The concurrence of typhoid and malaria as compared to typhoid and other diagnoses in adult patients admitted in the medical wards at Iringa Regional Hospital, Tanzania.

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DECLARATION

I, Dr. Alfred C.T. Kangolle, hereby declare that the work on which this dissertation is based is original (except where acknowledgments indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for the purposes of another qualification.

Signed by candidate

Signature: Signature Removed **Date:** 13 January 2005

CONTENTS

ACRONYMS:

CHMTs	Community Health Management Teams.
IMCI	Integrated Management of Childhood Illnesses.
MARA/ARMA	Mapping Malaria Risk in Africa/Atlas du Risqué de la Malaria en Afrique.
UNICEF	United Nations Children's Fund.
WHO	World Health Organisation.

ABSTRACT

Introduction

Malaria and typhoid are two diseases caused by different infectious organisms. Both have symptoms and signs that are very similar, making it possible to diagnose one instead of the other. In some parts of the world these two diseases are very common and may co-exist in one patient, hence making it difficult for health personnel once they have confirmed one disease, to always be aware of the possible presence of another. The patients' blood can be tested in the laboratory to confirm the presence or absence of these diseases.

Objectives

The objectives of this study were:

1: To determine the proportion of malaria and typhoid among patients admitted with a malaria admission diagnosis and with other admission diagnoses.

2: To measure the proportion of concurrent typhoid and malaria among patients admitted with a malaria admission diagnosis and with other admission diagnoses.

3: To determine the validity and reliability of using the on-slide agglutination test, as a rapid test for diagnosing typhoid among adult patients with admission diagnosis of malaria.

4. To assess the distribution of the risk factors of malaria and typhoid between the two groups studied: a malaria admission diagnosis, and other admission diagnoses among adult patients admitted in medical wards.

Methods

A cross-sectional analytic study was conducted on 214 patients admitted in medical wards at Iringa Regional Hospital, Tanzania. For every subject diagnosed on admission with malaria, a patient with another admission diagnosis was selected. Data collection was through questionnaire interview, review of patient's folder and diagnostic criteria, as well as blood tests that were used to determine the presence of typhoid and malaria. Ethical approval was obtained from the Ethics Committee, University of Cape Town. Informed consent was obtained from each study participant. Data analysis was undertaken using STATA (version 8) software, and validity and reliability were calculated using relevant formulae. Pearson correlation and 95% confidence intervals (CI) of proportions and proportions differences were used to assess the concurrence of typhoid and malaria. Sensitivity, specificity, positive and negative predictive values, likelihood ratios and their 95% CI were calculated to determine the validity of the on-slide agglutination test as compared to the Widal test.

Results

A total of 232 patients were approached and 92.2% (214) agreed to participate. The proportion of typhoid among study participants was 31.8% - 46.1% among those diagnosed on admission with malaria and 15.2% for those with other admission diagnoses. The correlation of typhoid and malaria admission diagnoses was significant with Pearson $\chi^2 = 23.485$ ($p < 0.001$). Correlation was also significant between the diagnosis of typhoid and malaria based on diagnostic criteria with Pearson $\chi^2 = 5.677$ ($p = 0.017$). There was no difference between the distribution patterns of symptoms and

signs of typhoid and those of a malaria admission diagnosis. The sensitivity and specificity of the on-slide agglutination test when both STO and STH are positive were 86.8% (95% CI 76.7 – 92.9%) and 90.4% (95% CI 84.7 – 94.0%) respectively. The positive predictive value was 80.8% (95% CI 70.3 – 88.2%) and the negative predictive value was 93.6% (95% CI 88.3 – 96.6%). The likelihood ratio positive was 9.05 (95% CI 5.45 – 15.02) and the likelihood ratio negative was 0.15 (95% CI 0.08 – 0.28).

Conclusion

A high proportion of typhoid was found in patients included in this study. In addition, a large proportion of those with an admission diagnosis of malaria, either had typhoid, or had both typhoid and malaria. Since there was no difference between the patterns of symptoms and signs of typhoid and malaria when diagnosed on admission, and both diseases have a high case fatality rate if not treated properly, it is imperative to test for typhoid in any patient who is admitted with these symptoms and signs. The on-slide agglutination test, when both STO and STH are positive, though not statistically different from a positive STO or STH test alone, can be used to diagnose typhoid in areas with a high prevalence of typhoid.

CHAPTER 1: INTRODUCTION

1.1: *LITERATURE REVIEW*

Epidemiology of malaria

Malaria is one of the most common diseases. An estimated 20% of the world's population - mostly living in the poorest countries - is at risk of contracting malaria (WHO, 2003a). Worldwide there are three hundred million clinically-diagnosed malaria cases a year and one million deaths.

Almost 90% of these deaths occur in sub-Saharan Africa. Malaria causes nearly 250 times the deaths in the world's poorest countries than in the richest countries (WHO, 1999; WHO, 2003a; WHO, 2003b). These deaths are due to the fact that the majority of infections in Africa are caused by *Plasmodium falciparum*, the most dangerous species of the four malaria parasites (WHO, 2003b; WHO, 1999).

The economic burden of malaria to households can be extremely high (WHO, 1999; WHO, 2003b). Even in the poor countries of sub-Saharan Africa, households have been found to spend between $2 and $25 on malaria treatment, and between $0.20 and $15 on prevention each month (WHO, 1999). WHO (2003b) in the Africa Malaria Report states that malaria is responsible for a high proportion of public health expenditure on curative treatment.

In Tanzania, about 30 million people are at risk of contacting malaria (MARA/ARMA Collaboration 2002) and 45% of hospital admissions are due to malaria. In a demographic

surveillance system in rural areas, under-five mortality following acute fever (much of which would be expected to be due to malaria) was 39% higher in the poorest socio-economic group than among the more affluent (WHO, 2003b). From the Tanzania Ministry of Health Report, acute febrile illness constituted approximately 70% of the disease burden in Integrated Management of Childhood Illnesses (IMCI) in the Morogoro district in 2001. Women of reproductive age suffered more than eight percent of the malaria burden.

In Tanzania, the incidence and prevalence of malaria varies from place to place. Studies among children aged 0–15 years old in the Kyela district by Minja (1990) and Matola (1990) found a prevalence of 44.58%. Magnussen et al. (2001) undertook a study in the Pangani district, Tanzania, where once yearly malaria-metric surveys on children aged 7-15 years were conducted (1995-1997). *Plasmodium falciparum* accounted for 100% of infections and the parasite prevalence varied between 32.7 and 35.3% from 1995 to 1997. Mwageni et al. (2002) conducted a follow-up study in the Rufiji district, where 104,757 person-years were investigated; 1,306 deaths were recorded, 482 were coded as due to malaria, with the poorest having 66% more malaria mortality compared to the more affluent.

Malaria is one of top ten causes of outpatient attendances and admissions in the Iringa region. In 2002 it contributed 37.9% and 41.1% of outpatient attendances for children under-five and adults respectively. For admissions, the proportions were 38% and 49.6% respectively (Regional Department of Health, 2003).

The high burden of malaria reported may be partly a result of misdiagnosis, since many facilities lack laboratory capacity and it is often difficult clinically to distinguish malaria from other infectious diseases. Even with good laboratory facilities, a positive malaria test in endemic areas does not mean that the person is suffering from malaria (WHO, 2003b). Malaria parasitaemia is common among clinic attendees in many endemic areas, where 25-40% (with an average of 30%) of all outpatient clinic visits are due to malaria, and 20% to 50% of all hospital admissions, a consequence of malaria (WHO, 2003b). This makes it important to look for other diseases causing similar presentation to that of malaria in endemic areas. Malaria diagnosis is therefore achieved by a combination of its clinical presentation, laboratory findings and exclusion of other diseases with similar presentation.

Similarity of malaria and typhoid

The clinical presentation of malaria includes fever, malaise, headache, joint pains, nausea or vomiting, loss of appetite, general body weakness and sometimes diarrhoea. When in severe form, it may present with mental dullness, or convulsions or confusion, which may mimic meningitis. Cough may occur as a result of pulmonary oedema (WHO, 1999).

If malaria is diagnosed and treated promptly, the infection may quickly subside, but without effective treatment, severe complications - such as cerebral malaria, anaemia or multiple organ failure - can rapidly develop, leading to a case-fatality of 10-30%. The progression from mild symptoms to death can be rapid (WHO, 1999).

Typhoid presents with a very similar clinical picture of fever of sudden onset, severe headache, severe loss of appetite, nausea, constipation or diarrhoea and sometimes a hoarse cough. Mental dullness and meningitis occur in severe forms (WHO, 1997). This makes it difficult to differentiate typhoid from malaria because their symptoms and signs often overlap (Nsutebu, Martins and Adiogo, 2003; WHO, 2003b; Ammah et al., 2002).

Epidemiology of typhoid

Annually, typhoid affects 17,000,000 people worldwide, with approximately 600,000 deaths. The case-fatality rate of typhoid is 10%. This case fatality can be reduced to one percent with proper diagnosis and appropriate antibiotic therapy (WHO, 1997).

About 10% of untreated patients will discharge bacteria for up to three months and 2-5% will become a permanent carrier, thus increasing the chances of disease transmission. Transmission of typhoid occurs when there is contamination of food or water by faeces or urine of patients or carriers (WHO, 1997).

Africa has an incidence of 10–100/100,000 (with a crude incidence of 50/100,000) cases per year. The highest crude incidence of 233/100,000 cases per year is in southern Africa. Other parts of Africa; eastern, northern, middle and western Africa have similar crude incidences of 33–39/100,000 cases per year (Crump, Luby & Mintz, 2004).

In Tanzania, almost one third of those seeking health care are due to typhoid, some of them being admitted. Typhoid is not among the top 10 causes of admission or outpatient attendance in the Iringa region (Regional Department of Health, 2003).

Similar to malaria, the transmission of typhoid increases during the rainy seasons, as water sources and food become easily contaminated. Transmission is even higher in poor countries where water treatment and waste disposal is problematic. Malaria increases as a result of the increase of breeding sites for mosquitoes, the vectors of *Plasmodium* (WHO, 1997; WHO, 2003b; WHO, 1999). The increase of cases of typhoid and malaria during the same seasons makes their differential diagnosis more critical.

Epidemiology of concurrent malaria and typhoid infection

There are few studies that have been undertaken worldwide to determine the number of individuals suffering at the same time with both malaria and typhoid. One study, by Ammah et al. (2000) conducted in Cameroon, found that among fever patients, 17% of those studied had concurrent malaria and typhoid based on proven bacteriological diagnosis, as compared to 47.9% based on the Widal test. Nsutebu, Martins & Adiogo (2003) undertook another study among febrile patients in Cameroon. They found that there were no patients with both malaria and typhoid. Forty seven percent had malaria only, and 2.5% had only typhoid. Four percent of patients were sure that they had taken antibiotics prior to consultation (i.e. before the study). There was no difference in symptoms and signs between patients with malaria, typhoid, and fever of unknown

diagnosis. There are no known studies of the concurrence of typhoid and malaria in Tanzania.

Diagnosis of malaria

The gold-standard for diagnosing malaria is blood smear (thick and thin smear) (Hänscheid, 1999). Mutanda (1998) found that 97% of febrile patients had positive blood smears. Chandramohan et al. (2001) found that the sensitivity of blood smears changed with the inclusion of malaria symptoms in the diagnosis. Only 7% of children and 12% of adults had microscopically confirmed malaria. The sensitivity and specificity increased to 60% and 61.2% respectively when there was a combination of clinical features associated with the slide positivity or when judged by clinicians to be of importance. Magnussen et al., (2001) found that the sensitivity of feeling feverish was 96.5% with a specificity of 54.5%. The positive predictive value of feeling feverish was 89.9% and the negative predictive value was 78.6%.

A serological test was performed to diagnose *P. falciparum* malaria using the dipstick antigen capture assay for the detection of *Plasmodium falciparum histidine rich protein II* antigen (Pf HRP-II) in peripheral blood. The sensitivity and specificity of the test was found to be 97% and 100% respectively. The persistence of the antigen varied from 5 to 15 days after initiation of anti-malarial therapy (Mishra, Samantaray & Mirdha 1999). Studies done in Kenya and an experimental challenge study in the USA assessed the accuracy of a dipstick antigen-capture assay based on qualitative detection of *Plasmodium falciparum histidine-rich protein 2*(PfHRP-2) in peripheral blood for the

diagnosis of *P. falciparum* infection. They found that the assay was 96.5–100% sensitive for detection of greater than 60 *P. falciparum* asexual parasites/microL blood; 70-81% sensitive for 11-60 parasites/microL blood, and 11-67% sensitive for 10 parasites or less/microL blood. Specificity was 95% (95% CI 85-105%; n = 20) among Native American volunteers; 98% (96–101%; n = 112) among volunteers exposed to the bite of *P. falciparum*-infected mosquitoes, and 88% (84–92%; n = 285) among Kenyans living in an area with holoendemic malaria. The antigen PfHRP-2 was not detectable in blood 6 days after initiation of curative chemotherapy, and suggests that such circulating antigens rarely lead to false-positive tests (Beadle et al., 1994).

Diagnosis of typhoid

The definitive diagnostic test for typhoid is isolation of *Salmonella typhi* from blood, faeces, urine or other body fluids by culture (Jumba, Mirza & Mwaura, 1995). The commonly used laboratory test for diagnosing typhoid is the Widal test. This is a serodiagnosis test. It is an agglutination test using suspensions of *Salmonella typhi* (a causative agent of typhoid) treated to retain only the somatic (O) or flagella (H) antigens (Chew et al., 1992). This is done by serial dilution technique in test tubes (Jumba, Mirza & Mwaura, 1995). Saha et al., (1996) studied healthy school children; patients with non-typhoidal fever, and patients with bacteriological proven typhoid It was found that *Salmonella typhi* O and H agglutinin titres >1:80 and >1:160 significantly predicted disease with a sensitivity of 88% and 98% respectively. There are many contradictions related to whether only one of the STO and STH antigens or both, should be used to diagnose typhoid.

