

# WORLD HEALTH & POPULATION

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The Potential for Transmission of Hospital-Acquired Infections by Non-critical Medical Devices: The Role of Thermometers and Blood Pressure Cuffs

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## From the Editor-in-Chief

**T**his issue of *World Health & Population* presents papers that have been published online by *WHP* and are selected here as representative of recent interesting contributions to the journal. Three of the five articles originate from Nigeria, and two of these focus on malaria. The other two articles report on healthcare in South Asian settings – slums in Calcutta (Kolkata) and health facilities planning in the city of Khulna in Bangladesh.

The initial paper in this volume, “The Potential for Transmission of Hospital-Acquired Infections by Non-critical Medical Devices: The Role of Thermometers and Blood Pressure Cuffs,” builds on the case for looking at the basics for avoiding hospital-acquired (nosocomial) infections.

Uneke and colleagues have published previously in *World Health & Population* (cf. Vols. 10-4 and 11-3) on infections from stethoscopes and hospital uniforms (“white coats”). Given the relatively low cost and straightforward implementation for improvements in these areas, emphasis on them should seem obvious across the world, and is particularly appropriate for resource-constrained settings such as Nigeria. Unfortunately, they continue to be overlooked and underemphasized (see, for example, Bailey and Rees 2005).

The first of the two articles in this issue on malaria in Nigeria reports a cross-sectional knowledge and practice survey of women attending antenatal clinics in Ekiti State. This study by Akinleye and Ajayi reveals an encouragingly high awareness of the consequences of malaria during pregnancy, but distressingly low knowledge regarding causes of the disease, and parallel low use of preventive measures, including insecticide-treated mosquito nets (ITNs) and intermittent preventive treatment with antimalarial drugs. Achievement of “Roll Back Malaria” goals (Global Malaria Partnership 2010) will not be realized without improved knowledge of the disease and receptiveness to proven intervention at the village level.

In “Measuring Physical Accessibility to Health Facilities – A Case Study on Khulna City” Islam and Akter use spatial techniques and geographic information system (GIS) analysis to assess population access to urban primary healthcare clinics and hospitals in Khulna City, Bangladesh. The analysis takes into account both physical (distance) location and the availability of public transport as factors influencing access. Although use of GIS has become a relatively common technique in epidemiology (Oregon State University 2011), its application to healthcare planning and facility location is not yet fully realized in Bangladesh or in other countries. GIS is yet another tool, along with manpower planning and logistics, with potential for improving access to healthcare.

The fourth paper in this issue is “Balancing the Present and the Future: A Study of Contraceptive Use in Calcutta’s Slums.” Using data from the Demographic and Health Surveys (DHS), Data and Husain examine the impact of traditional factors of contraceptive acceptance (son preference, religion, age, education, wealth, etc.) on the choice of contraceptive method through a series of econometric models. Although contraceptive prevalence rates are generally high, adoption in different slum communities remains variable, and son preference a continuing important and troubling factor.

The final paper, “Assessing the Progress of Malaria Control in Nigeria,” by Jimson Amzat, complements the earlier paper by Akinleye and Ajayi through providing a larger picture of prevention and control initiatives in the country. Amzat’s analysis is not optimistic regarding achievability

of the Millennium Development Goals (Mugs) related to malaria. Among the interesting observations is that the continuing promotion and use of chloroquine, despite its ineffectiveness in the area, may be contributing to the lack of credibility and acceptance of known and effective malaria control methods, such as ITNs.

In conclusion, we hope that you find the papers in this issue interesting and worthwhile, and that you will also consult others recently released online at [www.worldhealthandpopulation.com](http://www.worldhealthandpopulation.com). *WHP* remains committed to its mission to provide a forum for researchers and policy makers worldwide to publish and disseminate health- and population-related research, and to encourage applied research and policy analysis from diverse global and resource-constrained settings. *WHP* is indexed on MEDLINE and is accessible through PubMed.

We look forward to continued enthusiastic submission of manuscripts for consideration, peer review and publication. Finally, the editors and publishers of *WHP* are always interested in any comments or suggestions you might have on the papers or about the journal and our mission. Please feel free to write or e-mail us.

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# The Potential for Transmission of Hospital-Acquired Infections by Non-critical Medical Devices: The Role of Thermometers and Blood Pressure Cuffs

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## **Abstract**

Healthcare-associated infection (HAI) is a major but often neglected public health problem. Most attention to HAI prevention is given to high-risk invasive diagnostic and therapeutic healthcare tools, while the importance of less critical tools tends to be underestimated. This study was designed to assess the potential contributory role played by thermometers and blood pressure cuffs in HAI transmission in a Nigerian teaching hospital. Analysis of swabs from thermometers and blood pressure cuffs used in the teaching hospital was conducted using standard microbiological techniques.

Results showed that 62.1% of thermometers and 82.1% of blood pressure cuffs examined were contaminated with *Staphylococcus aureus*, *Pseudomonas aeruginosa* or *Enterococcus faecalis*. *S. aureus* was the most common bacterial isolate, constituting 86.1% and 73.9% of the isolates from thermometers and blood pressure cuffs, respectively. Up to 80% and 100% of thermometers and pressure cuffs from the nursing unit and medical ward were contaminated. The bacterial isolates were resistant to the majority of the antibiotics tested, but all were susceptible to ciprofloxacin and streptomycin to varying degrees. This study emphasizes the urgent need to sanitize thermometers and blood pressure cuffs between patients to minimize transmission of resistant bacteria within hospitals by cross-colonization of non-critical medical devices used by healthcare staff.

## Introduction

Healthcare-associated infection (HAI), or nosocomial infection, is a major but often neglected public health problem in both developed and developing countries (Pittet 2005). The World Health Organization (WHO) defines HAI as an infection acquired in a hospital or other healthcare facility by a patient in whom the infection was not present or incubating at time of admission. This includes infections acquired in the hospital but appearing after discharge, and occupational infections among staff of the facility (WHO 2002). Reports indicate that at any one time more than 1.4 million people worldwide are estimated to suffer from infections acquired in hospitals (Tikhomirov 1987; Vincent 2003). Schwegman (2008) noted that because of an increase in invasive procedures and a growing resistance to antibiotics, HAIs have increased by 36% in the last 20 years and are consuming more healthcare resources each year. He added that the burden these infections place on the healthcare system can be divided into three categories: the cost of quality (i.e., excellent standards of care), the cost in human lives and the financial impact. In most developing countries, particularly in resource-poor settings, the estimated rate of HAI ranges from 25% to 40% and exacts a tremendous toll on patients, families and systems of care, resulting in increased morbidity and mortality, and increasing the cost of healthcare (Pittet 2005; WHO 2000, 2011).

Most attention to HAI prevention is given to high-risk invasive diagnostic and therapeutic healthcare tools, while the importance of less critical tools tends to be underestimated (Schwegman 2008; Uneke and Ijeoma 2010). Recent studies have reported the potential nosocomial spread of microbial flora by means of non-critical healthcare tools including stethoscopes (Uneke et al. 2009; Schroeder et al. 2009), ultrasound transducers (Schabrun et al. 2006), gloves (Katherason et al. 2010), tourniquets (Ormerod et al. 2006), physicians' and nurses' pens (Wolfe et al. 2009), scissors (Cleal 2006), white coats (Treakle et al. 2009; Uneke and Ijeoma 2010), thermometers (Donkers et al. 2001) and blood pressure (BP) cuffs (Baruah et al. 2008; Davis 2009).

