted at the respondents' homes in Pujini and Matale. Interviews were conducted by a member of the U.S. team with a trained English-Swahili bilingual translator.

Household survey data were collected during three consecutive days in each village. Before data collection, the local village Sheha or assistant Sheha were provided with information about the survey and were asked to assist with locating the randomly selected households. Trained data collectors were provided with the lists of selected households. The U.S. team members and the local project coordinator supervised data collection to ensure that the correct households were identified, that questions were asked as designed, and responses correctly recorded.

Data collectors read the survey questions and as determined by the specific question either read responses or asked for a spontaneous answer. Responses were recorded on a survey form with a unique individual identification number. Each survey took ~30 minutes. Respondents were given a package of laundry soap for their time.

Data management and analysis. Qualitative data were transcribed and translated into English. Texts were coded for traditional medicine, general and symptom-specific healthcare utilization, accessibility of healthcare, and knowledge, perceptions, and experience with typhoid fever. As needed, terms for local medicines were researched to determine the plant species and literature regarding use of those plants for treatment of specific symptoms. Coded texts were reviewed for patterns and consistencies in relation to the research questions. Two members of the research team were involved in the coding and analysis of the qualitative data. In addition, the qualitative data were triangulated with the household survey data to further assess consistencies as well as possible contradictions between data sets. Demographic data from residents and local leaders were entered into SPSS (SPSS, Inc., Chicago, IL). Analysis of these data followed the same procedures as described below for the household survey data.

Household survey data were double entered into Microsoft FoxPro 7.0 (Microsoft, Seattle, WA) by trained local staff. Raw data were reviewed and corrections were made as necessary. The raw data were converted to and analyzed in SPSS version 11.5 and frequencies, means, and ranges were run for further data cleaning. A variable was created from a scale of questions about perceived severity of typhoid fever for infants, children, adults, and elderly.

Descriptive analysis provided information on demographics, healthcare utilization, and knowledge and perceptions of typhoid fever. Bivariate analysis included use of Pearson's χ^2s (categorical) and independent *t* tests and analysis of variance (continuous) for testing significance. Multinomial logistic regression analysis was used to determine independent association of residency (village), gender, age, and education for beliefs about cause of typhoid fever, perceived household vulnerability to typhoid fever, and symptom-specific (sustained fever for 3 days and abdominal pain) hypothetical healthcare utilization for respondent (self) and his/her child.

Research ethics. The protocol and instruments (interview guides and survey) were approved by the ethics board at the International Vaccine Institute, Seoul, Korea, and through the Zanzibar Research Council Ethics Committee. Consents were read to respondents and respondents either signed or imprinted a fingerprint with a witness's signature to acknowledge consent. Data collectors were trained in research ethics and consenting procedures.

RESULTS

Demographics. Twenty qualitative interviews were conducted in two villages (Pujini and Matale). A total of 435 household surveys were completed in the four research villages with ~25% of surveys conducted per village (range 23.2–27.1%). Among qualitative interview respondents, 55% (11 of 20) were female; among household survey respondents, 73.1% (318 of 435) were female. Mean ages were 38.6 [SD 11.3] years (range 16–55 years) for qualitative interview respondents and 41.1 years (SD 15.6, range 18–96) for survey respondents. Among the survey respondents, male respondents were significantly older than female respondents (47.1 versus 38.9 years: $t = 4.945$, degrees of freedom [df] 412: $P < 0.001$). All respondents were Muslim. Additional demographic data are provided in Table 1.