Typhoid can also be diagnosed using, the on-slide agglutination screening test. This test works in a similar way to the Widal test except it does not involve serial dilution. It is performed by mixing a drop of serum and a drop of antigen (typhoid antigen) on a slide. If agglutination occurs, a positive test result has been achieved. Patients included in the study by Jumba, Mirza & Mwaura (1995) were first screened using a slide agglutination test. The sera of those who reacted to this test were then titrated (Widal test done) to determine their levels of typhoid titres. It was found that among typhoid patients (who reacted to a screening test), 85% had titres ≥ 1:160, while in healthy individuals the overall result was 96%, had titres ≤1:80 (93% and 99% for Naivasha and Nairobi respectively). The agglutinin slide test showed that 30% of healthy, unvaccinated individuals' sera did not react and thus did not undergo titration (Jumba, Mirza & Mwaura 1995).

Diagnosis of typhoid and malaria

Currently, there is no single criterion for the diagnosis of typhoid and malaria. For example, when diagnosing typhoid using the Widal test, different studies have used different cut-off points (Chew et al., 1992; Jumba, Mirza& Mwaura, 1995; Mutanda, 1998; Saha et al., 1996; Nsutebu, Martins & Adiogo 2003; Nsutebu, Ndumbe & Koulla, 2003; Onuigbo, 1990; Ammah et al., 1999). Most current diagnoses are reached using a combination of diagnostic criteria for both malaria and typhoid and excluding and including other causes of similar symptoms and signs.

Summary

In summary, malaria and typhoid are among the commonest infectious diseases. They both have high morbidity and mortality rates when they are not correctly diagnosed and treated. They impose heavy economic and social burdens on individuals, households, communities and the country in general, especially in the developing world. The similarity of their signs and symptoms makes it difficult to reach a diagnosis unless laboratory tests are done. In some areas these laboratory tests are unavailable or inaccessible due to running and maintenance costs, and in order to be able to differentiate between the two diseases, good and affordable laboratory facilities are required.

1.2: *AIMS*

This study aimed to determine the proportion of typhoid in adult patients admitted with an admission diagnosis of malaria, and whether there is a possibility of an association between malaria and typhoid. In addition, the study aims to investigate the validity, predictive values and likelihood ratios of using the on-slide agglutination test for typhoid.

1.3: *RATIONALE*

The rationale of undertaking this study was to find out if some patients diagnosed on admission with malaria also were suffering from typhoid. The study attempted to determine if there was a possibility of over-diagnosing malaria when the diagnosis is based only on clinical presentations associated with malaria. It compared the findings

obtained from patients admitted with malaria to the findings from patients with other admission diagnoses.

This study also looked at the possibility of using the on-slide agglutination test for diagnosing typhoid in patients with an admission diagnosis of malaria. Because there is not enough evidence to show that using both STO and STH positive tests is better than using STO or STH alone, this study collected information for each of these categories to assess their differences as screening tests in comparison to the gold standard.

1.4: *OBJECTIVES*

1: To determine the proportion of malaria and typhoid among patients admitted with a malaria admission diagnosis and with other admission diagnoses.

2: To measure the proportion of concurrent typhoid and malaria among patients admitted with a malaria admission diagnosis and with other admission diagnoses.

3: To determine the validity and reliability of using the on-slide agglutination test, as a rapid test for diagnosing typhoid among adult patients with admission diagnosis of malaria.

4. To assess the distribution of the risk factors of malaria and typhoid between the two groups studied: a malaria admission diagnosis, and other admission diagnoses among adult patients admitted in medical wards.

CHAPTER 2: METHODS

This chapter describes the methodological aspects of this study. It includes data analysis and ethical issues.

2.1: STUDY DESIGN

A cross-sectional analytic study design was used. The study analysed the possibility of the coexistence of malaria and typhoid, and the possibility of misdiagnosis. Outcomes only were investigated and no exposure(s) was studied.

2.2: STUDY POPULATION

The study population included people who were admitted for medical care at Iringa Regional Hospital. This hospital is situated in the Southern-west highlands of Tanzania. It provides a service mostly to residents of the Iringa urban and rural districts (including a new district - Kilolo). It also receives referred patients from the district hospitals and health centres within the Iringa region.

2.3: SAMPLING AND SAMPLE SIZE

Two hundred and fourteen patients admitted in medical wards from 06th –26th January 2004 were included in the study. Study subjects were between 10 and 85 years of age.

Sample size

Based on the proportion of hospital admissions due to malaria in Tanzania (45%) (MARA/ARMA Collaboration, 2002), the sample size was calculated using the following formula:-

$n = Z^2_{1-\alpha/2}P(1-P)/d^2$ (Lwanga & Lemeshow, 1991); where Z is normal deviation (1.96), P is the expected proportion (45%), d is the required precision (10%), $100(1-\alpha)$ is the confidence level (95%) i.e. $\alpha=0.05$ (or 5%).

This gave a sample size of 95 subjects. Because the study compared subjects with malaria to those with other admission diagnoses, for every subject with malaria, a patient with another admission diagnosis was selected, giving a total sample size of 190.

Sampling procedure

The medical wards admit an average of 20 patients per day and the study period was 20 days. This made a total number of 400 patients. A sampling interval of 400/190 = 2.11 ~2 was chosen to ensure that the studied participants were equally distributed within 24 hours of admission and for the entire study duration. Every second patient with an admission diagnosis of malaria was thus asked to participate in the study. On the first day, the sampling starting point was obtained using a random number table after a list of patients admitted within a 6-hour period had been assigned with numbers. The selection continued until the required sample size was achieved. For convenience, for every subject with an admission diagnosis of malaria, another subject with another admission diagnosis was selected.

2.4: MEASUREMENT TOOLS

Data was collected using a patients' coding sheet, symptoms checklist and laboratory test results.

1: Demographic characteristics such as age, sex, occupation, residence, and level of education were captured on the patients' coding sheet and checklist/questionnaire. These were analysed to see if they had any effect on the findings [Appendix 1 and Appendix 3].

2: The admission diagnoses were obtained from the patients' files. A diagnosis of malaria was based on the doctor's written diagnosis and/or the presence of anti-malaria drugs in the list of prescribed drugs during admission [Appendix 1]. A list of signs and symptoms of malaria and typhoid (on the checklist) was used to obtain the admission information for each study participant [Appendix 1]. The researcher coded each study subject. [Appendix 3].

The researcher and assistant researcher interviewed patients to gather information needed on the checklist and questionnaire. Symptoms and signs noted in the files of all participants during admission were compared with those obtained from a checklist. Immediately after the interview, the researcher collected blood specimens for laboratory examination.

3: Laboratory diagnosis of malaria: Malaria parasite detection was undertaken using blood smears. Blood was obtained by finger prick for the thin and thick blood smears and stained with Field's stain.

Asexual parasites were counted against 200 white blood cells on the thick smear and species was confirmed on the fixed thin smear. Thick smears were examined on a minimum of 100 high-powered microscopic fields before recording them as negative.

In all patients with fever and/or any malaria symptom, the presence of peripheral parasitaemia (at least 1 per 100 thick fields) was considered malaria positive during analysis (Nsutebu, Martins & Adiogo, 2003). The presence of 5 or more peripheral malaria parasitaemia per 100 thick fields in participants without symptoms was also labelled malaria positive. If the thick malaria smear was negative and the thin smear was positive; then one was labelled positive, although generally the thick smears were used to categorize participants (Duggan & Beyer, 1975). [Appendix 2].

4: Laboratory diagnosis of typhoid: Two tests were done on each study subject for the determination of typhoid; the slide agglutination test (as a screening test) and Widal test (as a gold standard). For the on-slide agglutination test, a drop of serum from the subject and a drop of the antigen were mixed on a glass slide. Visible agglutination after 1 minute was labelled as the serum positive, and if there was no reaction after 1 minute it was labelled negative. These results were recorded on the Results Recording Sheet [Appendix 2].

Sera of all subjects, whether positive or negative to the on-slide agglutination test, had to undergo Widal testing. The conventional tube agglutination Widal test was performed using bacteria agglutinable suspensions of *Salmonella typhi* containing H and O antigens.

Serial dilution of individual serum of between 1:20 and 1:1600 was prepared using normal saline. A negative saline control was introduced in each batch of tests. The sera were incubated at 50^0C for 4 hours after adding in the O agglutinable suspension in the diluted tubes of serum. They were then left to stand for 24 hours after which they were read for O titres. This was followed by adding a drop of the H agglutinable suspension in each tube of diluted serum. The mixture was shaken thoroughly and re-incubated for 2 hours at 50^0C and then re-read.

The cut-off point for Widal test titres for both titres O and H was 1:80 for O titres and/or 1:80 for H titres, i.e. any finding of equal or greater than these titres were considered typhoid positive (Onuigbo, 1990, Chew et al., 1992, Saha et al., 1996).

No name, checklist information [Appendix 1] or patients' coding sheet [Appendix 2] was available to either of the two laboratory technicians; who were only aware of the codes.

2.5: VARIABLES

Independent variables were age, sex (gender), occupation, level of education and area of residence/distance from hospital to one's residence. Dependent variables were symptoms and signs of malaria/typhoid, malaria parasite count and typhoid titres (O and H titres).

2.6: VALIDITY AND RELIABILITY

Validity and reliability were achieved through the following:

The information obtained from the file notes was compared with that from the checklist. The researcher and assistant researcher were involved in the collection of this information using a checklist/questionnaire. Before commencing with data collection, the research assistant was trained to ensure uniformity in asking questions and using the checklist.

The checklist/questionnaire were translated into Kiswahili, which is the language used by all residents of Iringa (official language of United Republic of Tanzania). The checklist/questionnaire were back-translated into English; compared, and found to have similar meanings.

Laboratory technicians read all samples without knowledge of participant details. Each participant was given different paired codes to be used by the different technicians. The results obtained by each technician for the thick and thin blood slide smears for malaria were compared, as well as results of the on-slide agglutinin test compared to that of the Widal test.

Whenever there was a disagreement between the results of the two laboratory technicians, a third person (the senior laboratory technician) was consulted, and his finding taken as final.

The pilot study included 10 admitted patients. This helped to identify areas that needed modification before the study started, for example, questions on the checklist and how to interpret/read the results in the laboratory.

2.7: FIELD MANAGEMENT

2.7.1: Introduction of concept: The researcher introduced the study topic to the Iringa Regional Hospital administration and gained permission to undertake research at this hospital. The study was further introduced to laboratory technicians and staff in the medical wards to encourage their cooperation during data collection.

2.7.2: Training laboratory technicians: The researcher and senior laboratory technician trained the 2 laboratory technicians in testing procedure, interpretation and reporting results of malaria smears (thick and thin films) on slide agglutination tests and Widal test titres.

2.7.3: Training assistant researcher: The researcher trained the assistant researcher on how to interview and use the checklist/questionnaire.

2.7.4: Samples and data collection: All study participants were informed of the objectives and purpose of doing this research. Enrolment was undertaken after obtaining participants' informed consent, or in the case of children or those who presented with confusion/altered consciousness, the consent of parents or guardians. The enrolment of study subjects continued until the sample size was achieved. The researcher collected

specimens, coded them (paired codes) and then passed them on to the 2 laboratory technicians for testing and interpretation.

2.7.5: Inputs: Personnel: The following personnel were involved in this study: 1 researcher; 1 assistant researcher; 1 senior laboratory technician; 2 laboratory technicians; medical ward nurses and doctors.

2.7.6: Equipment: Equipment included glass slides, reagents for malaria and typhoid tests, incubator, pipettes and microscopy.

2.7.7: Transport/travel: The researcher travelled from Cape Town, South Africa. During the study, the researcher stayed at the Iringa Regional Hospital until all data were obtained.

2.8: ANALYSIS

The data from the questionnaire, checklist and from laboratory findings were entered into STATA (version 8) software. Each subject's information was linked using an unique identifier. The data were then analysed using STATA, except where the formulae given below were used.

1. The distribution of subject socio-demographic characteristics and risk factors of malaria and typhoid in the sample were analysed to determine if malaria and other diagnostic groups were comparable.

2. To assess the significance of concurrence between typhoid and malaria, the following statistical measures were used: 95% confidence intervals of the proportions, the Pearson correlation using Chi square and the difference of proportions of either typhoid or malaria between two compared study groups. The statistical significance for these statistical measures of association was $p< 0.05$.
3. Patients who had taken anti-malarial medication since they developed (current) symptoms were analysed separately. Their laboratory malaria smears might have been negative as a result of treatment and not because they did not have parasitaemia.
4. The Non-Parametric Mann-Whitney test was used to assess if there were significant statistical differences (p-values) between the medians of age in years; years of schooling, and the distance of residence from the hospital; for participants admitted with malaria and those with other admission diagnoses.
5. *Formulae:* The following formulae were used. The 95% CIs were not calculated using the usual CI calculation for proportions because of possible incorrect estimations when the proportion is either small or large (Little, 2004).

- *Sensitivity (%) = (True positive/Total participants with typhoid)100.*
- *95%* Confidence interval (CI) *of sensitivity* $= \frac{A \pm B:}{C}$

Where:

A	=	$2r + z^2$; $B = z\,[z^2 + 4rq]^{½}$ and $C = 2(n+z^2)$
r	=	True positives
z	=	the cut-off of the standard normal distribution that relates to the desired level of confidence: for 95% CI, $z = 1.96$
q	=	False negatives/Total diseased
n	=	Total diseased.