Thermometers and BP (sphygmomanometer) cuffs are among the most commonly used non-critical medical devices in hospital settings. Both have been associated with the spread of HAI in healthcare facilities (Baruah et al. 2008; Davis 2009). Thermometers in particular are linked to the outbreak of nosocomial infections in critical hospital units such as the intensive care unit (ICU) and neonatal and burns units (Donkers et al. 2001; Martínez-Pellús et al. 2002; v Dijk et al. 2002). In an earlier report, Livornese et al. (1993) found that an electronic thermometer was the vehicle that caused an outbreak of vancomycin-resistant *Enterococcus faecium* in a medical/surgical intensive care unit and ward of a university hospital. Similarly, a number of investigations including very recent studies have identified BP cuffs as potential vehicles for transmission of nosocomial infection in selected patient populations (Baruah et al. 2008; Base-Smith 1996; Davis 2009; Walker et al. 2006). BP cuffs have been associated with outbreaks of mupirocin-resistant *Staphylococcus aureus*, methicillin-resistant *S. aureus* (MRSA) and borderline methicillin-susceptible *S. aureus* (BMSSA) in various hospital settings (Boyce et al. 1997; Layton et al. 1993; Webb 2002). An outbreak of this sort and linked to BP cuffs has also been observed in the ICU of a teaching hospital (De Gialluly et al. 2006).

Despite the increasing awareness of the association of non-critical medical devices with HAI, information is scarce on the contributory role of these devices to the burden of HAI in developing countries. A review of the literature shows that nearly all investigations on non-critical medical devices and transmission of HAI originate from developed countries. Our study was therefore designed to assess the potential contribution of thermometers and BP cuffs to HAI transmission in a Nigerian teaching hospital. Study objectives were to (1) assess the profile of microbial contamination of thermometers and BP cuffs used by health workers, (2) evaluate the relationship between thermometers and BP cuff contamination and their usage and handling practices by health workers, (3) assess the susceptibility of microbial isolates to various antibiotics commonly used in acute care practice, and (4) discuss the implication of the findings for the control and prevention of HAI in developing countries.

## Materials and Methods

### Sampling Technique

We conducted our study from September 2008 to February 2009 at the Ebonyi State University Teaching Hospital (EBSUTH) Abakaliki, southeastern Nigeria. The study was approved by the Infectious Diseases Research Division of the Department of Medical Microbiology of the Faculty of Clinical Medicine, Ebonyi State University Abakaliki. Thermometers and BP cuffs used in the various units of the hospital were sampled. The units included a nursing station, accident and emergency, orthopedic, the medical ward, outpatient, and the children's ward. All available thermometers and BP cuffs present in these units at the time of authors' visit were sampled. Sampling of the devices was done according to the methods described by Walker et al. (2006). Briefly, with the aid of sterile gloves, an estimated surface area of 100 cm<sup>2</sup> of BP cuff material coming into direct contact with patients' skin during BP measurement was swabbed using a sterile swab stick moistened with physiological saline. Likewise, thermometers were swabbed using swab sticks moistened with physiological saline as described by Baruah et al. (2008). Swabs were labelled appropriately and transferred to the Medical Microbiology Laboratory of Ebonyi State University Abakaliki for analysis. All laboratory analyses were done within one hour of sample collection.

### Laboratory Investigation

The swabs were directly inoculated on blood agar and nutrient agar. The pairs of inoculated media were incubated aerobically at 37°C for 24 hours and then examined for bacterial growth according to standard protocol (Cheesbrough 2000). The authors isolated bacteria by assessing colony characteristics and Gram reaction and performed the following five tests: (1) catalase and coagulase, (2) hemolysis, sugar fermentation and other biochemical tests including indole production, citrate utilization and urase activity, (3) triple sugar iron (TSI) agar test (for glucose, sucrose and lactose fermentation), (4) gas and hydrogen sulphide production tests, and (5) oxidase tests, according to previously described protocols (Cheesbrough 2000). Three or more colony forming units (CFUs) were considered before assigning species as a contaminant (Uneke et al. 2009). Bacterial isolates were subjected to antibiotic sensitivity analysis using the Kirby Bauer disc diffusion method (Cheesbrough 2000; WHO 2003). The disc used was commercially available (Optun Laboratories Nig Ltd., Lagos, Nigeria) and contained a number of antibiotics: ciprofloxacin, norfloxacin, gentamicin, lincomycin, streptomycin, rifampicin, flucloxacillin, erythromycin, chloramphenicol, ampicillin-cloxacillin, ofloxacin, pefloxacin, amoxicillin-clavulanic acid, cefalexin, nalidixic acid, trimethoprim and ampicillin.

### Statistical Analysis

Differences between proportions were assessed by Chi-square analysis. Statistical significance was set at < .05.

## Results

Of the 58 thermometers screened, 36 (62.1%) were contaminated by bacteria, whereas of the 28 BP cuffs screened, 23 (82.1%) were contaminated. Table 1 shows the spectrum of bacterial isolates from the devices. *S. aureus* was the most common bacterial isolate, constituting 86.1% and 73.9% of the isolates from the thermometers and BP cuffs, respectively. *Escherichia coli* was not isolated from any thermometers but constituted 8.7% of isolates from BP cuffs. *Pseudomonas aeruginosa* constituted 8.3% of isolates from thermometers and 4.4% from BP cuffs. *Enterococcus faecalis* constituted 5.6% of isolates from thermometers and 13.0% from BP cuffs.

All thermometers sampled from the nursing station and the children's ward were contaminated with bacteria. Of thermometers sampled at the medical ward, 80% were contaminated (Table 2). The lowest rate of thermometer contamination (33.3%) was observed at the outpatient unit. Statistical analysis indicated a significant difference in the trend ( $\chi^2 = 15.85$ ,  $df = 5$ ,  $p < .05$ ). This implies a strong association between bacterial contamination of thermometers and their use in the various units. All BP cuffs sampled at the nursing station, medical ward and outpatient unit were contaminated,

while the lowest rate of BP cuff contamination (63.6%) was observed at the accident and emergency unit. Statistically, however, there was no significant difference in the trend ( $\chi^2 = 5.71$ ,  $df = 4$ ,  $p > .05$ ) (Table 3). This implies that there is no strong association between bacterial contamination of BP cuffs with any specific unit of the hospital; that is, no unit in the hospital necessarily has a higher risk of BP cuff contamination. However, the observed outcome might have occurred purely by chance.

**Table 1. Bacterial isolates from thermometers and blood pressure cuffs in Ebonyi State University Teaching Hospital Abakaliki, Nigeria**

Bacterial isolates	Thermometers (N = 58)		Blood pressure cuffs (N = 28)		Overall total
	No. (%) of isolates	95% confidence interval	No. (%) of isolates	95% confidence interval	No. (%) of isolates
<i>Staphylococcus aureus</i>	31 (86.1)	85.0–97.4	17 (73.9)	54.9–91.1	48 (81.4)
<i>Escherichia coli</i>	–	–	2 (8.7)	2.8–20.2	2 (3.4)
<i>Pseudomonas aeruginosa</i>	3 (8.3)	0.7–17.3	1 (4.4)	4.0–12.8	4 (6.8)
<i>Enterococcus faecalis</i>	2 (5.6)	1.9–13.1	3 (13.0)	0.7–26.7	5 (8.5)
<b>Total</b>	<b>36 (62.1)</b>	<b>48.6–73.4</b>	<b>23 (82.1)</b>	<b>26.6–51.4</b>	<b>59</b>

**Table 2. Bacterial contamination of thermometers used in various units of Ebonyi State University Teaching Hospital Abakaliki, Nigeria**

Hospital units	No. of thermometers examined	No. (%) of thermometers contaminated	95% confidence interval
Nursing station	6	6 (100)	100.0–100.0
Accident and emergency	12	5 (41.7)	38.9–44.5
Orthopedic	11	6 (54.5)	25.1–83.9
Medical ward	10	8 (80.0)	55.2–100.0
Outpatient	12	4 (33.3)	6.6–60.0
Children's ward	7	7 (100)	100.0–100.0
<b>Total</b>	<b>58</b>	<b>36 (62.1)</b>	