Perceptions of typhoid fever. A majority of survey respondents (91.3%) either did not know or were unsure about typhoid fever (homa ya matumbo). There were no significant differences in knowledge of typhoid fever by gender, age, residency, or education. To obtain perceptions of vulnerability and severity, respondents were provided with a brief description of typhoid fever symptoms (sustained fever for 3 days and abdominal pain). Although a majority of respondents agreed that typhoid could be caused by contaminated tap water (84.4%/367), not washing hands (86.2%/375), and/or unhygienic latrines (83.0%/361), only 57.5% stated that the disease could be caused by drinking unboiled water. In addition, 91.7% (399) perceived the disease as "God's will" and 38.4% (167) perceived typhoid fever to be caused by "Jin" (witchcraft). Female respondents were more likely than male respondents (40.9% versus 31.6%) to perceive "Jin" as a cause of typhoid fever, odds ratio (OR) 1.76 (confidence interval [CI] 1.02–3.03), $P = 0.043$. Belief in "Jin" also differed by site with 48.5% Matale respondents, 46.7% Pujini respondents, 30.5% Uwandani respondents, and 29.4% Umangani respondents stating "Jin" causes typhoid fever. Lower education and attendance at Koran school were also associated with respondents' belief in "Jin" (Table 2).

On the household survey severity scale, those respondents with no formal education perceived typhoid fever as more severe (mean 12.23, SD 3.0) compared with respondents with secondary education (mean 11.22, SD 3.0) [$F = 2.330$, df 6: $P = 0.012$]. There was no difference in perceived severity by gender ($F = 0.171$, df 1: $P = 0.679$) or research site ($F = 0.035$, df 3: $P = 0.991$).

TABLE 1
Demographic characteristics of qualitative interview and household survey respondents

		Qualitative interviews ($N = 20$)	Household survey ($N = 435$)
Marital status	Married	90.0% (18)	78.8% (342)
	Single	5.0% (1)	4.8% (21)
	Divorced/separated	5.0% (1)	6.7% (29)
	Widow/widower	0	9.7% (42)
Mean household size		6.8 (SD 2.7; 2–12).	12 (SD 5.7; 2–30).
Mean children (< 19 yrs)		4.1 (SD 1.9; 0–8).	5.5 (SD 3.0; 1-15)
Mean household income (US$)		$105 (SD$57; $33–$267).	See expenditure
Mean household expenditure (US$)		See income	$102 (SD $64; $66–$462).
Household has electricity		No data	15.3% (66)
Education	No schooling	0	43.2% (187)
	Koran school	35.0% (7)	15.7% (68)
	Primary school	35.0% (7)	23.6% (102)
	Secondary school	30.0% (6)	17.5% (76)
Occupation	Farming	60.0% (12)	65.3% (282)
	Government sector	20.0% (4)	2.3% (10)
	Fishing	5.0% (1)	0.9% (4)
	Self-used	10.0% (2)	10.8% (47)
	Housewife	5.0% (1)	16.9% (73)

Survey respondents ranked typhoid fever less common than malaria, pneumonia, cholera, and dysentery. There was no difference for ranking of disease prevalence by gender (t = 1.018, df 429: $P = 0.309$) or education (F = 0.343, df 3: $P = 0.794$). However, there was a difference for perceptions of disease prevalence by site (F = 4.211, df 3: $P = 0.006$), with Uwandani (site with confirmed typhoid fever cases) ranking it higher in prevalence 2.89 (SD 1.48) than the other three sites.

In terms of personal vulnerability, 51.1% (222 of 434) survey respondents said it was "somewhat likely" or "very likely" someone in their household would contract typhoid fever. Female respondents more often stated that it was "unlikely" that a household member would contract typhoid fever, OR 2.12 (CI 1.03–4.36), $P = 0.041$. There was no difference in perceptions of likelihood of household members contracting typhoid fever between villages with blood culture-confirmed cases of typhoid fever (Pujini and Uwandani) and those without confirmed cases (Matale and Umangani), OR 1.14 (CI 0.62–2.08), $P = 0.677$. Respondents with secondary education were four times as likely, OR 4.00 (CI 1.56–10.27), $P = 0.004$ and those with primary education more than two times as likely, OR 2.22 (CI 1.00–4.93), $P = 0.049$ as respondents with no education to report that it is "somewhat likely" as opposed to "very likely" a household member would contract typhoid fever.

In the resident qualitative interviews, a majority of respondents were not immediately familiar with typhoid fever, and those who had heard of the disease had few or no specific information about symptoms and treatment. In Pujini, which had recently experienced blood culture-confirmed cases of typhoid fever, a respondent was asked if he had heard about the disease.