- *Specificity (%) = (True negative/Total participants without typhoid) 100.*

- *95% Confidence interval (CI) of Specificity* = $\frac{2d + z^2 \pm z\,[z^2 + 4d(b/m)\,]^{1/2}}{2(m+z^2)}$

Where:

d	=	True negatives
z	=	Cut-off of the standard normal distribution that relates to the desired level of confidence: for 95% CI, z = 1.96
b	=	False positives
m	=	Total non-diseased

- *Positive predictive value (%) = (True positive/Total on slide test positives) 100.*

- *95% CI of Positive Predictive value (PPV)* = $\frac{2a + z^2 \pm z\,[z^2 + 4a(b/v)\,]^{1/2}}{2(v+z^2)}$

Where:

a	=	True positives
z	=	Cut-off of the standard normal distribution that relates to the desired level of confidence: for 95% CI, z = 1.96
b	=	False positives
v	=	Total test positive

- *Negative predictive value (%) = (True negative/Total on slide test negatives)100.*

- *95% CI of Negative Predictive Value (NPV)* = $\frac{2d + z^2 \pm z\,[z^2 + 4d(c/w)]^{1/2}}{2(w+z^2)}$

d	=	True negatives
z	=	Cut-off of the standard normal distribution that relates to the desired level of confidence: for 95% CI, z = 1.96
b	=	False negatives
w	=	Total test negative

- Likelihood ratios (LR) were calculated after obtaining the sensitivity and specificity of the on-slide agglutination test. It is a measure of how much a given diagnostic test result will raise or lower the pre-test probability of the disorder. It was calculated using:

- *Likelihood ratio positive (LR +) = Sensitivity/1- Specificity.*

- *Likelihood ratio negative (LR -) = 1- Sensitivity/Specificity.*

- 95% CI for LR+ = exp[95% CI for $\log_e$(LR+)]
  = exp[$\log_e$(LR+) ± 1.96 x SE($\log_e$(LR+))]

  Where:

  SE($\log_e$(LR+) = $[1/a - 1/(a+c) + 1/b - 1/(b+d)]^{1/2}$

- 95% CI for LR- = exp[95% CI for $\log_e$(LR+)]
  = exp[$\log_e$(LR+) ± 1.96 x SE($\log_e$(LR+))]

  Where:

  SE($\log_e$(LR-) = $[1/d - 1/(b+d) + 1/c - 1/(a+c)]^{1/2}$

  And:

  a = True positives
  a + c = Total diseased
  b = False positives
  b + d = Total non-diseased
  c = False negatives

The likelihood ratio can be interpreted as follows:

The LR value of 1-2 and 0.5-1 has no significant change in the probability;

2-5 and 0.2-0.5 has small changes in the probability;

5-10 and 0.1-0.2 has moderate changes in the probability;

>10 or < 0.1 has conclusive probability changes.

LR+ measured how much the on slide agglutinin test raised the pre-test probability of typhoid and LR- measured how much the on slide agglutinin test lowered the pre-test probability of typhoid in the study sample.

2.9: ETHICAL ISSUES

This study aimed at determining the prevalence of typhoid in adult patients with admission diagnosis of malaria, to determine if there is an association between malaria and typhoid, and to determine the validity and predictive values of using the on-slide

agglutination test for typhoid. Thus it involved collection of blood/serum samples from study participants.

Specimen collection from study subjects is painful because of pricking for malaria blood smears, or withdrawing serum (blood) for the Widal test. This had to be explained to every participant.

Two hundred and fourteen people aged between 10 and 85 years participated in this study. The study took an average of twenty days to collect data/information. An informed consent was obtained from all participants or from parents/guardians for children under 18 years and subjects who were admitted with altered level of consciousness or unconscious, the children's views on whether to participate in the study or not were respected. Every participant was given the detailed information regarding the study [Appendix 4] and was then required to sign a consent form [Appendix 5].

The consent form [Appendix 5] consisted of two parts to be signed; only adults and fully conscious persons signed the first part, and the second part was signed by parents/guardians of children or guardians, parents or relatives of patients with an altered level of consciousness/ altered ability to consent. The second part required writing down the reason(s) why the participant could not consent. Those who participated while unconscious were required to give their decision on whether or not to continue participating when they regained consciousness.

The participants were told that whether or not they agreed to be included into the study, would not affect the health care given by the hospital. All the tests done in this study were free of charge.

All subjects who were identified as having malaria or typhoid were prescribed the appropriate treatment(s). The researcher recorded names, age, sex and addresses of participants to be used for feedback. All participants were given the results of their blood tests.

Participants were free to withdraw from the study at any stage. All information collected was confidential and the researcher was required to maintain confidentiality.

The final report of the study will be presented at the University of Cape Town by the researcher as a mini-dissertation as part of the academic assessment required for a Masters in Public Health. The copies of the final report will be available in the University of Cape Town library and in the Iringa Regional Hospital library. Iringa Regional Hospital may use the report to improve its health care.

Before the study commenced, the researcher obtained ethical approval from the University of Cape Town Ethics Committee and permission from Iringa Regional Hospital administration.

2.10: STAKEHOLDERS

Stakeholders include:

- University of Cape Town; Faculty of Health Sciences, School of Public Health and Family Medicine.
- Iringa Regional Hospital administration.
- Study participants (the subjects).
- The community served by Iringa Regional Hospital.

CHAPTER 3: RESULTS

This cross-sectional analytic study was carried out at Iringa Regional Hospital, Tanzania from 06th January 2004 to 26th January 2004. Two hundred and thirty-two participants were approached and a total of 214 (92.2%) people agreed to participate in this study, with 115 (53.7%) having been diagnosed on admission with malaria and 99 (46.3%) with another admission diagnosis. Of those approached, 4.3% (10) people refused because they had already had specimens taken, 2.2% (5) did not see the importance of participating in the study and 1.3% (3) did not give reasons for their refusal.

3.1: THE DISTRIBUTION OF BACKGROUND CHARACTERISTICS OF STUDY SUBJECTS WITH MALARIA ADMISSION DIAGNOSIS AND OTHER ADMISSION DIAGNOSES.

Table 1: The demographic distribution by malaria admission diagnosis and other admission diagnoses among study subjects.

	Malaria admission diagnosis n = 115	Other admission diagnoses n = 99	Total N = 214	p-values
AGE (Years)				
Median	28	40	31.5	
Range	10-81	11-85	10-85	0.0001
GENDER				
Males (%)	45.2	54.5	49.5	0.17
Females (%)	54.8	45.5	50.5	0.17
SCHOOLING YEARS				
Median	7.0	7.0	7.0	
Range	0-16	0-17	0-17	0.14
DISTANCE FROM HOSPITAL (km)				
Median	8.0	8.0	8.0	
Range	0-100	0-105	0-105	0.70
OCCUPATION				
Peasants (%)	42.6	44.4	43.5	0.79
Teachers (%)	6.1	10.1	7.9	0.28
Accountants/ Clerks/ /Shopkeepers (%)	6.1	7.1	6.5	0.77
Tailors/ Businessmen (%)	13.1	14.1	13.6	0.82
Pupils/ Students (%)	21.7	6.1	14.5	0.001
Retired (%)	3.5	4.0	3.7	0.83
Security personnel/ Drivers (%)	4.4	5.1	4.7	0.81
Others (%)	2.6	9.1	5.6	0.04

Out of 99 (46.3%) study participants who were admitted with other admission diagnoses, 21.2% had chest infections, 22.2% had cardiovascular disease, 14.1% gastrointestinal disease, 6.1% liver disease, 4% meningitis, 8.1% chronic lung disease, 6.1% neurological disorders, 7.1% renal and endocrine disorders and 11.1% other diseases.

There was a significant statistical difference in age distribution between malaria admission diagnosis and other admission diagnoses ($p = 0.0001$). Those admitted with other admission diagnoses were older than those with malaria admission diagnosis (Table 1, Figure 1). Of all occupations, pupils and students were significantly differently distributed between these admission diagnoses groups, $p = 0.001$.

Age groups were significantly statistically correlated with malaria admission diagnosis (Pearson $\chi^2 = 19.1$ and $p = 0.008$). Age and typhoid were not statistically correlated (Pearson $\chi^2 = 8.82$ and $p = 0.266$). The only age group in which typhoid and malaria admission diagnosis were significantly correlated was 70 - 79 years with Pearson $\chi^2 = 9.0$ and $p = 0.003$. This age group had 9 study participants; 5 (55.56%) had an admission diagnosis of malaria and 4 (44.44%) had other admission diagnoses. The same distribution was for typhoid positive and negative respectively. Thus the concurrence of typhoid and malaria did not depend on age.

In addition, the effect of occupation was assessed. Occupation and malaria admission diagnosis were correlated with Pearson $\chi^2 = 14.36$, $p < 0.05$ (p=0.045). There was no correlation between occupation and typhoid (Pearson $\chi^2 = 5.88$, p=0.55). Each occupation was analysed to see if it affected the correlation between typhoid and malaria. It was found that the correlation of typhoid and malaria was significant in the following occupational groups; peasants (Pearson $\chi^2 = 10.21$, p=0.001), teachers (Pearson $\chi^2 = 7.47$, p= 0.006), and pupils/students (Pearson $\chi^2 = 4.7$, p=0.03). Some occupations might predispose people to the concurrence of typhoid and malaria, but this could not be concluded with certainty since it might be a result of differing socio-economic status. The details on socio-economic status were not studied.

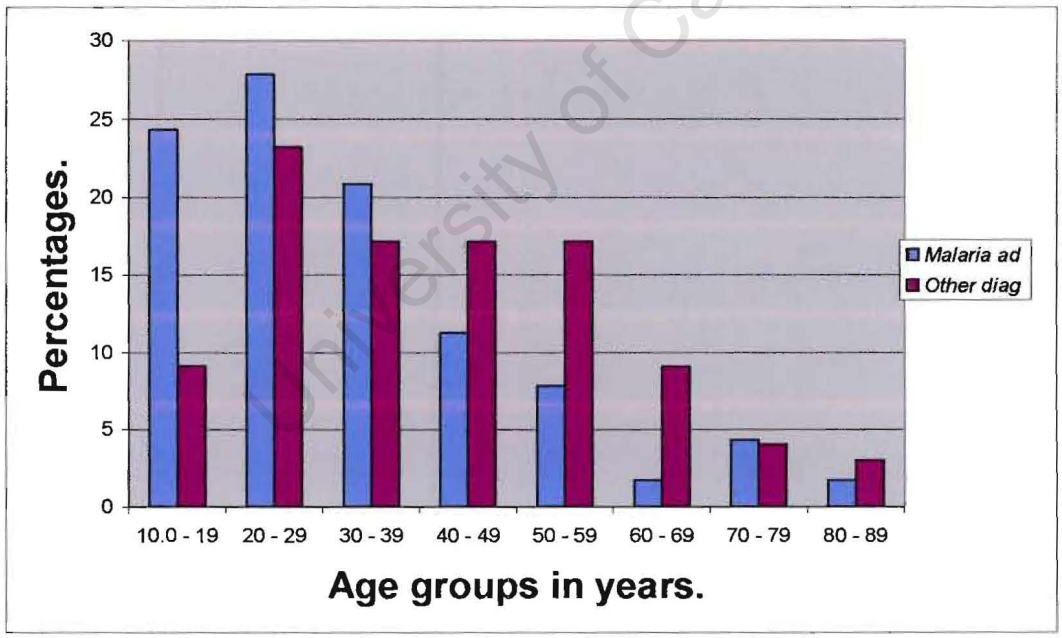

Figure 1: The percentage distribution of malaria admission diagnosis and other admission diagnoses by age groups.

NOTE: *Malaria ad* = malaria admission diagnosis.

Other diag = other admission diagnoses.

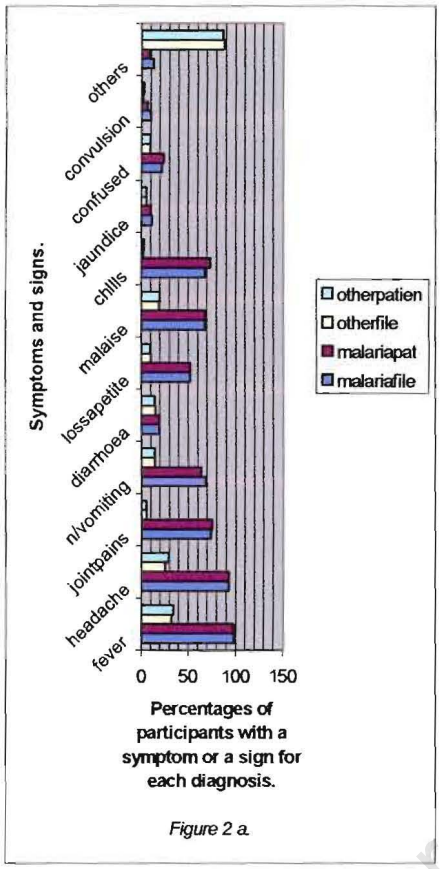

Figure 2 a.

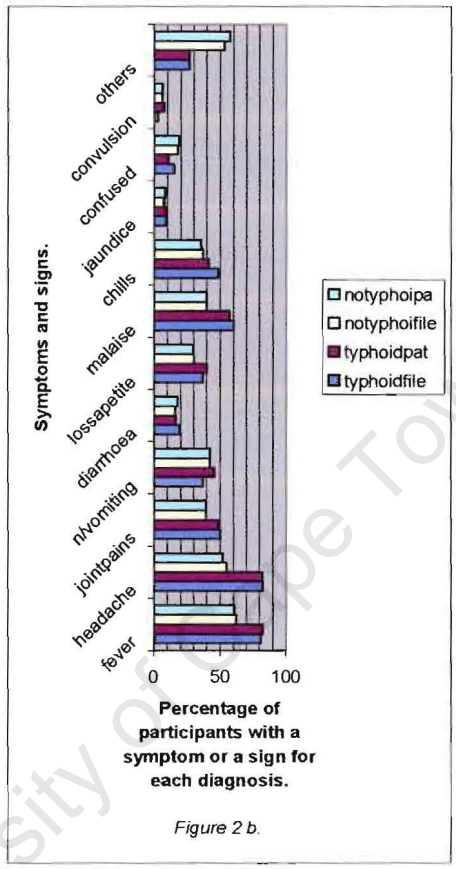

Figure 2 b.

Figures 2(a) and 2(b). The graphs show the distribution patterns of symptoms/signs among patients with malaria admission diagnosis and other admission diagnoses, figure 2(a) and the pattern among patients with typhoid disease and those without typhoid, figure 2 (b).

NOTE: In figure 2 a:

malariafile = malaria admission diagnosis, information obtained from the file
malariapat = malaria admission diagnosis, information obtained from the patient
otherfile = other admission diagnoses, information obtained from the file
otherpatien = other admission diagnoses, information obtained from the patient

In figure 2 b:

typhoidfile = typhoid disease, information obtained from the file
typhoidpat = typhoid disease, information obtained from the patient
notyphoifile = no typhoid disease, information obtained from the file
notyphoipa = no typhoid disease, information obtained from patient

As shown on the above graphs, symptoms and signs copied from the files were similar to those obtained during interviews. The pattern of distribution of symptoms and signs for malaria admission diagnosis was similar to those of typhoid.