**Table 3. Bacterial contamination of Blood pressure cuffs used in various units of Ebonyi State University Teaching Hospital Abakaliki Nigeria**

Hospital units	No. of blood pressure cuffs examined	No. (%) of blood pressure cuffs contaminated	95% confidence interval
Nursing station	4	4 (100)	100.0–100.0
Accident and emergency	11	7 (63.6)	35.2–92.0
Orthopedic	3	2 (66.7)	38.8–94.6
Medical ward	5	5 (100)	100.0–100.0
Outpatient	5	5 (100)	100.0–100.0
<b>Total</b>	<b>28</b>	<b>23 (82.1)</b>	<b>67.9–96.3</b>

Findings from the antibiotic sensitivity test are presented in Table 4. The bacterial isolates exhibited resistance to a majority of the antibiotics tested, with *E. coli* exhibiting the highest level of resistance. All bacterial isolates were susceptible to ciprofloxacin and streptomycin. *S. aureus* was susceptible in varying degrees to many of the antibiotics tested, including ciprofloxacin, ofloxacin, gentamicin, lincomycin, streptomycin, rifampicin and pefloxacin, but was resistant to the beta-lactam antibiotics such as flucloxacillin, ampicillin-cloxacillin, amoxicillin-clavulanic acid and ampicillin (Table 4).

**Table 4. Antimicrobial susceptibility test of bacterial isolates from the thermometers and blood pressure cuffs**

Antibiotic	Concentration	Bacterial isolates			
		<i>S. aureus</i>	<i>P. aeruginosa</i>	<i>E. Faecalis</i>	<i>E. coli</i>
Ciprofloxacin	10 mcg	100.0	33.3	66.7	33.3
Nofloxacin	30 mcg	33.3	R	R	R
Gentamicin	10 mcg	33.3	R	R	R
Lincomycin	30 mcg	33.3	33.3	R	R
Streptomycin	30 mcg	66.7	66.7	33.3	66.7
Rifampicin	10 mcg	R	R	R	R
Flucloxacillin	30 mcg	R	R	R	R
Erythromycin	30 mcg	R	R	R	R
Chloramphenicol	20 mcg	R	R	R	R
Ampicillin-cloxacillin	30 mcg	R	R	R	R
Ofloxacin	10 mcg	33.3	R	R	R
Pefloxacin	10 mcg	33.3	R	33.3	R
Amoxicillin-clavulanic acid	30 mcg	R	R	R	R
Cefalexin	10 mcg	R	R	R	R
Nalidixic acid	30 mcg	R	R	R	R
Trimethoprim	30 mcg	R	R	R	R
Ampicillin	30 mcg	R	R	R	R

R = resistant.

## Discussion

Evidence remains scant on the importance of non-critical medical devices in HAI transmission in healthcare settings in developing countries. Underestimating the contributory role of non-critical medical devices in transmitting HAI has resulted in the neglect of basic decontamination guidelines for these devices. Findings from our investigation clearly showed that thermometers and BP cuffs have the potential to harbour and transmit antibiotic-resistant bacteria in hospital settings.

We were concerned to observe that 62.1% of thermometers screened in this study had bacterial contamination, and it was even more worrisome to note that all thermometers screened at the children's ward were contaminated. Moreover, the difference in the trend was statistically significant

( $p < .05$ ). Other studies have reported similar findings. Donkers et al. (2001) observed a nosocomial outbreak of multi-resistant *Enterobacter cloacae* in the neonatal ICU at a medical centre in Amsterdam due to the use of contaminated thermometers. Furthermore, in another study at a university medical centre in Philadelphia, Livornese et al. (1992) reported a nosocomial outbreak of infection due to a highly vancomycin-resistant strain of *Enterococcus* (VRE) in which an electronic thermometer was implicated as the vehicle of transmission. In an earlier study, Brooks et al. (1992) had noted that replacing electronic thermometers with single-use disposables significantly reduced the incidence of *Clostridium difficile*-associated diarrhea in both acute care and skilled nursing care facilities. In another investigation, Brooks et al. (1998) reported 60% and 40% risk reductions for nosocomial VRE and *C. difficile* infections, respectively, after switching to tympanic thermometers following a 20-month observation.

The high rate of BP cuff contamination (82.1%) observed in this study was not a surprise, as no other piece of hospital equipment was in more common use without adequate disinfection than this device. Base-Smith (1996) noted that in the hurried milieu of operating rooms, emergency departments and ICUs, contaminated BP cuffs may not be routinely sanitized or replaced with clean cuffs between patient use. Recent studies have revealed high rates of bacterial contamination of pressure cuffs, ranging from 45% to 97% (Baruah et al. 2008; Davis 2009; De Gialluly et al. 2006; Walker et al. 2006). The findings of the present study revealed 100% bacterial contamination of all BP cuffs screened at the nursing station, medical ward and outpatient unit. In other studies, De Gialluly et al. (2006) and Baruah et al. (2008) observed that the highest rates of contamination with potentially pathogenic micro-organisms were observed on cuffs used in ICUs and those kept on nurses' trolleys. The implication of the findings from the present and similar studies is that BP cuffs represent a source of bacterial contamination that is yet to be fully realized and that may play significant part in a hospital's nosocomial infection rate. This is further substantiated by the fact that bacteria have been shown to survive for up to five days on BP cuffs (Cormican et al. 1994). Against this backdrop, therefore, Cormican et al. (1994) had suggested a need for awareness of the potential cross-contamination to patients and healthcare workers from seemingly innocuous items of general use hospital equipment, specifically BP cuffs.

In this study, bacterial isolates from the screened devices exhibited a high level of antibiotic resistance. This finding is of enormous public health significance because it has been proven that some of the bacterial agents isolated in this study, particularly antibiotic-resistant *S. aureus* and *E. faecalis*, are capable of initiating severe nosocomiasis in a hospital environment and often require contact isolation and aggressive treatment to prevent their spread (Nester et al. 2004; Struelens 1998; WHO 2000, 2003). Nearly all of the *S. aureus* showed resistance to the beta-lactam antibiotics such as flucloxacillin, ampicillin-cloxacillin, amoxicillin-clavulanic acid and ampicillin, and can therefore be classified as methicillin-resistant *S. aureus* (MRSA). This finding confirms a previous report of a nationwide survey that revealed that 78% of community-acquired pathogens in Nigeria produced beta-lactamases, while more than 50% of most community-isolated pathogens showed in vitro resistance to most commonly prescribed antibiotics (Oyelese and Oyewo 1995). In a study of the prevalence of methicillin-resistant *S. aureus* in eight African hospitals, Kesah et al. (2003) indicated that the rate of MRSA was relatively high in Nigeria. Furthermore, recent studies in Nigeria have shown that a high rate of multiple-drug-resistant *S. aureus* could be isolated from non-critical medical materials such as stethoscopes and white coats (Uneke et al. 2009; Uneke and Ijeoma 2010). Antibiotic resistance increases the morbidity and mortality associated with infections and contributes substantially to rising costs of care resulting from prolonged hospital stays and the need for more expensive drugs (Struelens 1998). This situation is worrisome and of serious public health concern in developing countries including Nigeria, where dysfunctional health services, inadequate drug supplies, non-adherence to treatment strategies, self-medication and dubious drug quality all favour the emergence and sustenance of microbial resistance (WHO 2000).