"I heard that (about typhoid fever)...honestly I didn't get any information...I didn't get information for that (causes of typhoid), but we have been told about other disease symptoms...we have been told about cleaning the environment, they come one time and give us training. They told us because of cholera...."

A local leader from Matale stated, "*I only hear (about the disease) but never heard about the causes...we heard from the health members when they come in the village...*"

Those who were familiar with typhoid fever considered it a "dangerous" disease. One older woman from Matale noted, "*This (disease) is serious because it reduces the power of a person.*"

Healthcare utilization. Household survey respondents were asked about general healthcare facility use, and what facility they would use for themselves and for a child with symptoms associated with typhoid fever (sustained fever for three days and abdominal pain). The primary facilities used for self and child were the village PHCUs (42.8% and 49.3%), the cottage hospitals (PHCCs) (31.7% and 36.0%), and the Chake Chake district hospital (11.3% and 10.3%). Overall, 13.3% of respondents stated they would self-medicate or go to the pharmacy for themselves, and 4.0% said they would use these treatment options for a child.

The three primary means of transportation to facilities include walking (69.9%, $N = 300$), minibus (18.9%, $N = 81$), and bicycle (8.4%, $N = 36$). Travel time to health care facilities ranged from 1 to 180 minutes (mean 47.7 minutes [SD 37.3]). There was a significant difference by research village and time to health facilities (F = 1.765, df 23: $P = 0.017$).

Multinomial logistic analysis was conducted in relation to hypothetical use of health facilities for symptoms associated with typhoid fever for self and child. Factors included in the analysis were the respondent's gender, education, and village residency. Age was included as a co-variate. Males were two times as likely as females to use self-medication or go to a pharmacy for themselves, OR 2.07 (CI 1.09–3.90), $P = 0.025$

TABLE 2
Perceptions of "Jin" as cause of typhoid fever by gender, residency, and education

Variable		
Gender*	Female	OR 1.76 (CI 1.02–3.03)§
Residency†	Pujini	OR 2.07 (CI 1.07–4.01)§
	Matale	OR 2.15 (CI 1.11–4.18)§
	Uwandani	OR 0.96 (CI 0.49–1.89)
Education‡	No education	OR 2.60 (CI 1.25–5.42)§
	Koran school	OR 3.67 (CI 1.58–8.49)¶
	Primary school	OR 2.99 (CI 1.41–6.17)¶

*Reference-male.
†Reference – Umangani village.
‡Reference – secondary education.
§$P < 0.05$.
¶$P < 0.01$.
OR = odds ratio.

and three times as likely to use a hospital, OR 3.03 (CI 1.50–6.13), $P = 0.002$. Male respondents more often stated than female respondents that they would use hospital treatment of a child, OR 2.95 (CI 1.38–632), $P = 0.005$. Female respondents were more than two times as likely as male respondents to use the cottage hospital (PHCC) for themselves, OR 2.53 (CI 1.35–4.72), $P = 0.004$ but this difference did not extend to use of the cottage hospitals for a child, OR 0.67 (CI 0.36–1.23), $P = 0.198$.

Residents of Pujini, Matale, and Uwandani were more likely than residents of Umangani to state they would use the PHCU for themselves and for their child. Residents of Umangani were more likely than respondents from Pujini and Matale to report they would use the cottage hospital. Respondents from Matale were more likely than residents of Umangani to state they would use the hospital for both themselves and for their children. Education was also associated with utilization of health facilities for symptoms associated with typhoid fever. Residents with no education or primary education were more likely than those with secondary education to report they would use the PHCU. Respondents who were educated in the Koran schools were more likely than those with secondary education to report they would use the cottage hospital, whereas those with secondary education were more likely to report that they would use the district hospital for their child (Table 3).

Choice of healthcare facility for symptoms associated with typhoid fever were significantly related to perception of severity of those symptoms for self ($X^2 = 91.37$, df 6: $P < 0.001$), with those perceiving the symptoms as "not too serious" more likely to use self-treatment and pharmacies and less likely to use PHCU, or cottage, or district hospitals. Alternatively, for children, there was no significant difference in treatment-seeking based on perception of symptom severity ($X^2 = 6.272$, df 6: $P = 0.393$).