3.2: OBJECTIVE 1:

TO DETERMINE THE PROPORTION OF MALARIA AND TYPHOID AMONG PATIENTS ADMITTED WITH MALARIA ADMISSION DIAGNOSIS AND OTHER ADMISSION DIAGNOSES IN THE MEDICAL WARDS AT IRINGA REGIONAL HOSPITAL, TANZANIA.

Table 2 (a): The distribution of typhoid disease between malaria admission diagnosis and other admission diagnoses among study subjects.

Typhoid disease	Malaria admission diagnosis n (%)	Other admission diagnoses n (%)	Total N (%)
YES	53 (46.1)	15 (15.2)	68 (31.8)
NO	62 (53.9)	84 (84.8)	146 (68.2)
Total	115 (100.0)	99 (100.0)	214 (100.0)

Table 2 (b): The distribution of malaria, according to diagnostic criteria[1], between malaria admission diagnosis and other admission diagnoses among study subjects.

Malaria disease by diagnostic criteria[1]	Malaria admission diagnosis n (%)	Other admission diagnoses n (%)	Total N %
YES	54 (47.0)	5 (5.1)	59 (27.6)
NO	61 (53.0)	94 (94.9)	155 (72.4)
Total	115 (100.00)	99 (100.0)	214 (100.0)

[1] In all patients with fever and/or any malaria symptom, the presence of any peripheral parasitaemia (at least one per 100 thick fields) was considered to have malaria during analysis. The presence of 5 or more peripheral malaria parasitaemia per 100 thick fields in participants without symptoms was also labelled as having malaria. If the thick malaria smear was negative and thin smear was positive; then one was labelled as having malaria.

Table 2 (c):The distribution of typhoid between malaria and other admission diagnoses in relation to whether participants had used anti-malaria medication before admission.

Anti-malaria medication before admission				No anti-malaria medication			
Typhoid Disease	Malaria admission diagnosis n (%)	Other admission diagnoses n (%)	Total N (%)	Typhoid Disease	Malaria admission diagnosis n (%)	Other admission diagnoses n (%)	Total N (%)
YES	37 (47.4)	6 (42.9)	43 (46.7)	YES	16 (43.2)	9 (10.6)	25 (20.5)
NO	41 (52.6)	8 (57.1)	49 (53.3)	NO	21 (56.8)	76 (89.4)	97 (79.5)
Total	78(100.0)	14 (100.0)	92 (100.0)	Total	37(100.0)	85(100.0)	122 (100.0)

Forty three percent (n=92) of participants had used anti-malaria medication before admission. However, using the malaria diagnostic criteria, the study found that 44.6% of those who had used anti-malaria medication had malaria. Of those who had not used anti-malaria medication, 14.8% were diagnosed with malaria.

3.3: OBJECTIVE 2:

TO MEASURE THE PROPORTION OF CONCURRENT TYPHOID AND MALARIA AMONG PATIENTS ADMITTED WITH MALARIA ADMISSION DIAGNOSIS AND OTHER ADMISSION DIAGNOSIS IN MEDICAL WARDS AT IRINGA REGIONAL HOSPITAL, TANZANIA.

Table 3(a): The concurrence of typhoid with malaria according to diagnostic criteria[2], and other admission diagnoses.

Typhoid disease	Malaria diagnosis by diagnostic criteria[2] n (%)	Other diagnoses n (%)	Total N (%)
YES	26 (44.1)	42 (27.1)	68 (31.8)
NO	33 (55.9)	113 (72.9)	146 (68.2)
Total	59 (100.0)	155(100.0)	214 (100.0)

[2] In all patients with fever and/or any malaria symptom, the presence of any peripheral parasitaemia (at least one per 100 thick fields) was considered to have malaria during analysis. The presence of 5 or more peripheral malaria parasitaemia per 100 thick fields in participants without symptoms was also labelled as having malaria. If the thick malaria smear was negative and thin smear was positive; then one was labelled as having malaria.

The correlation between a typhoid and malaria diagnosis (using diagnostic criteria[2]) was significant with Pearson $\chi^2 = 5.68$ ($p = 0.017$). The 95% CI for the proportion of typhoid disease among those diagnosed with malaria was 31.4% to 56.7% and that of typhoid disease among other admission diagnoses was 20.1% to 34.1%.

The correlation of typhoid disease and a malaria admission diagnosis was significant with Pearson $\chi^2 = 23.49$ ($p<0.001$). The 95% CI for the proportion of typhoid disease among patients with a malaria admission diagnosis was 37.0% to 55.2% and that of typhoid disease among other admission diagnoses was 8.1% to 22.2%.The typhoid proportions difference between malaria admission diagnosis and other admission diagnoses was 30.9% (95% CI 19.4% - 42.5%; $p < 0.0001$) (Table 2a).

The correlation of a typhoid and malaria admission diagnosis among those who had used anti-malarial medication was not significant with Pearson $\chi^2 = 0.1$ ($p = 0.75$) although it was significant among those who had not used anti-malaria medication, Pearson $\chi^2 = 16.87$ ($p < 0.001$) (Table 2c). The correlation of a typhoid and malaria diagnosis based on diagnostic criteria was not significant in either those who had used anti-malaria medication Pearson χ^2 was 0.12 ($p = 0.73$), or those who had not used anti-malaria medication Pearson χ^2 was 2.14 ($p < 0.14$).

Anti-malaria medication use was correlated with typhoid; Pearson χ^2 =16.67 ($p < 0.001$) and with a malaria admission diagnosis Pearson $\chi^2 = 62.56$ ($p < 0.001$). There was a significant correlation between anti-malarial use and a malaria diagnosis based on diagnostic criteria Pearson $\chi^2 = 23.34$ ($p < 0.001$) (Table 2c). Thus, patients with either typhoid or malaria were likely to have used anti-malaria medication.

For those who had taken anti-malaria medication before admission, the 95% CI of the proportion of typhoid among those with malaria admission diagnosis was 36.4% to 58.5% and 16.9% to 68.8% among other admission diagnoses. For those who had not used anti-malaria medication before admission, the 95% CI was 27.3% to 59.2% and 4.0% to 17.1% respectively (Table 2c).

Table 3 (b): The distribution of malaria, according to diagnostic criteria[3], between malaria and other admission diagnoses in relation to typhoid .

Typhoid				No Typhoid			
Malaria by diagnostic criteria[3]	Malaria admission diagnosis n (%)	Other admission diagnoses n (%)	Total N (%)	Malaria by diagnostic criteria[3]	Malaria admission diagnosis n (%)	Other admission diagnoses n (%)	Total N (%)
YES	25 (47.2)	1 (6.7)	26 (38.2)	YES	29 (46.8)	4 (4.8)	33 (22.6)
NO	28 (52.8)	14 (93.3)	42 (61.7)	NO	33 (53.2)	80 (95.2)	113 (77.4)
Total	53 (100.0)	15 (100.0)	68(100.0)	Total	62 (100.0)	84 (100.0)	146 (100.0)

[3] In all patients with fever and/or any malaria symptom, the presence of any peripheral parasitaemia (at least one per 100 thick fields) was considered to have malaria during analysis. The presence of 5 or more peripheral malaria parasitaemia per 100 thick fields in participants without symptoms was also labelled as having malaria. If the thick malaria smear was negative and thin smear was positive; then one was labelled as having malaria.

The proportion of malaria based on diagnostic criteria[3] among participants with typhoid was 38.2% (95% CI 26.7% - 49.7%) as compared to 22.6% (15.8% - 29.4%) for those without typhoid (Table 3 b).

The proportion difference between the proportion of malaria based on diagnostic criteria[3] among participants with typhoid and the proportion of malaria based on diagnostic criteria[3] among patients without typhoid was 15.6% (95% CI 2.2% - 29%, p = 0.017).

3.4: OBJECTIVE 3:

TO DETERMINE THE VALIDITY AND RELIABILITY OF THE ON-SLIDE AGGLUTINATION TEST AS A RAPID TEST FOR DIAGNOSING TYPHOID AMONG ADULT PATIENTS WITH AN ADMISSION DIAGNOSIS OF MALARIA AND OTHER ADMISSION DIAGNOSES AT IRINGA REGIONAL HOSPITAL, TANZANIA.

3.4.1: THE VALIDITY AND RELIABILITY OF THE ON-SLIDE AGGLUTINATION TEST.

Table 4 (a): The distribution of the on-slide agglutination test in relation to typhoid (positive Widal test).

	Typhoid Disease by Widal test		
On slide (screening) test	YES	NO	Total
Positive*	59	14	73
Negative	9	132	141
Total	68	146	214

* On-slide agglutination test positive when both on-slide agglutination tests for STO and STH were positive.

Table 4 (b): The distribution of STO and STH on-slide agglutination tests in relation to typhoid diseases (positive Widal test).

	Typhoid Disease by Widal test				Typhoid Disease by Widal test		
On-slide STO test	YES	NO	Total	On-slide STH test	YES	NO	Total
Positive	64	28	92	Positive	63	32	95
Negative	4	118	122	Negative	5	114	119
Total	68	146	214	Total	68	146	214

Table 5: The validity, predictive values and likelihood ratios of the on-slide agglutination test as a rapid test for diagnosing typhoid among adult patients admitted with malaria and other admission diagnoses

	On-slide agglutination test:		
	STO Positive.	STH Positive.	Both STO/STH Positive.
Sensitivity % (95% CI)	94.1 (85.8 - 97.7)	92.7 (83.9 - 96.8)	86.8 (76.7 - 92.9)
Specificity % (95% CI)	80.8 (73.7 - 86.4)	78.1 (70.7 - 84.0)	90.4 (84.7 - 94.0)
Positive Predictive Value % (95% CI)	69.6 (59.5 - 78.0)	66.3 (56.3 - 75.0)	80.8 (70.3 - 88.2)
Negative Predictive Value % (95% CI)	96.7 (91.9 - 98.7)	95.8 (90.5 - 98.2)	93.6 (88.3 - 96.6)
Likelihood ratio positive (95% CI)	4.91 (3.50 – 6.89)	4.23 (3.09 – 5.79)	9.05 (5.45 – 15.02)
Likelihood ratio negative (95% CI)	0.07 (0.03 – 0.18)	0.09 (0.04 – 0.21)	0.15 (0.08 – 0.28)

3.4.2: THE EFFECT OF MALARIA DISEASE ON THE VALIDITY AND RELIABILITY OF THE ON-SLIDE AGGLUTINATION TEST

Table 6 (a): The distribution of on-slide agglutination test, both STO and STH positive, in relation to typhoid (positive Widal test), among patients diagnosed to have malaria and those without malaria

Patients with Malaria by diagnostic criteria[4]				Patients without Malaria by diagnostic criteria			
On-slide both STO and STH tests	Typhoid Disease by Widal test	No Typhoid by Widal test	Total	On-slide both STO and STH test	Typhoid Disease by Widal test	No Typhoid by Widal test	Total
Positive	22	3	25	Positive	37	11	48
Negative	4	30	34	Negative	5	102	107
Total	26	33	59	Total	42	113	155

[4] In all patients with fever and/or any malaria symptom, the presence of any peripheral parasitaemia (at least one per 100 thick fields) was considered to have malaria during analysis. The presence of 5 or more peripheral malaria parasitaemia per 100 thick fields in participants without symptoms was also labelled as having malaria. If the thick malaria smear was negative and thin smear was positive; then one was labelled as having malaria.

Table 6 (b): The distribution of the on-slide agglutination test STO positive in relation to typhoid with a positive Widal test result among patients diagnosed to have malaria and those without malaria.

Patients with Malaria by diagnostic criteria[5]				Patients without Malaria by diagnostic criteria[5]			
On-slide STO test	Typhoid Disease by Widal test	No Typhoid by Widal test	Total	On-slide STO test	Typhoid Disease by Widal test	No Typhoid by Widal test	Total
Positive	25	5	30	Positive	39	23	62
Negative	1	28	29	Negative	3	90	93
Total	26	33	59	Total	42	113	155

Table 6 (c): The distribution of the on-slide agglutination test STH positive in relation to typhoid with a positive Widal test result among patients diagnosed to have malaria and those without malaria.

Patients with Malaria by diagnostic criteria[5]				Patients without Malaria by diagnostic criteria[5]			
On-slide STH test	Typhoid by Widal test	No Typhoid by Widal test	Total	On-slide STH test	Typhoid by Widal test	No Typhoid by Widal test	Total
Positive	23	10	33	Positive	40	22	62
Negative	3	23	26	Negative	2	91	93
Total	26	33	59	Total	42	113	155

Table 7 (a): The validity, predictive values and likelihood ratios of the on-slide agglutination test as a rapid test for diagnosing typhoid among adult patients diagnosed with malaria[5].

Patients with Malaria using diagnostic criteria[5]			
	On-slide agglutination test: STO Positive.	On-slide agglutination test: STH Positive.	On-slide agglutination test: Both STO/STH Positive.
Sensitivity % (95% CI)	96.2 (81.1 – 99.3)	88.5 (71.0 – 96.0)	84.6 (66.5 – 93.9)
Specificity % (95% CI)	84.8 (69.1 – 93.3)	69.7 (52.7 – 82.6)	90.9 (77.9 – 95.4)
Positive Predictive Value % (95% CI)	83.3 (67.1 – 92.0)	69.7 (52.7 – 82.6)	88.0 (70.0 – 95.8)
Negative Predictive Value % (95% CI)	96.6 (82.8 – 99.4)	88.5 (71.0 – 96.0)	88.2 (73.4 – 95.3)
LR positive (95% CI)	6.33 (2.81 – 14.24)	2.92 (1.71 – 4.99)	9.30 (5.07 – 17.08)
LR negative (95% CI)	0.07 (0.01 – 0.48)	0.16 (0.05 – 0.47)	0.17 (0.07 – 0.42)

[5] In all patients with fever and/or any malaria symptom, the presence of any peripheral parasitaemia (at least one per 100 thick fields) was considered to have malaria during analysis. The presence of 5 or more peripheral malaria parasitaemia per 100 thick fields in participants without symptoms was also labelled as having malaria. If the thick malaria smear was negative and thin smear was positive; then one was labelled as having malaria.