## Conclusion

The findings of this study have clearly demonstrated that non-critical medical devices such as thermometers and BP cuffs can harbour potential infectious pathogens including antibiotic-resistant bacteria. The implication is that these devices are potential vehicles for the transmission of HAI in healthcare facilities. However, it is imperative to state that we have not been able to unequivocally demonstrate that the thermometers and BP cuffs could actually transmit pathogenic micro-organism. Future studies with a more complex design would be required to accomplish this. Nevertheless, because antibiotic resistance can be caused by transmission of resistant bacteria within hospitals by cross-colonization of non-critical medical devices used by healthcare staff, this study emphasizes the urgent need for sanitizing thermometers and BP cuffs between patient use. Furthermore, to minimize the risk of cross-contamination from thermometers, we advocate the use of disposable thermometers.

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# Knowledge of Malaria and Preventive Measures among Pregnant Women Attending Antenatal Clinics in a Rural Local Government Area in Southwestern Nigeria

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## **Abstract**

**Objective:** This study determined the level of knowledge of malaria and preventive measures among pregnant women and its influence on the uptake of preventive measures.

**Methods:** A cross-sectional survey was carried out among 209 participants selected from pregnant women attending antenatal clinics in primary healthcare centres in Irepodun/Ifelodun, a local government area in Ekiti state, Nigeria.

**Results:** Knowledge of malaria was found to be very good, average and poor among two (1.0%), 165 (78.9%) and 42 (20.1%) respondents, respectively. Of the 109 (52.2%) respondents who had heard about intermittent preventive treatment, eight (7.3%) scored "very good" on knowledge, while 53 (48.6%) and 48 (44.1%) scored "average" and "poor," respectively. Of the 144 (68.9%) respondents

who had heard about insecticide-treated nets, 95 (66.0%) scored "good" on knowledge, while 49 (34.0%) scored "poor." Factors that significantly influenced knowledge about malaria were occupation, level of education, months at first appearance at antenatal clinic and transportation cost. Knowledge significantly influenced uptake of insecticide-treated nets and intermittent preventive treatment in pregnancy ( $p < .05$ ).

**Conclusion:** There is a need to intensify efforts to provide health education on malaria and preventive measures as well as to encourage preventive practices among pregnant women.

## **Background**

In highly endemic countries, malaria poses a serious threat to the health of pregnant women and their unborn children, with resulting high maternal and neonatal mortality (Adefioye et al. 2007; Bishwaranjan and Mahapatra 2009; Federal Ministry of Health [FMOH] 2007; Miaffo et al. 2004).

In Nigeria, the maternal mortality rate is currently 704 per 100,000 (FMOH 2005), and malaria contributes a large proportion of deaths, with a disease-specific prevalence rate of 1858 per 100,000. The annual financial burden of malaria is estimated at about 132 billion Naira (approximately \$8.7 million dollars [US]), representing the cost of treatment, prevention and loss of work hours (FMOH 2008).

Since the early 2000s, the approach to malaria prevention in pregnancy in Nigeria has changed from a weekly or bimonthly chemoprophylaxis to intermittent preventive treatment (IPTp) using sulphadoxine–pyrimethamine (SP) and insecticide-treated nets (ITNs) (FMOH 2004). This switch was informed by evidence from past studies that showed that morbidity and mortality associated with malaria in pregnancy can be significantly reduced by widespread use of ITNs (Miaffo et al. 2004; Montgomery et al. 2006) and that use of IPT with SP is equally an effective and practicable strategy to decrease the risk of anemia in pregnant women in malaria-endemic areas (Asa et al. 2008; Falade et al. 2007).

Statistics have shown an insignificant reduction in malaria incidence, poor management of malaria at home, low uptake of IPTp by pregnant women at the antenatal clinic (ANC), and low and/or inappropriate use of ITNs. Coverage of malaria control interventions in Nigeria is currently below national targets (FMOH 2008). Studies conducted in many developing countries, such as Bangladesh, Ethiopia, India, Uganda and Nigeria, have shown that pregnant women have only superficial knowledge of malaria transmission, prevention and treatment (Adeneye et al. 2007; Ahmed et al. 2009; Erhun et al. 2005; Karunamoorthi et al 2010; Nganda et al. 2004; Okwa 2003; Sabin et al. 2010).

Knowledge about malaria has also been shown to influence malaria treatment choices and the success in implementing preventive interventions among pregnant women (Nganda et al. 2004). Nganda et al. (2004) found that knowledge about malaria influences the use of preventive measures such as ITNs but not IPTp among pregnant women. Probable predictors of malaria knowledge in a study conducted in India were age, sex, education, place of residence and geographical region (Sharma et al. 2007). Tongo et al. 2009 found that poor knowledge of the burden of malaria was significantly associated with low educational attainment and the site of the ANC. Although several studies have been conducted on knowledge about malaria, very few had investigated factors or predictors of knowledge on preventive measures. This study is part of a larger one on IPTp uptake by pregnant women (Akinleye et al. 2009). It set out to determine the knowledge and predictors of knowledge on malaria and on preventive measures such as IPT-SP and ITNs among pregnant women, as well as the influence of knowledge on the uptake of such preventive measures.

## **Materials and Methods**

### **Study Area and Population**

The study was conducted in Irepodun/Ifelodun local government area (LGA), Ekiti State. The area, which has previously been described by Akinleye et al. (2009), has a population of approximately

124,088 people who are predominantly Yoruba, according to the 1991 census (Fasuan 2002). Malaria is hyper-endemic in this LGA, with perennial transmission. The LGA is rural and is divided into six health districts. All but one of the 13 primary health centres (PHCs) in the LGA offer antenatal care services. These services are conducted on Mondays in the three PHCs at the local government headquarters, while the other health centres conduct antenatal clinics every Tuesday. Other activities at each PHC include distribution of free ITNs supplied by the Federal Ministry of Health and Immunization.

The study population comprised all consenting pregnant women attending antenatal clinics at all the PHCs rendering antenatal services in the study LGA between July and August 2007. Both newly registered pregnant women and those on follow-up routine visits were included in the study; pregnant women presenting as emergencies were excluded.

### **Study Design and Sampling**

A cross-sectional design was used. The sample size for the survey was calculated using an estimate of reported IPTp use among pregnant women (16%) (Mubyazi et al. 2005). The study required a minimum of 207 pregnant women. They were selected from ANC attendees at the 12 PHCs rendering antenatal services in the LGA, using systematic sampling technique. The sample size was distributed among PHCs based on proportionate-to-size allocation. The total ANC attendants for the previous year in each facility were used for the allocation. Using the estimate of the average clinic attendance from the month prior to the study, a sampling interval was determined for each PHC and systematic sampling was used to select the study subjects. The first pregnant woman to be interviewed was picked by balloting from the ANC appointment cards submitted to the record clerks.

### **Data Collection Methods**

A semi-structured questionnaire was designed and written in both English and Yoruba. It was tested prior to use and administered with the help of two trained local interviewers and the investigator. The questionnaire comprised questions on socio-demographic characteristics, obstetric history, knowledge of malaria and its prevention, and attitudes of pregnant women to malaria prevention including ITN and IPTp use (see Appendix 1).

### **Ethical Considerations**

Verbal informed consent was obtained from each respondent before the interview. Permission and approval to carry out the study was granted by the Director of the primary healthcare unit of the LGA. Confidentiality was maintained.

### **Data Analysis**

Data entry and analysis were performed using Statistical Package for Social Sciences (SPSS) version 13.0 (SPSS Inc., Chicago, IL, USA). Data were summarized using frequency tables, graphs, means and standard deviations. Bivariate analysis was done with chi-square test or Fisher's exact test to compare proportions for categorical variables. The variables found to have association with outcome variables were further analyzed using binary logistic regression to determine which were most strongly associated. Results were considered significant when the 2-sided *p*-value was < .05. An overall knowledge score was computed for respondents' knowledge of malaria, ITNs and IPTp.