Respondents reported a range of reasons for choice of a healthcare facility for self and child in relation to sustained fever and abdominal pain. The primary reasons included nearness to house (48.7% of 54.9%), drug availability (33.3% of 36.5%), and good treatment options (17.6% of 18.9%). Female respondents were more likely than male respondents to state "nearness to house" as a reason to use a healthcare facility for self, OR 2.00 (CI 1.24–3.22), $P = 0.004$, and for child OR 1.68 (CI 1.01–2.81), $P = 0.047$.

Through the qualitative interviews we obtained details about use of traditional medicines, western pharmaceuticals, and health facilities for fever and abdominal pain. Generally, the first treatment of abdominal pain was some form of traditional home-based treatment. These treatments included Mzamba (African bush basil), Mpatakuva (*Coleus forskohlii* or Indian coleus), and Muwarubaini ("neem"). Mpatakuva is also used for menstrual cramps and labor pain. Muwarubaini is considered to be effective for 40 conditions and has been recorded as being used for treatment of symptoms of typhoid fever in Kenya.[21,22] The home-based treatments are used as a first attempt to deal with an illness and may also be used when other health facilities are not immediately accessible. A resident of Matale discussed the use of Mpatakuva for stomach pain or vomiting.

"We just cut it (Mpatakuva) and boil it and then drink or (use) ripe cloves…maybe if you get stomach pain at night, I just tell someone to find Mpatakuva or cloves for me…."

For treatment of fever, only one traditional home-based remedy was discussed—Mukunda nyoka. The leaves and bark of Mukunda nyoka have been recorded to be used in Tanzania and Zimbabwe for symptoms including fever, hernia, and abdominal pain.[23] However, most respondents stated that the first treatment of fever was a western pharmaceutical, e.g., Panadol (*Acetominaphen*/*Paracetamol*) and for sustained fever, use of available public health facilities.

"*If it's a stomach (pain) we can help (the child) at that time by mzamba…if it's fever, we give him panadol and give him on the next day. Then we send to the hospital…."*

Table 3

Hypothetical use of healthcare facilities for symptoms associated with typhoid fever (sustained fever for 3 days and abdominal pain) for respondent (self) and child by residency and education

		PHCU	Cottage hospital	District hospital
SELF-residency	Pujini-Umangani	OR 5.91 (CI 3.06–11.40)*		
	Matale-Umangani	OR 4.92 (CI 2.50–9.68)*		
	Uwandani-Umangani	OR 3.87 (CI 2.02–7.41)*		
	Umangani-Pujini		OR 10.01 (CI 4.96–20.21)*	
	Umangani-Matale		OR 2.15 (CI 1.11–4.18)†	
	Umangani-Uwandani		OR 0.96 (CI 0.49–1.89)	
	Matale-Umangani			OR 7.29 (CI 2.76–19.28)*
SELF-education	No education-secondary	OR 2.62 (CI 1.34–5.12)†	OR 0.67 (CI 0.32–1.41)	
	Koran-secondary	OR 0.481 (CI 0.20–1.14)	OR 3.75 (CI 1.56–9.02)†	
	Primary-secondary	OR 2.00 (CI 1.00–3.98)‡	OR 0.67 (CI 0.31–1.46)	
CHILD-residency	Pujini-Umangani	OR 7.65 (CI 3.86–15.18)*		
	Matale-Umangani	OR 6.03 (CI 2.98–12.19)*		
	Uwandani-Umangani	OR 4.59 (CI 2.34–8.98)*		
	Umangani-Pujini		OR 10.00 (CI 4.95–20.18)*	
	Umangani-Matale		OR 14.82 (CI 6.71–32.71)*	
	Umangani-Uwandani		OR 3.25 (CI 1.73–6.12)*	
	Matale-Umangani			OR 7.67 (CI 2.64–22.32)*
CHILD-education	No education-secondary	OR 3.62 (CI 1.79–7.34)*	OR 0.49 (CI 0.23–1.03)	
	Koran-secondary	OR 0.67 (CI 0.29–1.57)	OR 3.32 (CI 1.38–7.98)†	
	Primary-secondary	OR 2.14 (CI 1.05–4.35)‡	OR 0.53 (CI 2.48–1.14)	
	Secondary-Koran			OR 3.87 (CI 1.06–14.09)‡

* $P < 0.001$.
† $P < 0.01$.
‡ $P < 0.05$.
PHCU = Primary Health Care Units.