Table 7(b): The validity, predictive values and likelihood ratios of on-slide agglutination test as a rapid test for diagnosing typhoid among adult patients without a diagnosis of malaria[6]

	Patients without Malaria using diagnostic criteria[6]		
	On-slide agglutination test: STO Positive.	On-slide agglutination test: STH Positive.	On-slide agglutination test: Both STO/STH Positive.
Sensitivity % (95% CI)	92.9 (81.0 – 97.5)	95.2 (84.2 – 98.7)	88.1 (75.0 – 94.8)
Specificity % (95% CI)	79.6 (71.3 – 86.0)	80.5 (72.3 – 86.8)	90.3 (83.4 – 94.5)
Positive Predictive Value % (95% CI)	62.9 (50.5 – 73.8)	64.5 (52.1 – 75.3)	77.1 (63.5 – 86.7)
Negative Predictive Value % (95% CI)	96.8 (90.9 – 98.9)	97.8 (92.5 – 99.4)	95.3 (89.5 – 98.0)
LR positive (95% CI)	4.55 (3.13 – 6.62)	4.88 (3.33 – 7.14)	9.18 (5.18 – 16.27)
LR negative (95% CI)	0.09 (0.03 – 0.27)	0.07 (0.02 – 0.27)	0.13 (0.06 – 0.3)

[6] In all patients with fever and/or any malaria symptom, the presence of any peripheral parasitaemia (at least one per 100 thick fields) was considered to have malaria during analysis. The presence of 5 or more peripheral malaria parasitaemia per 100 thick fields in participants without symptoms was also labelled as having malaria. If the thick malaria smear was negative and thin smear was positive; then one was labelled as having malaria.

3.5: OBJECTIVE 4:

TO ASSESS THE DISTRIBUTION OF THE RISK FACTORS OF MALARIA AND TYPHOID BETWEEN A MALARIA ADMISSION DIAGNOSIS AND OTHER ADMISSION DIAGNOSES AMONG ADULT PATIENTS WITH AN ADMISSION DIAGNOSIS OF MALARIA AND OTHER ADMISSION DIAGNOSES AT IRINGA REGIONAL HOSPITAL, TANZANIA.

3.5.1: KNOWLEDGE AND PREVENTIVE PRACTICE FOR MALARIA.

Table 8 (a): The distribution of knowledge and preventive practise for malaria among participants admitted with malaria and other admission diagnoses.

	Malaria admission diagnosis %	Other admission diagnoses %	Total %	p-values
PREVENT MOSQUITO BITES:				
Yes	n = 115	n = 97	N = 212[φϕ]	
No	79.1	76.3	77.8	0.62
	20.9	23.7	22.2	0.62
METHOD OF PREVENTING MOSQUITO BITES:[#]	n = 91	n = 74	N = 165	
Mosquito Nets	47.3	55.4	50.9	0.3
Spray	22.0	14.9	18.8	0.24
Repellents	7.7	8.1	7.9	0.92
Coils	23.0	21.6	22.4	0.82
EVER HEARD MOSQUITO NETS:			N = 212[φϕ]	
Yes				
No	98.3	99.0	98.6	0.66
	1.7	1.0	1.4	0.66
EVER HEARD ITN[♣]			N = 212[φϕ]	
Yes	42.6	44.3	43.4	0.80
No	57.4	55.7	56.6	0.80
USE ITN[♣]	n = 43	n = 49	N = 92[α]	
Yes	14.3	39.5	26.1	0.007
No	85.7	60.5	73.9	0.007

There was a significant statistical difference of ITN use between the two groups of admission diagnoses, with the use of ITN being greater among those with other

[φϕ] Two participants were unconscious, with admission diagnosis of meningitis, thus could not be interviewed.

[#] Methods used by 77.83% of 212 i.e. those who prevent mosquito bites.

[φϕ] Two participants were unconscious, with admission diagnosis of meningitis, thus could not be interviewed.

[♣] ITN insecticide treated mosquito nets

[φϕ] Two participants were unconscious, with admission diagnosis of meningitis, thus could not be interviewed.

[♣] ITN insecticide treated mosquito nets

admission diagnoses. When the correlations of those with a typhoid and malaria admission diagnosis was assessed in relation to ITN use; there were correlations of typhoid and malaria in all groups of those who used ITN or who did not use ITN. The Pearson ($\chi^2 = 8.54$, $p < 0.01$ ($p=0.003$)) in those who used ITN and Pearson ($\chi^2 = 4.74$, $p < 0.05$ ($p=0.03$)) in those who did not use ITN. Thus the correlation of typhoid and malaria was not dependent on whether one used ITN or not.

3.5.2: RISK BEHAVIOURS FOR MALARIA.

Table 8 (b): The distribution of risk behaviours for malaria among participants admitted with an admission diagnosis of malaria and other admission diagnoses

	Malaria admission diagnosis %	Other admission diagnoses %	Total %	p-values
NIGHT OUTDOOR ACTIVITIES:			N =212[φΦ]	
Yes	40.0	34.0	37.3	0.37
No	60.0	66.0	62.7	0.37
DRINK ALCOHOL:				
Yes	33.0	42.3	37.3	0.16
No	67.0	57.7	62.7	0.16
ALCOHOL DEPENDENCE ASSESMENT: CAGE[ƒ] SCORES	n = 43	n = 49	N = 79[9]	
0-1	68.4	46.3	57.0	0.03
2-4	31.6	53.7	43.0	0.03

Alcohol dependence, as assessed by CAGE, was the only significantly different variable (significance level of 5% ($p = 0.03$) (Table 8 (b)). A CAGE score of 2-4 was more common among patients diagnosed on admission with other diagnoses. Alcohol consumption assessed by CAGE was correlated with a malaria admission diagnosis

[ϖ] Those who have heard about insecticide treated mosquito nets.

[φΦ] Two participants were unconscious, with admission diagnosis of meningitis, thus could not be interviewed.

[ƒ] CAGE = Cut down, Annoyed, Guilt and Eye opener as alcohol drinking behaviour assessment questions each scores one if present; See appendix 1 question 3.8 a-d.

[9] Distributions of those who take alcohol (79 people) to show how many have alcohol disorders as per CAGE scores. A score of 2 or more indicates an alcohol drinking disorder.

(Pearson χ^2 = 3.92, $p<0.05$ (p = 0.048). Typhoid and alcohol consumption were not correlated (Pearson χ^2 = 0.8, p = 0.37). None of the study participants had ever been vaccinated for typhoid (Table 6 c).

3.5.3: KNOWLEDGE, PRACTICE AND RISK BEHAVIOURS FOR TYPHOID

Table 8 (c): The distribution of knowledge, practise and risk behaviours for typhoid among participants admitted with malaria and other admission diagnoses

	Malaria admission diagnosis. %	Other admission diagnoses. %	Total %	p-values
SOURCES OF WATER:			N = 212[φϕ]	
Tap	60.9	62.9	61.8	0.76
Well	20.9	14.4	17.9	0.22
River	18.2	22.7	20.3	0.42
WATER PREPARATION BEFORE DRINKING:				
Boiling	57.4	59.8	58.5	0.72
Filtering	14.8	13.4	14.2	0.29
Treating with Chemicals	7.8	4.1	6.1	0.26
Do nothing	20.0	22.7	21.2	0.63
EAT EGGS:				
Yes	74.8	78.4	76.4	0.54
No	25.2	21.6	23.6	0.54
EGGS PREPARATION BEFORE EATING:	n = 86	n = 76	N = 162[⊗]	
Eat raw	10.5	6.6	8.6	0.38
Fry	45.3	47.4	46.3	0.80
Boil	44.2	46.0	45.1	0.81
EAT FRESH VEGETABLE:			N = 212[7ϕ]	
Yes	91.3	95.9	93.4	0.18
No	8.7	4.1	6.6	0.18
FRESH VEGETABLE/FRUIT PREPARATION BEFORE EATING:	n = 105	n = 93	N = 198[9ϑ]	
Eat raw	33.3	37.6	35.4	0.53
Fry	0.0	1.1	0.5	0.29
Boil	1.9	1.1	1.5	0.64
Wash with cold water	30.5	37.6	33.8	0.29
Wash with warm water	34.3	22.6	28.8	0.07
OWN AND USE TOILETS FOR EXCRETA DISPOSAL:			N = 212[8ϕ]	
Yes	98.3	96.9	97.6	0.52
No	1.7	3.1	2.4	0.52
EVER HEARD OF TYPHOID VACCINE:[9]			N = 212[φϕ]	
Yes	7.8	10.3	9.0	0.53
No	92.2	89.7	91.0	0.53

[φϕ] Two participants were unconscious, with admission diagnosis of meningitis, thus could not be interviewed.

[⊗] 162 people eat eggs.

7

[9ϑ] 198 people eat fresh vegetables/fruits.

8

CHAPTER 4: DISCUSSION

Both malaria and typhoid were common which might be due to the study being conducted during the rainy season, similar to the reports by WHO (1997), WHO (2003b), WHO (1999) and Duggan and Beyer (1975). This study found that 27.6% (59) of admitted study patients had malaria based on diagnostic criteria. Malaria diagnostic criteria were used because in many malaria endemic areas, the presence of the malaria parasite on a blood slide does not mean that the individual has malaria (Africa Malaria Report 2003). This proportion of malaria among admitted patients was lower than that reported by other studies in Tanzania. The MARA/ARMA Collaboration (2002) reported that 45% of hospital admissions are due to malaria in Tanzania. Studies by Minja (1990) and Matola (1990) in the Kyela district, Tanzania, found the prevalence of malaria to be 44.6% among 0–15 year-old children. Magnussen et al., (2001) in the Pangani district, Tanzania, found that parasite prevalence varied between 32.7% and 35.3% from 1995 to 1997. However, according to WHO (2003b), 20–50% of all hospital admissions were due to the consequences of malaria.

This study found that 47% of those with malaria admission diagnosis also had typhoid. Ammah et al., (2000) found that, among fever patients, 17% of those studied had concurrent malaria and typhoid based on proved bacteriological diagnoses as compared with 47.9% based on the Widal test. This was different from the findings of Nsutebu, Martins and Adiogo (2003), who studied febrile patients in Cameroon. They found that

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[9] None of study participants had ever been vaccinated with typhoid vaccine.

[φϕ] Two participants were unconscious, with admission diagnosis of meningitis, thus could not be interviewed.

there were no patients with both malaria and typhoid. Forty seven percent had only malaria and 2.5% had only typhoid. The difference in findings from other studies may be due to the seasons in which these studies were carried out. If a similar study is carried out in the winter, one may find less typhoid present. Another reason might be the use of the Widal test to diagnose typhoid in this study. The Widal test has been said to lack validity and reliability for diagnosing typhoid.

There have been concerns about the effect of malaria on the accuracy of the Widal test. The presence of malaria is said to reduce the validity and reliability of the agglutination test for typhoid. This study found that the presence of malaria had no effect on the validity and reliability of the on-slide agglutination test. Several studies have found conflicting results about this issue. Duggan and Beyer (1975) explained that acute malaria suppresses the antibody response to salmonella O antigen, which leads to increased susceptibility to typhoid. This means than when a patient has both typhoid and malaria, a Widal test may not identify typhoid because of the low titres that will be detected. This indicates that a low titre of antibodies against *Salmonella* in a patient with confirmed malaria may indicate that the patient also has typhoid. This supports the suggestion given by Saha et al.(1996) of interpreting negative results with caution.

Contradictions arise when an appropriate diagnosis is not reached as can be the case when a diagnosis has been made using only treatment response. Onuigbo (1990) found that 10 patients had high titres using the Widal test, 7 patients out of 10 had malaria positive blood films and responded to treatment with Fansider®. Typhoid, even when

resistant to chloramphenicol, has been found to respond to co-trimoxazole (Mukhtar and Mekki, 1981). Co-trimoxazole has some actions that are similar to Fansider®. This response may indicate that the patients had both malaria and typhoid or one of these diseases. If the patients had both malaria and typhoid or typhoid alone, then the Widal test was able to diagnose these cases.

Nsutebu et al., (2002) found that the increased occurrence of typhoid fever reported in Cameroon was an over-diagnosis due to misuse of the Widal test. Different findings were reported from a study by Hatta et al., (2002) where they found that only 65.9% of the typhoid cases had a positive culture where the detection of antibodies against typhoid was 43.5%, 92.9% and 100% of samples collected 4-6 days, 6-9 days and >9 days after onset of fever. This indicates that sensitivity of antibody detection increases with the duration of the typhoid illness. This is a common presentation among most typhoid patients. who present with persistent fever, and outweighs the sensitivity of blood culture, which decreases when the duration of illness is not within 7-10 days of the onset of symptoms (W.H.O. 2003c).

On the other hand, use of the Widal test to diagnose typhoid is questionable because of its lack of validity and reliability (Onuigbo 1990, Saha et al., 1996, Nsutebu et al., 2002). Saha et al., (1996) noted that reliance on somatic typhoid O antigen only will result in a missed diagnosis, and suggested that negative results should be interpreted with caution and both agglutinins, i.e. agglutinin O and H, must be considered equally important. This study found that there were no significant statistical difference in the validity and

reliability of on-slide agglutination tests between using positive STO or STH tests alone, and using both STO and STH positive tests.

This study found that the validity and reliability of the on-slide test for STO, STH or STO and STH positive were not statistically significant, whether an individual had malaria or not which contradicts the findings of Saha et al. (1996) of using both STO and STH, and Duggan and Beyer (1975) of reduced STO antibodies in malaria patients.

This study had some limitations, mainly due to the difficulties associated with the validity and reliability of the tests used to diagnose typhoid. Blood culture, the "gold standard" currently used for the diagnosis of typhoid, has some limitations. The validity of blood culture declines if the specimens from patients with fever are not collected within 7 to 10 days of illness, while most patients may present with typhoid fever as a persistent fever for as long as 2 or more weeks (W.H.O. 2003c). Other causes of failure to isolate the organism using blood culture are: (i) the limitations of laboratory media and the possibility of re-inoculation or contamination (ii) the presence of antibiotics, and (iii) the volume of the blood specimen cultured (usually a required blood volume is 10 –15ml in adults and 2 –4 ml in toddlers) (W.H.O. 2003c).