To assess respondents' knowledge of IPTp, responses to questions on the definition of IPTp were rated as 1 (very good) if they defined IPTp as treatment for prevention of malaria during pregnancy and recognized SP as the drug of choice and the correct interval for IPTp treatment. Respondents were rated 2 (average) if they knew that IPTp is given to prevent malaria during pregnancy or that IPTp is the use of SP during pregnancy. They were rated 3 (poor) if they could not define IPTp at all.

Responses to questions on malaria were rated 1, 2 and 3. Respondents were rated 1 – very good if they were able to attribute mosquito bites as the cause of malaria without being prompted and if they also correctly attributed symptoms such as fever, cold and body aches. They were rated

2 – average if they associated only fever, cold, pain and headaches to malaria; and 3 – poor if unable to define malaria at all.

Responses to questions on the difference between ITNs and other mosquito nets were also rated. Respondents scored 1 – very good if they were able to differentiate between the two by mentioning that ITNs are treated by insecticide and kill mosquitoes that perch on them, thereby preventing entry. Respondents were rated 2 – average if they mentioned that ITNs are treated while other nets are not, and 3 – poor if they could not differentiate at all.

### Knowledge Score

Three knowledge scores were calculated in this study: a malaria score, an IPTp score and an ITNs score. Scores were computed and assigned to respondents based on their responses to questions pertaining to malaria, IPTp and ITNs in the questionnaire.

Malaria knowledge scores were rated as very good (scores below 20), average (from 21 to 30) or poor (above 30); IPTp scores were rated as very good (scores below or equal to 19), average (from 20 to 29) or poor (above 30); and ITNs scores were rated as good (from 1 to 5) or poor (from 6 to 9).

## Results

### Socio-demographic Characteristics

Two hundred and nine pregnant women were studied. Their mean  $\pm$  SD age was 25.1  $\pm$  1.1 years, with a range of 16 to 42 years. The majority (161, or 77.0%) were Yoruba, 47 (22.5%) had achieved a post-secondary education, and a high percentage (175, or 83.7%) were Christians. One hundred and sixty-seven (79.9%) respondents were married, 73 (34.9%) were traders or farmers, and the majority (161, or 77%) had no regular source of income.

### History of Malaria Episodes among Respondents

About half (119/209, or 56.9%) of the respondents reported having had malaria at one time or another in pregnancy. Of these, 109 (91.6%) said they reported at the hospital for their first treatment, 41 (34.5%) mentioned having used herbs as treatment, and 27 (22.7%) had treated themselves at home with drugs bought over the counter from the chemist. The majority (111, or 93.3%) were cured after their first treatment.

### Health Talks at the ANC

A hundred and sixteen (55.5%) respondents indicated that ANC staff had given malaria talks. When asked what they were taught during these visits, 67 respondents mentioned hygiene (personal and environmental), 18 mentioned malaria prevention and seven mentioned malaria transmission.

### Knowledge of Malaria

The frequency of distribution of responses on the cause of malaria and its effect on pregnancy is shown on Table 1. Only 38 respondents (18.2%) provided a good definition of malaria. They attributed the occurrence of the disease to mosquito bites and associated it with the symptoms of fever, headaches and body aches. A little more than half (116, or 55.5%) of respondents were able to list the symptoms but did not report the cause and 55 (26.0%) gave no response or did not know. One hundred and ninety-three (92.3%) respondents agreed that mosquitoes transmit malaria, 194 (92.8%) mentioned a dirty environment and 147 (70.3%) attributed malaria to ill-ventilated and ill-lit houses.

Multiple responses were given on other aspects of malaria knowledge. A large percentage of respondents (179, or 85.6%), knew that malaria affects everyone, either young and old, 140 (67%) knew that malaria can affect pregnant women, while 63 (30.1%) believed otherwise. When respondents were asked about the effects of malaria on pregnancy, the most well known were low birth weight, mentioned by 140 (67.0%), and maternal death, mentioned by 130 (62.2) (Table 1).

Table 1. Respondents' knowledge about malaria (N = 209)

Variables	Frequency	Percentage
<b>Ability to say what malaria is</b>		
1 = very good	38	18.2
2 = average	116	55.5
3 = poor	55	26.3
<b>Causes of malariaa</b>		
Dirty environment	194	92.8
Mosquito bites	193	92.3
Dirty houses	176	84.2
Lakes, pits around environment	173	82.8
Ill-ventilated and ill-lighted house	147	70.3
<b>Effects of malaria in pregnancy<sup>a</sup></b>		
Yes	179	85.6
No	25	12.0
Don't Know	5	2.4
<b>Pregnant women don't have malaria</b>		
Yes	140	67.0
No	63	30.1
Don't know	6	2.9
<b>Effects of malaria in pregnancy<sup>a</sup></b>		
Low birth weight	140	67.0
Maternal death	130	62.2
Maternal anemia	127	60.8
Still birth	91	43.5
Abortion	78	37.3
Placental parasitemia	65	31.1
HIV	35	16.7
Tuberculosis	29	13.9

ITN = insecticide-treated net.

<sup>a</sup> Multiple responses

When the malaria knowledge score was calculated, two respondents (1.0%) were rated as very good, 165 (78.9) as average and 42 (20.1%) as poor. The higher the level of respondents' education, the better was their score ( $p < .05$ ;  $X^2 = 23.719$ ) and their ability to describe malaria correctly. Probable predictors significantly associated with respondents' score included level of education

( $p < .05$ ;  $X^2 = 23.719$ ), occupation ( $p < .05$ ;  $X^2 = 13.798$ ), cost of transportation to the ANC ( $p < .05$ ;  $X^2 = 24.305$ ) and first ANC visit ( $p < .05$ ,  $X^2 = 24.305$ ).

### Knowledge of ITNs

A majority of respondents (144/209, or 68.9%) knew about ITNs, and 66 (45.8%) of those mentioned that ITNs can be used for treating malaria. However, 133/144 (92.4%) said ITNs can prevent mosquito bites, and 130 (90.3%) said ITNs can prevent malaria. Rating respondents' knowledge on the difference between ITNs and other nets, 84 (58.3%) knew and were rated as very good, 15 (10.4%) were rated as average and 45 (31.3%) could not differentiate and were rated as poor (Table 2).

**Table 2. Knowledge of ITNs by respondents who had heard of ITNs (n = 144)**

Knowledge	Frequency	Percentage
<b>An ITN is used for:</b>		
<b>a. Treating malaria</b>		
Yes	66	45.8
No	71	49.3
Don't know	7	4.9
<b>b. Preventing mosquito bites</b>		
Yes	133	92.4
No	6	4.2
Don't know	5	3.5
<b>c. Preventing malaria</b>		
Yes	130	90.3
No	7	4.9
Don't know	7	4.9
<b>Difference between ITNs and other nets</b>		
1 = very good	84	58.3
2 = average	15	10.4
3 = poor	45	31.3

ITN = insecticide-treated net.

Calculating the ITNs knowledge score for those who knew about ITNs, 95 (66.0%) were rated as good and 49 (34%) as poor. The mean  $\pm$  SD for the score was  $5.12 \pm 1.27$ ; range = 8.00. Respondents' knowledge score on malaria was significantly associated with their score on ITNs. The higher the respondents' knowledge score on ITNs, the higher their malaria knowledge score ( $p < .05$ ;  $X^2 = 7.087$ ). Probable factors showing association with respondents' ITN knowledge score included a history of malaria in the index pregnancy ( $p < .05$ ;  $X^2 = 12.702$ ), health talks on malaria from health nurses during ANC visits ( $p < .05$ ;  $X^2 = 7.880$ ) and respondents' number of deliveries

( $p < .05$ ;  $X^2 = 6.279$ ). Ninety two (67.2%) of 137 respondents with a previous delivery had an ITNs knowledge score of good.