Although most respondents discussed use of home-based treatments, only a few individuals discussed a distinction between "hospital diseases" and those you can treat at home, which require a specific intervention. A resident of Matale described an integrated use of traditional healing within the context of the local practice of Islam.

"...(to treat at home) a disease that has been caused by evil spirit (mabilisi)...the symptoms...you will know the disease from God. Also you will know how a person is sick...it has been caused by jealousy only and he (person causing disease) can give you the devil...first we remove that devil by using Quran and then we use herbs...."

Only a few individuals discussed the use of traditional doctors (mganga). A leader from Matale described the use of traditional doctors.

"There is no mganga (traditional or witch doctor) in some places. Honestly, in our shehia (village) there is about 40% people use this, but I have to say there is nothing...[most] witch doctors [do not have] not enough knowledge on what they cure and on what they give. They will tell you the kind of disease the patient suffers from, but they only guess. Maybe you can go and they will tell you that you took a wife of another man, he will give you leaves that he knows...to go boil and drink...but they don't know exactly the source of your problem. ...there is (also) a grandmother called bimaryam that she has the medicine for children and pregnant women that have abdominal pain. They go there and receive a massage and a little bit using roots...."

These accounts indicate a systemic use of an array of herbal remedies, ritual healing, and basic pharmaceutical medications, as well as regular use of biomedical facilities when symptoms are serious and persistent. Although the need for professional biomedical care is widely accepted, there are difficulties in accessing care at district hospitals, which include physical distance and costs for transportation and medications. As one villager in Matale described:

"We don't have transport where we live. We have to come to the road and rent (a passenger car). Then we go to the hospital and they tell us they have no medicine. We have to depend on ourselves to buy it, and our financial situation is difficult.

Resident healthcare utilization patterns for cases of typhoid fever. In Pujini we conducted interviews with residents in three households that had experienced laboratory-confirmed typhoid fever. A woman from Pujini described the symptoms of typhoid fever that she experienced:

"First I get a headache, a terrible headache so I stayed home and take the medicine. After that I went to the hospital....then I get stomach pain. It was stomach pain and headache, then I get a fever."

When asked what she thought might be the cause of her illness before she went to the hospital, she describes it as mabilisi bilisi (a "devil" problem). At that time, she used mtikiti, which was recommended to her as a treatment. After being sick for 4 days she went to the (cottage) hospital where she was diagnosed with and treated for malaria. When her symptoms did not improve with the malaria medicine, she went to Chake Chake hospital where she was tested for typhoid fever and admitted. She spent a week and half in the hospital. After hospitalization she took medication for 1 month.

Another respondent described his experiences when his child had typhoid fever.

"First the body gets lazy, the body gets dry, and then he can't eat and the ribs get sore. Having a headache and sleeping a lot...we guessed it was a fever and sent him to the hospital back and forth...I get the doctor's advice. They check the blood and we get medicine and he gets better."

Before taking the child to the hospital they used Panadol (*Acetominaphen*/*Paracetamol*) for the fever, but did not use traditional medicine.