There was no difference in the distribution patterns of symptoms and signs between patients with malaria and those with typhoid (Figures 2 a and 2 b); this was similar to the findings of Nsutebu, Martins and Adiogo (2003) who detected no difference in symptoms and signs between patients with malaria, typhoid, and fever of unknown diagnosis.

There was a statistical association between typhoid and malaria (Table 2a). There was a significant correlation between typhoid and malaria admission diagnosis, and between typhoid and malaria diagnosis using diagnostic criteria (Table 2a, Table 3a and Table 3b). Duggan and Beyer (1975) explained this correlation, based on animal studies, as the increased susceptibility to *Salmonella* among patients with *Plasmodium* infection. There is no known human study to confirm this. This study did not aim to show whether patients with malaria are more susceptible to typhoid, or vice versa.

There is significant correlation between the use of anti-malaria medication and typhoid and between use of anti-malaria medication and malaria admission diagnosis. This shows how difficult it is to diagnose malaria based on symptoms and signs of malaria that are similar to those of typhoid.

The lack of correlation between typhoid and malaria in patients who had used anti-malaria medication may indicate that most patients who had both typhoid and malaria were cured of malaria, yet remained infected with typhoid.

The sensitivity and specificity of the on-slide agglutination test (Tables 4a, 4b, 5) were similar to the results of Saha et al. (1996), who found the sensitivity of the Widal test for STO and STH to be 88% and 98% respectively. The positive and negative predictive values of the on-slide agglutination test were high due to the high prevalence of typhoid among studied participants (Tables 4a, 4b, 5).

There was no significant impact of malaria on validity and reliability of the on-slide agglutination test when assessed among patients who had no malaria; patients who had malaria, and for the entire study group. The difference was noted when comparing the likelihood ratio positive for STH in patients with malaria and both STO and STH positive tests of all 3 categories (Table 5, Table 7a and Table 7b)

The likelihood ratios positive and negative when both STO and STH were positive, though not statistically significant different from those of STO or STH test positive alone, showed moderate changes from the pre-test probability to the post-test probability of typhoid (Table 5). This can be demonstrated using a normogram (see Plate 1). The post-test probability can be obtained by passing a ruler from a pre-test probability through a calculated likelihood ratio.

The results of this hospital-based cross-sectional study could have been influenced by selection-bias, as patients who used anti-malaria medication and were cured, did not come to the hospital to be admitted. Thus those who had used anti-malaria medication and were not cured were most likely to have had typhoid as well. This could be displayed by the fact that, in those who had used anti-malaria medication, the proportion of typhoid among malaria admission diagnoses was similar to that of typhoid among other admission diagnoses (47.4% vs 42.9% with an overall proportion for this group of 46.7%). The exclusion of those who had used anti-malaria medication from the analysis gave a significant proportion difference between typhoid among malaria admission and typhoid among other admission diagnoses of 32.7% (95% CI 15.4% –49.9%) ($p< 0.001$).

Alhough the laboratory technicians were not informed that the study aimed to validate the on-slide agglutination test, measurement bias might have occurred. Technicians might have looked harder for typhoid (using the Widal test) among those who had showed a reaction to the on-slide agglutination test than among those who did not react; as when the on-slide test is positive, it suggests the presence of typhoid infection. This might have increased the validity, predictive values and likelihood ratios of the on-slide agglutination test.

The distributions of risk factors showed no significant statistical difference between a malaria admission diagnosis and other admission diagnoses. Even those factors that had significant difference in distribution had no significant correlation to typhoid or malaria (Table 1, Table 8a, Table 8b and Table 8c).

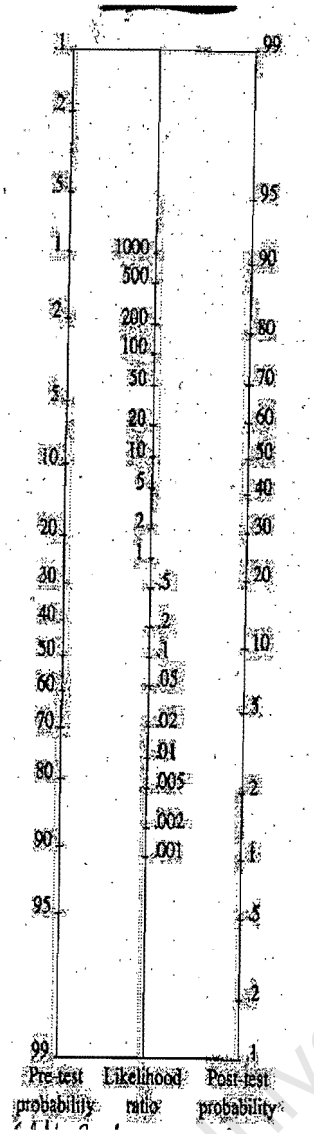

Plate 1: Nomogram for interpreting diagnostic test results.

Using a ruler one can pass it from a pre-test probability through a calculated likelihood ratio to obtain a post-test probability.

CHAPTER 5: CONCLUSION

Malaria and typhoid are diseases with similar clinical presentations. Their diagnoses do not only depend on the clinical features but also on laboratory tests.

This study found that typhoid accounted for 31.8% of admissions of studied patients, which differed from the Iringa Regional Department of Health Report (2002), in which typhoid was not among the top 10 causes of admission. Using the diagnostic criteria for malaria, 27.6% of study participants were diagnosed with malaria.

This study has found that the concurrence of malaria (diagnosed on admission or by diagnostic criteria) and typhoid was more common than typhoid with other admission diagnoses. Since there was no difference between the patterns of symptoms and signs of typhoid and those of a malaria admission diagnosis, and both diseases have a high case fatality rate if not treated properly, it is imperative to test for typhoid in any patient who is admitted with these symptoms and signs.

This study did not investigate the susceptibility to typhoid among patients with malaria or vice versa. Therefore these findings cannot be used to state that patients with one disease are more likely to have the other.

The on-slide agglutination test (when both STO and STH were positive) had very good validity and reliability, and was not significantly different from those for STO or STH alone. The likelihood ratios of the on-slide agglutination test showed a moderate

prediction of post-test results. The likelihood ratios when both STO and STH were positive were not significantly different from those of either STO or STH alone, with the exception of STH among patients with a malaria diagnosis based on diagnostic criteria.

CHAPTER 6: RECOMMENDATIONS

1. The Iringa Regional Department of Health Report does not include laboratory diagnoses; therefore there is a need to provide laboratory diagnoses reports as one of the surveillance tools. Programmes to record the presence and effect of disease require laboratory test results as well as admission diagnosis using diagnostic criteria.
2. The increased possibility of concurrence between the diagnosis of typhoid and malaria found in this study necessitates the need for health personnel in the areas where both typhoid and malaria are endemic, to be aware that these diseases often co-exist and to investigate each patient for the presence of both.
3. In areas where typhoid is common and facilities are unable to maintain the high cost of typhoid tests, the use of on-slide agglutination tests would be of help in attempting to reduce transmission. In addition, the on-slide agglutination test can be carried out at the bedside, making it easy to use and fast to obtain results. Since malaria and typhoid seem to co-exist, both a blood slide for malaria and an on-slide agglutination test can be done as quick bedside tests. This will reduce unnecessary deaths due to delayed treatment for typhoid, which according to WHO (1997), has a high case fatality of 10% among untreated patients.
4. Culture and sensitivity for *S. typhi* should be used, especially in cases where the diagnosis of typhoid is problematic. It is known that typhoid titres take at least 1 or more weeks to reach a diagnostic level (Mutanda 1998, WHO 2003), making culture and sensitivity of help during the early stages of typhoid.

5. The study suggests that further community-based investigations should be conducted to determine if the distribution and burden of these diseases are similar in the general population.
6. This study did not aim to determine if there could be susceptibility to typhoid among patients with malaria. It is therefore recommended that future studies be undertaken to determine if the susceptibility to typhoid is increased among patients with malaria.
7. In order to obtain a overall picture of these diseases and their seasonal variation, it is recommended that a 1-year study, which could include a review of admission records be undertaken,
8. A study to validate the on-slide agglutination and Widal tests, as well as blood culture is needed. This will help to ascertain the most valid test and whether it is necessary to use other tests at different stages of the illness.
9. Additional research is required to develop more valid and reliable tests for typhoid and malaria. This is because the currently available tests (including gold standards), for these diseases have some diagnostic limitations.

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Dr. Kangolle, A.C.T. 2003 - 2005 @ U.C.T.

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APPENDICES.

Appendix 1: Date: / / and Time AM/PM of interview.
Checklist for malaria symptoms/ Questinnaire.
Patient's code number: Age years, **Residence**

- **Occupation . Years of study** years

Level of education: None [ ], Primary school [ ], Secondary school [ ], High school [ ], University [ ]

Tick [√] if one or more of these symptoms are present.

A: Direct from the patient/relative.

1.1:Fever	No (0) [ ] Yes (1) [ ]	1.1: [ ]
1.2:Headache	No (0) [ ] Yes (1) [ ]	1.2: [ ]
1.3:Joints pains/body aches	No (0) [ ] Yes (1) [ ]	1.3: [ ]
1.4:Vomiting and or nausea	No (0) [ ] Yes (1) [ ]	1.4: [ ]
1.5:Diarrhoea	No (0) [ ] Yes (1) [ ]	1.5: [ ]
1.6:Loss of appetite	No (0) [ ] Yes (1) [ ]	1.6: [ ]
1.7:General body weakness	No (0) [ ] Yes (1) [ ]	1.7: [ ]
1.8:Feeling cold or chills	No (0) [ ] Yes (1) [ ]	1.8: [ ]
1.9:Yellow colouration of eyes	No (0) [ ] Yes (1) [ ]	1.9: [ ]
1.10:Altered level of consciousness/confusion:	No (0) [ ] Yes (1) [ ]	1.10: [ ]
1.11:Convulsions/fits	No (0) [ ] Yes (1) [ ]	1.11: [ ]
1.12:Others: specify		

Mention treatment(s) you have used since the start of these symptoms (illness):
....., ..., ...

Tick [√] if one or more of these symptoms are present.

B: From the patient's file admission notes.

2.1:Fever	No (0) [ ] Yes (1) [ ]	2.1: [ ]
2.2:Headache	No (0) [ ] Yes (1) [ ]	2.2: [ ]
2.3:Joints pains/body aches	No (0) [ ] Yes (1) [ ]	2.3: [ ]
2.4:Vomiting and or nausea	No (0) [ ] Yes (1) [ ]	2.4: [ ]
2.5:Diarrhoea	No (0) [ ] Yes (1) [ ]	2.5: [ ]
2.6:Loss of appetite	No (0) [ ] Yes (1) [ ]	2.6: [ ]
2.7:General body weakness	No (0) [ ] Yes (1) [ ]	2.7: [ ]
2.8:Feeling cold or chills	No (0) [ ] Yes (1) [ ]	2.8: [ ]
2.9:Yellow colouration of eyes	No (0) [ ] Yes (1) [ ]	2.9: [ ]
2.10:Altered level of consciousness/confusion:	No (0) [ ] Yes (1) [ ]	2.10: [ ]
2.11:Convulsions/fits	No (0) [ ] Yes (1) [ ]	2.11: [ ]
2.12:Others: specify		

Copy from the file the treatment(s) prescribed for this admission.
....., ...,.....
Admission diagnosis: (Copy the admission diagnosis from the file)
1: .....; 2:.....
3: .....; 4:.....
5: If not specified tick [√].....[ ]

3.1:When did you start experiencing the symptom(s)?

i) On.....date — 3.1.i:___days/hrs

[Calculate days/hours past.....days/ hours

ii) Since (day/ time in hours)..... — 3.1.ii:___days/hrs

[Calculate days/ hours past].....days/ hours

{cross which is not applicable}

iii) Do not know (tick) [ ] — 3.1.iii [ ]

3.2: What is the duration of your current illness/symptoms? — 3.2.i:__days/hr

i).....days/hours

ii) Do not know (tick) [ ] — 3.2.ii: [ ]

3.3 a) Do you know mosquitoes? [TICK]

i) Yes (1) [ ] — 3.3.a: [ ]

ii) No (0) [ ] If no go to No: 3.4

b) If YES: Do you use anything to protect you from mosquito bites? [TICK] — 3.3.b: [ ]

i) Yes (1) [ ]

ii) No (0) [ ] If no go to No: 3.4

c) If YES: Which one do you use? [TICK] — 3.3.c: [ ]

i) Mosquito nets [ ]

ii) Sprays [ ]

iii) Mosquito repellents [ ]

iv) Burning mosquito coils [ ]

v) Others specify.....

3.4 a) Have you ever heard of mosquito nets? [TICK] — 3.4.a: [ ]

i) Yes (1) [ ]

ii) No (0) [ ] If no go to No: 3.5

b) If YES: Do you have one at home? [TICK] — 3.4.b: [ ]

i) Yes (1) [ ]

ii) No (0) [ ] If no go to No: 3.5

c) If YES: What do you use it for? — 3.4.c:.....

Mention.....