### Knowledge of IPTp

About half (109/209, or 52.2%) of respondents said they had heard about IPTp; 52/109 (47.7%) reported having heard about it at the ANC. Other sources included posters in the clinic, mentioned by 24 (22%); media, mentioned by 21 (19.3%); friends, 10 (9.2%); and spouses, three (2.8%). Twenty-six of the 109 (23.9%) were able to give a good definition of IPTp, and 63 (57.8%) said that IPTp can be given to pregnant women. When asked when IPTp drugs can be given during pregnancy, 67 (61.5%) mentioned between the fourth and sixth months of pregnancy, 12 (11.0%) mentioned the seventh to ninth, and one (0.09%) mentioned the first to second. About two thirds (73/109, or 67.0%) knew that SP is the recommended drug for IPTp. Asked about the different brand names of SP on the market, 13 (17.8%) identified Fansidar, 18 (24.7%) identified Amalar, and 42 (57.5%) identified Malareich, the major brand for IPTp used in the ANC at the time of the study. Of those who mentioned SP, 49 (67.1%) knew the correct dose for IPTp. The knowledge score calculated for IPTp showed that 8 (7.3%) respondents' scores were very good, 53 (48.6%) were average and 48 (44.1%) poor. The mean  $\pm$  SD of the IPTp knowledge score was  $28.50 \pm 7.44$ ; range = 24. Respondents' malaria knowledge score was not a determinant of their IPTp score ( $p > .05$ ;  $X^2 = 6.332$ ). Factors likely to be associated with the IPTp knowledge score included religion ( $p < .05$ ;  $X^2 = 16.024$ ), monthly income ( $p < .05$ ,  $X^2 = 40.159$ ), cost of transportation ( $p < .05$ ;  $X^2 = 20.465$ ), history of malaria in pregnancy ( $p < .05$ ;  $X^2 = 10.859$ ), supervision of IPTp use by ANC staff ( $p < .05$ ;  $X^2 = 14.314$ ) and number of pregnancies ( $p < .059$ ;  $X^2 = 7.526$ ). Fourteen (60.9%) of 23 respondents supervised during IPTp use by ANC staff had a poor IPTp knowledge score.

### Influence of Knowledge of Malaria and Preventive Measures on the Use of Preventive Measures

Of the 144 respondents who knew about ITNs, 97 (67.4%) had used them in the index pregnancy. Eighty-one (56.3%) had got their ITNs from the ANC, 4 (2.8%) from friends and relations, and 82 (56.9%) said they had got theirs free. Reasons given for not using ITNs included "not having one and it is very expensive," mentioned by 25 (22%). Two (1.7%) complained that their bed size was different from the ITNs size, and 3 (2.7%) said they already had window nets in their houses. Knowledge score on ITNs was a determinant of respondents' use of ITNs ( $p < .05$ ;  $X^2 = 21.586$ ). These results were further analyzed using binary logistic regression. Respondents' knowledge score on ITNs was found to be a determinant of their ITNs use ( $p \leq .05$ ; OR = 0.880; 95% CI = 1.009–5.759). Malaria knowledge score had no significant influence on ITN use ( $p > .05$ ;  $X^2 = 4.527$ ).

A little more than half (57/109, or 52.3%) of respondents who knew about IPTp had used it in the index pregnancy, and 23 (40.4%) had been supervised by a health nurse. Knowledge of IPTp was significantly associated with IPTp uptake ( $p < .05$ ;  $X^2 = 66.355$ ). The result was further analyzed by binary logistic regression, which showed that knowledge of IPTp among respondents is a determinant of their uptake of IPTp ( $p \leq .05$ ; OR 2.155; 95% CI = 2.973–25.014). Knowledge of malaria was not a determinant of respondents' IPTp uptake ( $p > .05$ ;  $X^2 = 3.896$ ).

### Discussion

Findings from this study showed that a high percentage of respondents identified mosquito bites as a major source of malaria infection, while none mentioned the parasite as the cause. This corroborates a study by Ahmed et al. (2009: 7-8), who reported "the awareness that malaria is caused and transmitted by mosquito bite is a common knowledge in malaria endemic countries; however, only a tiny fraction could actually state the correct transmission route." The majority of respondents from the current study identified factors that encourage malaria transmission, such as a dirty environment, pools, and lakes around dwelling places. Despite this, the study revealed a superficial knowledge on malaria transmission and cause among respondents. This finding is in line with previous studies

conducted in several endemic countries (Ahmed et al. 2009; Karunamoorthi et al. 2010; Mabogunje et al. 2002; Nganda et al. 2004; Sabin et al. 2010). They reported a wide gulf in respondents' knowledge about the cause, transmission and symptoms of malaria. This shows the need for improving the awareness of malaria, its causes, mode of transmission and consequences. Our study reveals commendable performance regarding respondents' knowledge of the consequences of malaria during pregnancy; this is encouraging as respondents are likely to report early for treatment whenever they suspect malaria, thus reducing morbidity and mortality.

Malaria prevention-related activities in ANCs were suboptimal. Few respondents mentioned they received health talks on malaria, its prevention and treatment in the clinic, and 60.9% of respondents who received IPTp still had little knowledge about it. Adherence of health workers to IPTp administration protocol was discouraging and has implications for morbidity and mortality from malaria in pregnant woman and the unborn child. In addition, poor compliance with antimalarial drugs poses a risk for the development of resistance to SP, a drug that is still used for combination therapy in the treatment of malaria. Monitoring of activities in the clinics and adherence to guidelines among health workers should be enforced. Continuing training on malaria and its preventive measures as well as reorientation programs for health workers should be conducted at all levels of the healthcare system. Guidelines for malaria control and prevention should be revised to further emphasize health education on prevention for everyone, but especially for women, who are at high risk of morbidity when pregnant.

In this study, the higher the level of respondents' education, the better their malaria knowledge score ( $p = 0.001$ ) and ability to describe malaria correctly. This is similar to findings of studies that reported the level of respondents' education was a major determinant of knowledge on the cause of malaria; these studies also stressed the importance of education in malaria control programs (Mabogunje et al. 2002; Nganda et al. 2004).

Our study shows that respondents' knowledge of malaria, its cause and effect during pregnancy has an association with their knowledge of preventive measures such as ITNs, but it was not a determinant of their knowledge of IPTp. This could be because IPTp was newly introduced at the time the study was conducted, and information about it was inadequate even among health workers. In our study, two thirds of respondents (68.9%) knew about ITNs, many demonstrated impressive knowledge of ITNs, and three quarters had a good ITNs knowledge score. This finding corroborates the results of several studies conducted in Bangladesh, Ghana and Nepal, which reported a high level of knowledge on the use of bed nets as preventive measures against mosquito bites among respondents (Ahmed et al. 2009). Respondents' knowledge on IPTp among those who were aware of it was really poor, as shown in their knowledge score; only a few respondents were rated as having high-level knowledge. Efforts on public enlightenment about IPTp should be intensified.

According to Nganda et al. (2004), knowledge of malaria in pregnancy was strongly associated with use of a combination of IPTp and an ITNs, and could independently predict use of an ITNs. However, malaria knowledge score in this study was not a determinant of ITNs use or IPTp uptake. Contrarily, respondents' knowledge scores on IPTp influenced IPTp uptake, and their knowledge score on ITNs determined their ITNs use. This finding suggests a weak link between knowledge of malaria and knowledge of preventive measures. It is similar to a finding in some past studies whereby there was no concordance between method of prevention and perceived causes of malaria mentioned by mothers (Ajayi et al. 2008; Brieger et al. 1996; Hamel et al. 2001). Our study was conducted in only one of the 774 LGAs in Nigeria, and is thus not generalizable. However, it provides useful information on how preventive measures could be effectively employed. Further research is needed on the probable predictors or factors affecting knowledge of malaria and its preventive measures at a micro level. Health workers should be encouraged to take up the challenge of providing comprehensive health education and training in the community to complement whatever health education activities are offered in the clinic, as many pregnant women have been shown to not attend clinics for antenatal care.