In another Pujini family, there were two blood culture-confirmed cases of typhoid fever among children in the household. In the case of one child, it started with a headache and later a fever began. After giving the child Panadol they took him to the local cottage hospital where he received medicine for four days. However, this treatment did not relieve his symptoms. As his parent described,

"*He got better at noon, but the fever came again at night. We sent him to the Chake (district) hospital. There they treated him with a drip and he stayed for one night. He stayed sick longer, only about a week (with the medicine they gave him).*"

Policy makers' and health administrators' perceptions of typhoid fever. The qualitative interviews with policy makers revealed their perceptions of the causes of typhoid fever on Zanzibar and the need for diagnostic and preventive programs including vaccination. Though there is no longitudinal data available to show patterns of the prevalence of typhoid fever on Pemba, many policy makers and administrators perceived an increase in the prevalence of typhoid fever as a result of increasing migration to and from the mainland. As noted by a health provider working with the EPI,

"There is a large number of typhoid (cases) from these movements from the mainland... because the source of water supply in our country is not bad but for mainland...you know the situation of the mainland is not good. So possibly there (are) a big number of typhoid (cases) in Pemba...."

Alternatively, a couple of medical administrators noted that increases in incidence may be linked to improved use of laboratory diagnosis and reporting systems, whereas a zonal health officer was concerned that practitioners at private clinics were misinterpreting Widal diagnostic tests and inflating rates of typhoid fever.

A primary concern of the majority of the policy makers and administrators was the availability of reliable data on the prevalence of typhoid fever and the ability to assess disease burden to prioritize programming funds. A high level official noted,

"...I heard from somebody that there's a problem from typhoid fever. But I don't know what it is and which areas? How many people are affected here? So we need to have that information...my request is to extend the surveillance program in Zanzibar...."

Similarly, a health officer in Pemba noted,

"You know we need a baseline...data first. How is it now in Pemba? How many (typhoid) patients per year? Who are the patients?...children under five years, maybe children above five or adults? What are the consequences of typhoid fever...?

This lack of information led the policy makers and administrators to speculate on the prevalence of typhoid fever with some expressing concern, whereas others were more conservative.

Respondents also discussed the need for information for making decisions about prevention activities including

introduction of a typhoid fever vaccination program. Of some concern to an EPI official were the increasing numbers of vaccines being introduced.

"*There are a lot of vaccines, many many vaccines. So overall it is better if we want to start another vaccine program, we need to have the baseline data....*"

A zonal official in Unguja stated, "*We are looking for the immunization...like measles and other infectious diseases....cholera and other...(but) for typhoid, actually for the typhoid....we don't have reliable data....*"

DISCUSSION

There is a paucity of data regarding typhoid fever incidence throughout sub-Saharan Africa despite indications of significant disease burden from both *Salmonella* Typhi and NTS.[3] Lack of sufficient population-based data has implications for health outcomes including complications and mortality, allocation of resources, and implementation of prevention measures including immunization campaigns. Passive surveillance with blood culture confirmation of typhoid fever can provide data on incidence rates across and within population groups, however understanding local healthcare utilization patterns is necessary to obtain accurate data.

The pluralistic health system on Pemba Island is a complex integration of home-based treatments, traditional spiritual healers (e.g., mganga), local interpretations of Islam, and biomedicine.[24] Although a majority of residents were not immediately familiar with typhoid fever, we were interested in how people respond to symptoms associated with typhoid fever, where they go for healthcare, and how such responses to symptoms may affect both surveillance efforts and disease morbidity and mortality.

In the current data analysis, we find that perceptions about typhoid fever and associated symptoms and healthcare utilization vary significantly based on respondents' residency, education, and gender. On the household survey, women are more likely than men to prescribe to beliefs about "Jin" (witchcraft) and also stated more often that it is "unlikely" a household member will contract typhoid fever. Compared with women, men report greater likelihood that they would go to the district hospital for sustained fever and abdominal pain, and women express more concern than men about the proximity of a health facility. Through our case studies interviews, we hear directly from a woman who had laboratory-confirmed typhoid fever regarding her use of local traditional treatments and delay in health-seeking at a public health facility. These data indicate that women may be less likely to obtain needed care as a result of both belief systems and social accessibility. Alternatively, the data also indicate that men were more likely than women to use self-medication and go to pharmacies for sustained fever and abdominal pain. This may be a consequence of men's less regular contact with local health providers and facilities, e.g., PHCU, where women seek both pre-and post-natal care and obtain vaccines and medications for their children.