3.5 a) Have you ever heard of insecticide treated mosquito nets? [TICK] i) Yes (1) [ ] ii) No (0) [ ] If no go to No: 3.6 b) If YES: Do you have one at home? [TICK] i) Yes (1) [ ] ii) No (0) [ ] If no go to No: 3.6 c) If YES: What do you use it for? Mention.....	3.5.a: [ ] 3.5.b: [ ] 3.5.c.....
3.6 a) Do you sometimes have outdoor activities at night? [TICK] i) Yes (1) [ ] ii) No (0) [ ] If no go to No: 3.7 b) If YES: Which activities (mention)..... ..... c) If YES: When you have outdoor activities at night, by average for how long do you stay out per each occasion? .....Hours/ minutes.	3.6.a: [ ] 3.6.b..... ..... 3.6.c.....hrs/min
3.7 a) Do you take (drink) alcohol? [TICK] i) Yes (1) [ ] ii) No (0) [ ] If no go to No: 4.1 b) If YES: How often do you drink? [TICK] i) Daily [ ] ii) Weekly [ ] .....Times per week iii) Monthly [ ] ..... Times per month iv) Occasionally [ ] v) Others (specify)..... c) If YES: Do you drink alcohol to get drunk? [TICK] i) Yes (1) [ ] ii) No (0) [ ] If no go to No: 4.1	3.7.a: [ ] 3.7.b: [ ] .....Times per..... 3.7.c: [ ]
3.8 a) Have you ever felt you could cut down your drinking? i) Yes (1) [ ] ii) No (0) [ ]	3.8.a: [ ]
3.8 b) Have people annoyed you by criticising your drinking? i) Yes (1) [ ] ii) No (0) [ ]	3.8.b [ ]
3.8 c) Have you ever felt bad or guilty about your drinking? i) Yes (1) [ ] ii) No (0) [ ]	3.8.c [ ]
3.8 d) Have you ever had a drink first thing in the morning to steady your nerves or to get rid of hangover (Eye-opener)? i) Yes (1) [ ] ii) No (0) [ ]	3.8.d [ ]

4.1 a) What is the source of water for your home? [TICK] i) Tape water [ ] ii) Well [ ] iii) River [ ] iv) Pond [ ] v) Others (specify).....	4.1.a: [ ]
4.2 Mention how is your drinking water treated or prepared before you drink?.....	4.2:.....
4.3 a) Do you eat eggs? [TICK] i) Yes (1) [ ] ii) No (0) [ ] If no go to No: 4.4	4.3.a: [ ]
b) If YES: How do you prepare them before eating? [TICK] i) Eat them fresh [ ] ii) Fry them [ ] iii) Boil them [ ] iv) Others (specify)	4.3.b: [ ]
4.4 a) Do you eat fresh food like vegetables or fruits? [TICK] i) Yes (1) [ ] ii) No (0) [ ] If no go to No: 4.5	4.4.a: [ ]
b) If YES: How do you prepare them before eating? [TICK] i) Eat them fresh [ ] ii) Fry them [ ] iii) Boil them [ ] iv) Wash them with cold water [ ] v) Wash them with boiled water [ ] vi) Others (specify).....	4.4.b: [ ]
4.5 a) Do you have a toilet at home? [TICK] i) Yes (1) [ ] ii) No (0) [ ] If no go to No: 4.5 (c)	4.5.a: [ ]
b) If YES: What are using it for? Mention.....	4.5.b.....
c) If NO: How do you dispose stool or urine? Explain.....	4.5.c:..... .....
• 4.6: a) Have you ever heard of typhoid vaccine? i) Yes (1) [ ] ii) No (0) [ ]	4.6.a: [ ]
b) Have you ever been vaccinated against typhoid? i) Yes (1) [ ] ii) No (0) [ ]	4.6.b: [ ]

Appendix 2

LABORATORY RESULTS RECORDING SHEET. *Note: mps/200wcc= malaria parasites per 200 white cell counts. Species= malaria parasites species.*

No:	Code No: (Patient's)	Thick film mps/200wcc	Thin film Species	On slide agglutinin test + or -	Widal test titres
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Appendix 3:
PATIENT CODING SHEET (TO BE FIELD AFTER CONSENTING):

SUBJECT'S NAME	SEX	Age(Years)	Address/Residence	Occupation	CODE1	CODE2

Appendix 4:

Information Sheet: (pre-consent information sheet).

The researcher is a public health student from university of Cape Town, South Africa; Health sciences faculty. He is as well an employee of Iringa regional hospital, Tanzania.

Name and contact details:
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Observatory
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Or
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Iringa,
Tanzania.
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Dear Reader

Thank you for taking time to read this information sheet.

Reasons for this study:

Research done in other areas has shown that malaria and typhoid do sometimes coexist in a person and both make him/her sick. This research wants to test if this situation is similar at our area and check the possibility of using a simple test to diagnose typhoid. The researcher will use this information for his mini-dissertation to be submitted at the University of Cape Town.

Participation is Voluntary

- If you wish to join the study, you have to give consent. If you are able to read and write, you will need to sign a consent form; if you are unable to write another person will witness your agreement to participate.
- You will be given a copy of this information and consent form to keep.
- You will be free to leave the study at any time, and do not have to give a reason for leaving. You will not be penalised for not joining the study or for leaving the study.
- You will not pay for any service provide by this study.
- You will continue to get the hospital services whether you join the study or not.
- You are welcome to contact the researcher at any time during or after the study.

The research design:
190 patients of age 10 years and above admitted in the medical wards at Iringa regional hospital will choose to join the study or not. Those who agree to take part in the study will be included in the study.

What the study involves:
You will be asked to give information of the symptoms you are presenting with. This will be noted on the checklist/ questionnaire and other information will be obtained from you file. You will be required to provide specimen for laboratory tests: finger prick for malaria tests and blood sample drown from you veins (mostly of your arm) for typhoid tests. Remember these procedures may be painful, so we expect you to anticipate this.

Confidentiality:
The researcher will make every effort to keep your information private. Your name will not be written on any of specimens collected nor on the checklist, a code number will replace it.
Because the study involves taking specimen people might suspect your participation once they note that you have provided the specimen.
All results will be kept confidential and data will be analysed without using your name.

Results of the study:
Every participant is entitled to get his/her laboratory results and may be prescribed treatment if s/he is found to have disease. The final report will be submitted at University of Cape Town for marking as a mini-dissertation of the researcher.
Other copies of final report will be available in the Iringa regional hospital library and the university of Cape Town library.
The researcher and his supervisor each will as well be having a copy of the final report.

Anticipated benefits to and protection of the study subjects:
- All information collected will be confidential.
- All the tests done by the study will be free of charge.
- All participants will be given the results of their blood tests.
- You should know that whether you agree to be included into the study or not, this will not affect the health care given by the hospital.
- Those found to have the diseases would be referred for appropriate treatment.
- You are likely to gain knowledge, as you will be eligible to ask the researcher questions.
- Participants can withdraw from the study at any stage.

Risks to the subjects:
- Since the study involves taking blood sample, you may experience pain during this process.
- Confidentiality may not be a hundred percent as yourself or your relative(s) may bleach the information of your involvement in the study; also one may suspect your involvement in the study during the process of data collection.

Anticipated gain in knowledge:

- The final report of study will be presented at the University of Cape Town by the researcher as a mini-dissertation, a part of his academic assessment, for achieving the Masters in Public Health degree. The copies of the final report will be available in the University of Cape Town library and in the Iringa regional hospital library.
- If the co-existence of malaria and typhoid is found to be significant, then health care personnel can start concentrating on typhoid as the most important differential diagnosis of malaria. This may reduce over-diagnosing malaria, saving life and costs.
- If co-existence of malaria and typhoid is found not to be significant, then health care personnel will not be forced to investigate for typhoid when they suspect malaria. This will save their time in managing patient and minimise the number of tests for typhoid.
- If the on-slide agglutinin test for typhoid shows good validity for the detection of typhoid, then its use for patients who are in need of urgent care (in the severe form of illness) will save life, time and cost as compared to the commonly used widal test which usually takes at least 24 hours to get results (when using the incubation technique).
- If it is found that the association between malaria and typhoid is very strong, then malaria and typhoid can be treated concurrently even when the laboratory results are not available.

If you wish to join the study, read and sign the consent form.
Thank you for paying attention.

Appendix 5:

CONSENT FORM:

PART:A:(To be used by adults and fully conscious persons):

I (NAME IN FULL).....have understood the information I have been given/ I have read.

I, ... agree to take part in the study and give the researcher(s) my permission to use my file notes/information and blood sample for this research study.

Signature.....

Date .....

Witness (NAME AND SIGNATURE).....

Signature.....

Date.....

PART:B: (To be used by parents/guardians of children OR guardians, parents or relatives of patients with altered level of consciousness/ altered ability to consent):

I (NAME IN FULL).....have understood the information I have been given/ I have read.

I, ...on behalf of ..... agree that he/she will to take part in the study and give the researcher(s) my permission to use his/her file notes/information and blood sample for this research study.

Reason of failure of (Name)..... to consent is (TICK):

(i) Child ( )

(ii) Altered consciousness ( )

(iii) Others (specify).....

Signature of parent/ guardian/ relative.....

Mention your relationship with the participant.....

Date .....

Witness (NAME AND SIGNATURE).....

Signature.....

Date.....

Kiambatanisho 1: Tarehe: / /200 na Muda Asu/Jio/Usi. wa mahojiano.

Orodhalinganishi ya dalili za malaria/Dodoso.

Namba ya mgonjwa: Umri miaka, **Anakoishi**

Kazi yake . Muda aliosoma shule miaka

Kiwango cha elimu: Hakuna [ ], Shule ya msingi [ ], sekondari [ ] Sekondari ya juu [ ], Chuo kikuu [ ]

Weka vema*[√] kama moja au zaidi ya hizi dalili anazo:*

***A: Kutokana na maelezo ya mgonjwa moja kwa moja/ndugu*:**

1.1: Homa	Hapana (0) [ ] Ndiyo (1) [ ]	1.1: [ ]
1.2: Kichwa	Hapana (0) [ ] Ndiyo (1) [ ]	1.2: [ ]
1.3: Maumivu ya viungo/maumivu ya mwili .	Hapana (0) [ ] Ndiyo (1) [ ]	1.3: [ ]
1.4: Kutapika na au kichefuchefu	Hapana (0) [ ] Ndiyo (1) [ ]	1.4: [ ]
1.5: Kuharisha	Hapana (0) [ ] Ndiyo (1) [ ]	1.5: [ ]
1.6: Kukosa hamu ya kula	Hapana (0) [ ] Ndiyo (1) [ ]	1.6: [ ]
1.7: Mwili kunyong'onyea	Hapana (0) [ ] Ndiyo (1) [ ]	1.7: [ ]
1.8: Kujisikia baridi	Hapana (0) [ ] Ndiyo (1) [ ]	1.8: [ ]
1.9: Macho kuwa na rangi ya njano	Hapana (0) [ ] Ndiyo (1) [ ]	1.9: [ ]
1.10: Kuchanganyikiwa/kuweweseka	Hapana (0) [ ] Ndiyo (1) [ ]	1.10: [ ]
1.11: Degedege	Hapana (0) [ ] Ndiyo (1) [ ]	1.11:[ ]
1.12: Zinginezo; Taja		

Taja dawa ulizokwishatumia tangu upate dalili za ugonjwa huu:

....., ..., ...

Weka vema *[√] kama moja au zaidi ya dalili hizi zipo:*

B: Kutoka katika jarada la mgonjwa

2.1: Homa	Hapana (0) [ ] Ndiyo (1) [ ]	1.1: [ ]
2.2: Kichwa	Hapana (0) [ ] Ndiyo (1) [ ]	1.2: [ ]
2.3: Maumivu ya viungo/maumivu ya mwili .	Hapana (0) [ ] Ndiyo (1) [ ]	1.3: [ ]
2.4: Kutapika na au kichefuchefu	Hapana (0) [ ] Ndiyo (1) [ ]	1.4: [ ]
2.5: Kuharisha	Hapana (0) [ ] Ndiyo (1) [ ]	1.5: [ ]
2.6: Kukosa hamu ya kula	Hapana (0) [ ] Ndiyo (1) [ ]	1.6: [ ]
2.7: Mwili kunyong'onyea	Hapana (0) [ ] Ndiyo (1) [ ]	1.7: [ ]
2.8: Kujisikia baridi	Hapana (0) [ ] Ndiyo (1) [ ]	1.8: [ ]
2.9: Macho kuwa na rangi ya njano	Hapana (0) [ ] Ndiyo (1) [ ]	1.9: [ ]
2.10: Kuchanganyikiwa/kuweweseka	Hapana (0) [ ] Ndiyo (1) [ ]	1.10: [ ]
2.11: Degedege	Hapana (0) [ ] Ndiyo (1) [ ]	1.11:[ ]
2.12: Zinginezo; Taja		

Andika dawa alizoandikiwa mgonjwa wakati analazwa kwa ajili ya ugonjwa huu.

....., ..., ...,

Jina la ugonjwa aliolazwanao mgonjwa: (Nakili toka kwenye jarada)

1: .....; 2:.....

3: .....; 4:.....

5: Kama ugonjwa haukutajwa weka vema hapa [√].....[ ]

....., ..., ...