## Conclusion

This study shows that despite concerted efforts at improving malaria control in endemic countries, there is still a wide knowledge gap that continues to impact negatively on the preventive practices and uptake of intervention. Results of this study provide insight on the importance and effectiveness of knowledge on the use of preventive measures such as IPTp and ITNs. It is therefore recommended that policies and guidelines on malaria prevention and control be modified to empower the healthcare workers and provide proper and comprehensive education to people living in endemic countries. Emphasis should be placed on re-orientation and training of trainers, as well as intensified monitoring of activities at ANCs. Predictors of knowledge of malaria and preventive measures at a micro level should be explored to help improve knowledge and uptake of malaria preventive measures as well as to foster behavioural changes. Provision of information, education and communication materials and prevention activities, especially in the ANCs, should be improved.

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# Balancing the Present and the Future: A Study of Contraceptive Use in Calcutta's Slums

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## **Abstract**

Calcutta, an important metropolitan city in eastern India, has a large slum population. Despite the poor economic status of this population, analysis of DHS data (2004–2005) reveals that contraceptive use levels in Calcutta slums is quite high, with a large proportion preferring terminal methods. Econometric analysis reveals that cultural factors are important determinants of contraceptive use. Results also indicate that respondents attempt to balance current needs (by trying to limit family size through use of contraceptives) but also try to provide for the future (by having at least one son before adopting family planning methods).

## **Introduction**

Calcutta is one of the largest metropolitan cities in India, with a population of 4.6 million, spread over an area of 1380 sq km. About a third of the city's population, amounting to 1.5 million, live in slums.<sup>1</sup> Over 40% of Calcutta's slum residents have been slum dwellers for two generations or longer, while more than half originate from the districts surrounding the city.<sup>2</sup> In addition, there are also migrants from the neighbouring states of Bihar, Jharkhand, Uttar Pradesh and Orissa. About 37% of the slum population is engaged in economic activities, and as many as 86% of this population are marginal workers. The proportion of female workers is even lower (12%).

An interesting finding is that the literacy level in Calcutta slums is 66% among males, while the corresponding figure for the female slum population is 60%. This is not markedly below the national urban average of 70%. Given the relatively high literacy levels, it is not surprising that researchers have generally found high contraceptive prevalence rate among slum dwellers, with a preference for modern and irreversible methods, like sterilization (Chattopadhyay et al. 2004; Sen 2001). The only exception is Biswas et al. (1991), who found a low contraceptive prevalence rate in Calcutta slums. The latest wave of Demographic Health Survey data (2005–2006) reports that contraceptive use in Calcutta (77% of currently married women) is higher than in other cities surveyed. This indicates that analysis of contraceptive use patterns in Calcutta slums is an interesting area of study.

A major limitation of these studies is that they focus on estimating the prevalence of contraceptives, without attempting to identify factors influencing decisions to adopt family planning or barriers to contraceptive usage. This lacuna contrasts strongly with the existence of a large body of literature on determinants of contraceptive use in South Asia. Such studies identify son preference (Arnold 2001; Jayaraman et al. 2009; Roy et al. 2008; Saha and Bairagi 2007), education (Gubhaju 2010; Kamal 2007; Kamal and Huda 2008), religious identity (Bhatt and Xavier 2005; Iyer 2002; James and Nair 2005; Kulkarni and Alagarajan 2005) and empowerment of women (Jejeebhoy 2001) as factors having a strong influence on the decision to use contraceptives. Such studies model decision making as a binary process – the respondent either uses contraceptives or does not. However, there are different types of contraceptive methods, differing in terms of their reliability and reversibility. The decision to adopt a folkloric method, or use the rhythm method, for instance, does not have the same implication for reproductive behaviour as sterilization, or even intra-uterine devices. Our paper is motivated by the realization that a study of the forces that determine contraceptive choice should, therefore, distinguish between alternative methods.

The objective of this paper is to understand contraceptive use patterns and their determinants in Calcutta slums. The focus on Calcutta may be justified on the following grounds. Like the other metropolitan cities of India, Calcutta has long acted as a magnet for migrants from rural areas and small towns. This has led to over-urbanization and the creation of slums, whose population is characterized by economic and social vulnerability. At the same time, the level of awareness is possibly higher in Calcutta slums, partly owing to the dominance of the Left Front coalition that has ruled the state since 1977. The constituents of this coalition, particularly its biggest partner, the Communist Party of India (Marxist), have created a network of organizations in the slums, trying to make the slum population politically aware, increase their overall awareness, remove patriarchal attitudes and empower women. Simultaneously, the state and municipal governments have emphasized providing healthcare services to the poor – particularly women and children – at affordable rates through a network of local level health facilities. A study of reproductive health practices in Calcutta's slums would, therefore, provide some indications about the extent to which these efforts have been successful in removing traditional inhibitions to adoption of family planning methods. Lessons from this study could, in the case of success, be used to design suitable intervention strategies in other cities. Simultaneously, this study is able to incorporate the impact of the social and cultural heterogeneity of Calcutta's slum population on the economic considerations dictating the decision to use contraceptives. This constitutes an important addition to the existing body of literature on son preference and contraceptive choice.

Our research hypothesis is that, given the economic vulnerability of the study group,<sup>3</sup> economic considerations will be important in determining contraceptive use. In particular, in line with the microeconomic models of fertility (Becker 1977; Willis 1973), it is argued that slum dwellers will try to limit their family size (to prevent thin spreading of resources over a large family in the current period). Simultaneously, they will also consider the opportunity costs of conception, in the form of wages lost from the woman's withdrawal from the labour market during pregnancy and the postnatal period. Such economic considerations will be balanced by the desire to have at least one son in order to ensure economic security in the long run. This implies that families with only sons are more likely to use contraceptives than families with only girls or childless couples.

### Database and Methods

The paper is based on unit level Demographic Health Survey (DHS) data. This survey, undertaken in 2005–2006, is the third in a series of national surveys. In DHS-3, the initial target sample size was 8500 completed interviews with ever-married women. Applying filters,<sup>4</sup> the data on Calcutta's female population were extracted from the DHS-3 data set. It was found that a total of 1615 out of 2471 respondents were currently married; 789 of these women resided in slum areas. The analysis is based on this subsample. As we are using a truncated section of the DHS sample, we prefer not to use sample weights during estimation. This may, of course, restrict our conclusions to the sample being used.

The function estimated takes the following form: Contraceptive choice = F (son preference, socio-religious identity, culture, age of respondent and its square, education of respondent and her partner, wealth index score, place of last delivery, participation in economic activities, whether respondent was allowed to go for health checkup alone).

The independent variables are explained in detail below.

- A categorical variable representing preference for sons is constructed by classifying families into four groups – those without any children, those with only daughters, those with only sons, and those with both sons and daughters (the reference category).
- Combining information on religion and social group, four socio-religious groups are constructed – Muslims (the reference category), Backward Caste Hindus (BCHs, comprising Hindus belonging to the Scheduled Castes or Tribes) and the remaining group (called All Others).
- Since age may not be linearly related to contraceptive choice, we use both age of respondent and its square.
- Education of the respondent and her partner are categorical variables. While respondents are classified into three groups – illiterate, primary (or less) and above primary, partners are divided into four groups – illiterate, below primary, above primary, and secondary level and above.<sup>5</sup>
- DHS calculates a wealth index score; in our study it is used as a proxy for household economic status.
- A dummy variable taking the value of unity if the respondent is unemployed, and zero otherwise, is also used.
- As a measure of the respondent's autonomy, a dummy variable capturing her ability to go alone for health checkups, is used. Three possibilities may occur – she may be allowed to go for checkups accompanied (the reference category), alone, or not at all. In the first two cases, the respondent has some freedom to make reproductive choices.
- As an index of institutional environment, the study uses place of last delivery. This is a dummy variable taking the value of unity if the first child is delivered in a public sector facility. In such cases, it is likely that healthcare providers may try to motivate the respondent to adopt family planning, particularly terminal methods.