A higher percentage of respondents in more remote villages and respondents with lower levels of education reported "Jin" as one cause of typhoid fever. Respondents with lower education perceived typhoid fever as more severe compared with respondents with higher education. However, respondents with secondary education were more likely than those with lower education to state they would use a hospital for a child with sustained fever and abdominal pain. Although some village residents may be aware of typhoid fever and the potential severity of the disease, logistical and alternative disease etiologies, which require socio-religious interventions, may delay treatment seeking. Individuals from higher education groups may also have greater knowledge of and accessibility to treatment and therefore perceive the disease as less severe. This is consistent with other research on infectious disease and healthcare utilization whereby income and education affect perceptions of vulnerability and severity, as well health-seeking patterns.[25,26]

Research conducted among policy makers across seven countries in Asia indicate respondents' recognition of typhoid fever as a problem—particularly with emerging MDR strains—and interest in vaccine introduction. However, these policy makers repeated the need for regional incidence data to determine where limited resources can have the greatest impact.[27] In our qualitative interviews with policy makers and health administrators in Zanzibar, they indicated that current Health Management Information System (HMIS) surveillance data on typhoid fever was insufficient to make decisions about intervention efforts. Some policy makers and administrators also perceived the "problem" of typhoid fever as primarily restricted to mainland Tanzania. Such perceptions of diseases as that of "others" can foster a sense of lowered risk.

The triangulation of the household survey and the qualitative interviews provides complementary data that emphasizes the importance of multimethods in healthcare utilization studies. Although relatively few respondents in the household survey stated that they did or would use self-medication or pharmacies both in general and for specific symptoms of typhoid fever, the qualitative data were rich in descriptions of local home-based treatment practices. These qualitative data also indicate regular use of western pharmaceuticals for fever reduction before treatment seeking at public health facilities. The qualitative data also provided detailed contextual data on actual healthcare utilization among individuals with blood culture-confirmed typhoid fever. Survey data were important to understanding the socio-demographic variables that affected healthcare utilization patterns.

These data have implications for education, intervention, and implementation of surveillance studies. In terms of the latter, passive facility (hospital) based surveillance will detect some portion of typhoid fever cases.[11] However, these data indicate that certain groups may be more likely to use hospitals for treatment. Short-term active surveillance should target women and residents of more remote villages. Data on use of different facilities can also improve calculations of crude incidence rates both in general and for specific socio-demographic groups.

Accurate incidence data of typhoid fever in Africa are essential for scientific purposes, but also are necessary for the education of policy makers and health administrators. Limited health resources require national and local decisions about allocation of funds and personnel across public facilities, which in turn require data on disease incidence, case fatality rates, prevalent serotypes (by age group, co-infections or geographic area), as well as risk factors for infection and carriage. Vaccine introduction also requires policy decisions about targeted implementation for higher risk groups versus

universal immunization, and associated costs and benefits of different strategies.[28]

Healthcare utilization and disease perception data can also contribute to targeted community-based interventions for health providers, local leaders, and residents to prevent and contain disease outbreaks, decrease risks of complications, and provide needed information about disease recognition, diagnosis, and treatment. Women's regular use of PHCUs provides educational opportunities regarding typhoid fever prevention and treatment of themselves and their families. Shehas are respected members of the community and need and have requested information that they can share with village residents. Knowledge of healthcare utilization patterns and local traditional beliefs and treatments can enable the development of educational materials and intervention strategies, which are consistent with local practices and use the existing local health system infrastructure.

The current data were collected in four villages on Pemba Island, Zanzibar. It is uncertain to what extent these data can be generalized for larger regions, e.g., Tanzania, East Africa. The methods used here however can be used as a means of obtaining similar data in other sites. These additional cross-cultural and regional-based survey and qualitative research are needed in sub-Saharan Africa to identify socio-demographic and cultural factors associated with knowledge and perceptions of typhoid fever and healthcare utilization patterns. Such research can contribute to surveillance strategies resulting in more reliable data on typhoid fever disease burden, and identification of effective prevention content and delivery, and accessible treatment.

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