3.1: Lini ulipoanza kuhisi dalili hizi? ii) Tangu tarehe/siku/saa…….. [Piga mahesabu ya siku/saa zilizopita]……siku/saa *{Futa isiyohusika}* ii) Sijui (weka vema) [ ]	3.1.i:___siku/saa 3.1.ii [ ]
3.2: Dalili za ugonjwa huu ulionao sasa zina kitambo cha muda gani? i)……siku/saa ii) Sijui (weka vema) [ ]	3.2.i:___siku/saa 3.2.ii: [ ]
3.3 a) Je unawafahamu mbu? [weka vema] i) Ndiyo (1) [ ] ii) Hapana (0) [ ] Kama hapana nenda NA: 3.4	3.3.a: [ ]
b)Kama NDIYO: Kuna njia yoyote unayotumia kujikinga na mbu wasikuume? [weka vema] i) Ndiyo (1) [ ] ii) Hapana (0) [ ] Kama hapana nenda NA: 3.4	3.3.b: [ ]
d) Kama NDIYO: Ni njia gani unayotumia? [weka vema] i) Chandarua [ ] ii) Dawa ya kupuliza [ ] iii) Dawa ya kupaka/kufukuza mbu [ ] iv) Dawa ya kuchoma (koili) [ ] v) Zingine: Taja……..	3.3.c: [ ]
3.4 a) Ulikwishasikia kuhusu vyandarua vya mbu? [weka vema] iii) Ndiyo (1) [ ] iv) Hapana (0) [ ] Kama hapana nenda NA: 3.5	3.4.a: [ ]
b) Kama NDIYO: Unachonyumbani kwako? [weka vema] i) Ndiyo (1) [ ] ii) Hapana (0) [ ] Kama hapana nenda NA: 3.5 c) Kama NDIYO: Unakitumia kwa kazi gani? Taja….. ……	3.4.b: [ ] 3.4.c: ……
3.5 a) Umewahi kusikia vyandarua vya/vyenye dawa? [weka vema] i) Ndiyo (1) [ ] ii) Hapana (0) [ ] Kama hapana nenda NA: 3.6	3.5.a: [ ]
b) Kama NDIYO: Unacho nyumbani kwako/kwenu? [weka vema] i) Ndiyo (1) [ ] ii) Hapana (0) [ ] Kama hapana nenda NA: 3.6 c) Kama NDIYO: Unakitumia kwa kazi gani? Taja….. ……	3.5.b: [ ] 3.5.c: ……

3.6 a) Je kuna wakati wewe huwa nashughuri za kufanya nje ya nyumba wakati wa usiku? [weka vema] i) Ndiyo (1) [ ] ii) Hapana (0) [ ] Kama hapana nenda NA: 3.7 b) Kama NDIYO: Ni shughuri zipi (zitaje).....	3.6.a: [ ] 3.6.b.....
..... c) Kama NDIYO: Unapokuwa na shughuri za nje ya nyumba usiku, kwa wastani wewe hukaa nje kwa muda gani kwa kila tukio moja? .....Saa/dakika	3.6.c.....saa/dk
3.7 a) Je wewe unakunywa pombe/kileo chochote? [weka vema] i) Ndiyo (1) [ ] ii) Hapana (0) [ ] Kama hapana nenda NA: 4.1 b) Kama NDIYO: Mara ngapi unakunywa? [weka vema] i) Kila siku [ ] ii) Kila juma [ ] Mara.....kwa juma iii) Kila mwezi [ ] Mara.....kwa mwezi iv) Mara chache [ ] v) Zinginezo (taja)..... c) Kama NDIYO: Je hunywa hadi ukalewa?[weka vema] i) Ndiyo (1) [ ] ii) Hapana (0) [ ] Kama hapana nenda NA: 3.8	3.7.a: [ ] 3.7.b: [ ] Mara...kwa..... 3.7.c: [ ]
3.8.a) Umewahi kujisikia unahitaji kupunguza au kuacha unywaji pombe? i) Ndiyo (1) [ ] ii) Hapana (0) [ ]	3.8.a: [ ]
b) Umewahi kujisikia vibaya au unakosea kuhusu unywaji wako? i) Ndiyo (1) [ ] ii) Hapana (0) [ ]	3.8.b [ ]
c) Umewahi kuudhiwa na watu waliokushauri kuhusu unywaji wako wa pombe? i) Ndiyo (1) [ ] ii) Hapana (0) [ ]	3.8.c [ ]
d) Umewahi kuhitaji pombe kama kitu cha kwanza asubuhi kukufanya uondoe unyonge au kuondoa mning'inio (hangover), (yaani kifungua macho?) i) Ndiyo (1) [ ] ii) Hapana (0) [ ]	3.8.d [ ]

4.1 a) Mnapata wapi maji ya kunywa hapo nyumbani? [weka vema] 4.1.a: [ ]

i) Bombani [ ]
ii) Kisimani [ ]
iii) Mtoni [ ]
iv) Bwawani [ ]
v) Kwingine (taja).....

4.2 Eleza jinsi mnavyoandaa maji ya kunywa kabla hamjayanywa. 4.2:.....
.....
.....

4.3 a) Unakula mayai? [weka vema] 4.3.a: [ ]

i) Ndiyo (1) [ ]
ii) Hapana (0) [ ] Kama hapana nenda NA:4.4

b) Kama NDIYO: Huwa unayaandaaje kabla ya kuyala? [weka vema] 4.3.b: [ ]

v) Nakula mabichi [ ]
vi) Nayakaanga [ ]
vii) Nayachemsha [ ]
viii) Njia zingine (taja) .....

4.4 a) Je huwa mnakula vyakula vibichi/vipya (fresh) kama matunda au mbogamboga? [weka vema] 4.4.a: [ ]

i) Ndiyo (1) [ ]
ii) Hapana (0) [ ] Kama hapana nenda NA:4.5

b) Kama NDIYO: Mnayaandaaje kabla ya kuyala? [weka vema] 4.4.b: [ ]

vii) Tunakula yalivyo [ ]
viii) Tunayakaanga [ ]
ix) Tunayachemsha [ ]
x) Tuanyaosha kwa maji baridi [ ]
xi) Tuanyaosha kwa maji moto [ ]
xii) Njia zingine (zitaje).....

4.5 a) Mna choo nyumbani? [weka vema] 4.5.a: [ ]

i) Ndiyo (1) [ ]
ii) Hapana (0) [ ] Kama hapana nenda NA:4.5 (c)

b)Kama NDIYO: Mnakitumia kwa kazi gani?

Taja ..... 4.5.b.....
.....

c) Kama hapana mnajisaidia wapi? 4.5.c:.....

Eleza.....
.....

4.6 a) Je umewahi kusikia kuhusu chanjo dhidi ya homa ya matumbo (typhoid)? 4.6.a: [ ]

i) Ndiyo (1) [ ]
ii) Hapana (0) [ ]

4.6 b) Je umewahi kupewa chanjo dhidi ya homa ya matumbo (typhoid)?

i) Ndiyo (1) [ ] 4.6.b: [ ]
ii) Hapana (0) [ ]

Kiambatanisho 4:
Karatasi ya taarifa ya utafiti: (Isomwe kabla ya kuweka saini kwenye fomu ya kuafiki).
Mtafiti ni mwanafunzi katika kitengo cha Afya ya Jamii, kitivo cha sayansi za Afya cha chuo kikuu cha Cape Town, Afrika Kusini. Vile vile ni muajiriwa wa hospitali ya mkoa Iringa, Tanzania.

Jina na Anwani yake:
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AU
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Iringa,
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Barua pepe: kangoalfred@yahoo.com

Mpendwa msomaji

Nakushukuru kwa kuchukua muda kusoma taarifa hii.

Sababu za utafiti huu:
Utafiti uliofanyika katika maeneo mengine umeonesha kuwa ugonjwa wa malaria na homaya matumbo (typhoid) mara nyingine humpata mtu kwa pamoja na kumfanya augue. Utafiti huu unataka kupima kama hali hiyo ni sawa katika eneo letu na kuangalia uwezekana wa kutumia kipimo rahisi/chepesi kupima na kugundua homa ya matumbo (typhoid).
Mtafiti atatumia uchunguzi huu kwa ajili kutengeneza ripoti atakayoipeleka chuo kikuu cha Cape Town kama sehemu ya mafunzo yake kwa vitendo..

Kushiriki ni hiari:
- Kama unapenda kushiriki katika utafiti huu, utajaza fomu ya kuafiki ushiriki wako. Kama unaweza kusoma na kuandika, utatakiwa kuweka saini yako kwenye fomu ya kuafik; kama huwezi kuandika mtumwingine atakuwa shahidi wa kukubari kwako.
- Utapewa nakara ya taarifa hii uisomayo na ya fomu ya kuafiki.uvitunze.
- Uko huru kujitoa muda wowote kutoka katika utafiti huu, hutakiwi kutoa sababu za kujitoa. Hutaadhibiwa kwa kujitoa au kutoshiriki katika utafiti.
- Hutatakiwa kulipia huduma yoyote itakayo tolewa na utafiti huu.

- Utafiti huu hautaathiri huduma za kawaida za hospitali hii, kwa atakayejiunga au asiyejiunga na utafiti.
- Unakaribishwa kuwasiliana na mtafiti wakati wowote wa utafiti au baada yake.

Muundo wa utafiti:
Wagonjwa 190 wa umri wa miaka 10 au zaidi watakaolazwa mawodi ya magonjwa ya homa (medical) katika hospitali ya mkoa Iringa watachagua kujiunga na utafiti au la. Wale watakaokubali kujiunga na utafiti ndio watakaoshiriki kwenye utafiti.

Utafiti unahusisha nini:
Mshiriki ataulizwa kutoa taarifa za dalili alizolazwa nazo. Hizi zitaandikwa kwenye orodhalinganishi au dodoso na taarifa zingine zitapatikana toka kwenye jarada lako. Pia utachukuliwa vipimo kupeleka maabara: kipimo cha damu toka katika kidole kwa ajili ya kupima malaria, na damu ya mshipa (mkononi) kwa ajili ya homa ya matumbo (typhoid). Kumbuka mara nyingine uchukuaji wa vipimo hivi husababisha maumivu, hivyo unategemewa kuweka katika fahamu zako hilo endapo litatokea.

Usiri:
Mtafiti atajitahidi kuweka taarifa zako katika hali ya siri/binafsi. Jina lako halitaandikwa katika vipimo vitakavyopelekwa maabara wala katika dodoso/orodhalinganishi, number pekee ndiyo itatumika kwa ajili hiyo. Kwasababu utafiti uanahusisha uchukuaji vipimo, watu wanaweza kuhisi ushiriki wako maara wagunduapo kuwa ulichukuliwa vipimo. Majibu yote yatatunzwa kwa siri na upembuzi yakinifu wa matokeo ya utafiti utafanywa bila kuhusisha majina ya wahusika.

Matokeo ya utafiti:
Matokeo ya mwisho ya utafiti yatapelekwa chuo kikuu cha Cape Town kwaajili ya kusahihishwa kama sehemu ya masomo ya mtafiti.
Nakala za matokeo ya utafiti huu zitawekwa kwenye maktaba ya hospitali ya mkoa Iringa na maktaba ya chuo kikuu cha Cape Town. Mtafiti na msimamizi wake vile vile watakuwa na nakala za matokeo ya mwisho ya utafiti huu.

Matarajio ya faida kwa na kumjali mshiriki katika utafiti:
- Taarifa zote zitakazokusanywa zitakuwa za siri.
- Vipimo vyote vya mshiriki vitakavyochukuliwa havitalipiwa.
- Washiriki wote watapewa majibu yao ya vipimo vya damu.
- Kushiriki au kutokushirki kwako katika utafiti hakutaathiri huduma utakayopata toka hospitalini.
- Watakaogundulika kuwa na ugonjwa watapelekwa kwa daktari ili kupatiwa matibabu.
- Washiriki wanaweza kuongeza maarifa ya afya, wanayonafasi ya kumuuliza mtafiti maswali.
- Mshiriki anaweza kujitoa katika utafiti huu wakati wowote.

Wasiwasi juu ya utafiti huu kwa mgshiriki:

- Kwavile utafiti unahusisha kuchukua vipimo vya damu, mshiriki anaweza akajisikia maumivu wakati wa zoezi hilo.
- Utunzaji wa siri hauwezi kuwa na uhakika wa asilimia mia moja; kwani mshiriki mwenyewe au ndugu zake wanaweza kutoa maelezo ya ushiriki huo kwa mtu mwingine. Pia watu wanaweza kuhisi ushiriki huo kutokana na zoezi zima la ukusanyaji wa taarifa za mshiriki.

Matarajio ya faida kitaaluma:

- Taarifa ya mwisho itawasilishwa chuo kikuu cha Cape Town kama sehemu ya mafunzo ya mtafiti kwa ajili ya digrii ya pili ya afya ya jamii. Nakala za taarifa ya mwisho zitakuwepo kwenye maktaba ya chuo kikuu cha Cape Town na maktaba ya hospitali ya mkoa Iringa.
- Kama utafiti ukidhihirisha kuwa malaria na homa ya matumbo vyaweza kumpata mtu mmoja kwa mara moja, basi watumishi wa idara ya afya wataanza kuupa kipaumbele ugonjwa wa homa ya matumbo.
- Kama utafiti ukidhihirisha kuwa malaria na homa ya matumbo havina uwezekano wa kumpata mtu mmoja kwa mara moja, basi watumishi wa idara ya afya watakuwa hawapotezi muda mwingi katika kugndua ugonjwa alionao mgonjwa na itapunguza idadi ya vipimo vinavyofanywa ili kugundua kuwepo kwa homa ya matumbo.
- Kama kipimo chepesi/rahisi cha homa ya matumbo kitaonesha kuwa na uwezo wa kutambua ugonjwa huo, basi matumizi yake hasa kwa wagonjwa wanaohitaji huduma ya haraka (walio na aina kali ya ugonjwa/waliozidiwa) yataokoa maisha, muda na gharama ukilinganisha na kipimo cha sasa cha damu (Widal) ambacho kwa kawaida majibu yake huchukua si chini ya masaa 24 kupatikana
- Kama ikionesha kuwa uhusiano wa kuwepo kwa malaria na typhoid kwa mgonjwa mmoja ni mkubwa sana, basi matibabu ya magonjwa haya yanaweza kuendeshwa kwa pamoja hata kabla ya kupata majibu ya vipimo vya maabala hayajapatikana.

Kama unapendelea kujiunga na utafiti huu, soma maelezo haya na uweke saini kwenye fomu ya kuafiki.

Asante kwa ushirikiano.

Kiambatanisho 5:
FOMU YA KUAFIKI:
SEHEMU:A: (Ijazwe na mtu mzima aliyena fahamu zake kamili):
Mimi (JINA KAMILI)..... nimeelewa maelezo ya taarifa niliyopewa/ niliyosoma.
Mimi, ...
nakubali kushiriki katika utafiti na kumpa mtafiti ruhusa yangu ya kutumia jarada/taarifa zangu na vipimo vya damu kwa ajili ya utafit huuI,

Saini.....

Tarehe .....

Shahidi (Jina na Saini).....

Saini.....

Tarehe.....

SEHEMU:B: (Ijazwe na mzazi/mlezi/ndugu wa mtoto Aumzazi/ mlezi/ndugu wa mgonjwa aliyepoteza/pungukiwa fahamu za kuweza kuafiki):
Mimi (JINA KAMILI)..... nimeelewa maelezo ya taarifa niliyopewa/ niliyosoma.
Mimi, ...kwaniaba ya
..... nakubali kuwa atashiriki katika utafiti na kumpa mtafiti ruhusa yangu ya kutumia jarada/taarifa za mshiriki na vipimo vya damu kwa ajili ya utafit huu.
Sababu zilizomfanya..... ashindwe kuafiki mwenyewe ni (weka vema):

(iv) Mtoto ( )
(v) Kupungua/kupoteza fahamu ( )
(vi) Zingine (taja).....

Saini ya mzazi/mlezi/ndugu.....

Taja uhusiano wako na mshiriki.....

Tarehe .....

Shahidi (Jina na Saini).....

Saini.....
Tarehe.....