### The regression model is estimated in four steps:

Model 1: Son preference dummy, socio-religious identity, and age (and its square) are used as explanatory variables.

Model 2: Education of respondent is added.

Model 3: Educational level of partner is added.

Model 4: Remaining variables are added.

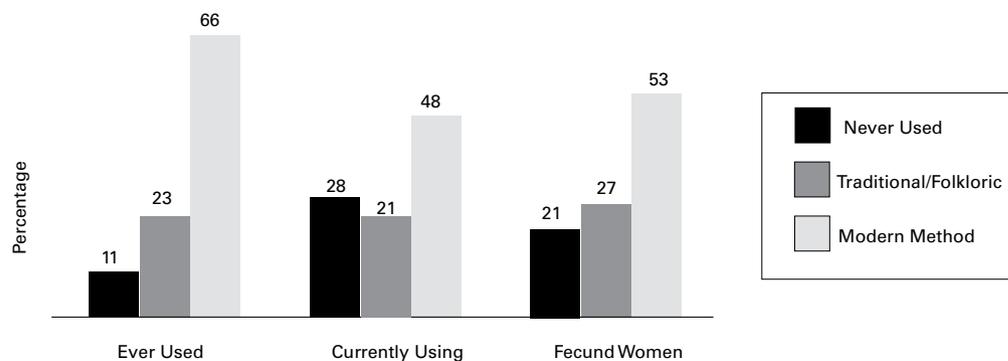
Most studies (D'Souza 2003; Kamal 2000, 2007; Kamal and Huda 2008; Stephenson and Hennink 2004; Waiz 2000) use binary or multinomial logistic models to identify the determinants of contraceptive prevalence rates. Now, the choice variable analyzed is discrete but not binary. Possible responses are not using any method, using a folkloric method, using the traditional method (rhythm and *coitus interruptus*, or withdrawal) or using a modern method (including methods like condoms, an intrauterine device, pills, injectables and sterilization). Given the low incidence of

folkloric methods, traditional and folkloric methods can be put together, so that the choice variable can assume three values (no method, traditional or folkloric, modern). In such cases a multinomial model is appropriate.

### Findings

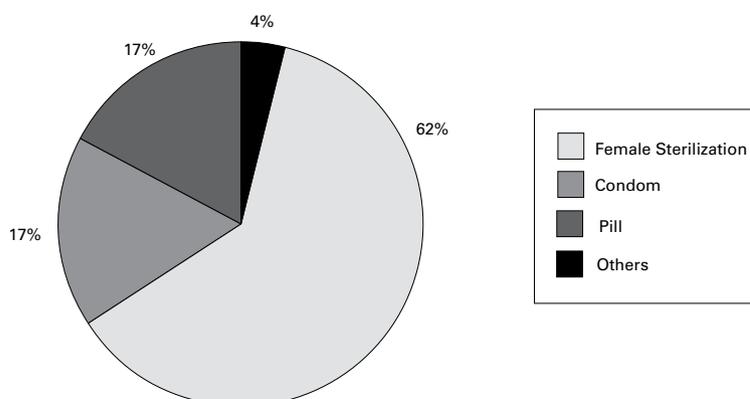
Analysis of DHS-3 data indicates that contraceptive prevalence rates in Calcutta's slums (72%) are higher than those in the other eight cities covered in the survey (64%) and also national levels (56%). Only 11% had never used contraceptives (Figure 1).

Figure 1. Contraceptive prevalence rates in Calcutta slums



Analysis of the methods used indicates that the incidence of female sterilization is very high, followed by use of condoms and pills (Figure 2). This corresponds to the preference for terminal methods (comprising male and female sterilization) observed in other Indian slums (Agarwal and Bharti 2006; Das and Shah 2001). Sen (2001) and Chattopadhyay et al. (2004), too, make a similar observation for Calcutta's slums. The reasons underlying preference for a method that allows less freedom than condoms, pills, IUD, and so forth, in terms of birth spacing needs investigation. But what is interesting is that 60% of respondents who have been sterilized had a boy on their last delivery. This may be indicative of the desire to satisfy son preference while limiting family size.

Figure 2. Distribution of population by contraceptive method



Analysis of the reasons for not adopting any contraceptive method shows that factors like religious strictures and opposition by partner or family members are unimportant. About 63% of respondents were either infecund, subfecund or had undergone hysterectomy. Since such terminal methods prevent further conceptions but do not protect women from sexually transmitted disease (STD) or HIV/AIDS, it appears that contraceptives are viewed primarily as a method for family planning, rather than protection against STD or HIV/AIDS. A further 11% either do not have intercourse or do so infrequently. Thus about 73% of the non-users do not require family planning methods. Examination of future intentions of the remaining 27% of non-users reveals that about 53% are planning to use contraceptives in the future. Again, it is interesting to note that 58% of these non-users who had a boy plan to use contraceptives in the future, while only 43% of non-users who had a girl will use contraceptives in the future.

This discussion indicates a high awareness about family planning methods among slum dwellers and willingness to adopt such methods. However, we argue that while slum dwellers realize the economic benefits of limiting family size, they are also motivated by the benefits of investing in male children as a means of assuring financial security for the future. If our hypothesis is valid, then the probability of using contraceptives will increase as the number of sons and daughters increases, but the increase will be greater for additional sons. That is, if we run an econometric model, the results should indicate that families with sons will be significantly more likely to adopt family planning, relative to families without sons.

### Multivariate Analysis

As mentioned earlier, the multivariate analysis is based on a multinomial logit model with the respondent assumed to face three choices – no use, traditional/folkloric method and modern method. The results of the models are reported below. Note that non-usage of family planning methods is used as the base outcome. Thus the top panel reports results for traditional and folkloric methods (other methods) versus non-adoption of contraceptives, while the bottom panel reports results for modern methods versus non-adoption of contraceptives. In addition, instead of reporting coefficients, we report relative risk ratios (RRR). This is the probability that members of a particular group will adopt traditional and folkloric methods (in the top panel) and modern methods (in the bottom panel), relative to the reference group.

The  $\chi^2$  statistic, based on the log likelihood ratio, is significant in each of the four models. Pseudo  $R^2$  values are low; but, given the cross-sectional nature of the study and the fact that this measure is only an approximation of goodness of fit, this is not a serious problem.

In Model 1, we test for son preference, controlling for only age and socio-religious identity of respondent. Since respondents with only sons are used as the reference category, we would expect RRRs of the dummy variables to be less than unity. The coefficients of “No children” and “Only girl” are significant; further, the RRR is less than unity. This indicates that respondents without any children or with only girls are less likely to adopt other methods than respondents with only sons. The coefficient of “Only son” is insignificant in the top panel. This possibly reflects the desire to have at least one girl because of social duty like *kanya dan* (selflessly giving away a daughter in marriage, a feeling strong among Hindus, the largest religious group in India), reported in several studies (Arnold 2001; Kabir et al. 1994; Visaria 1994). In the bottom panel, however, this coefficient is significant, with an RRR less than unity. The results hold in Models 2, 3 and 4, also – confirming our hypothesis of son preference dictating the decision to adopt contraceptives, as well findings by earlier researchers in the South Asian context (Jayaraman et al. 2009; Roy et al. 2008; Saha and Bairagi 2007).

Our results also confirm existing findings regarding the reluctance of Muslims to use contraceptives compared to other socio-religious communities (Bhatt and Xavier 2005, Iyer 2002; James and Nair 2005; Kulkarni and Alagarajan 2005). Only in the bottom panel (modern method versus no use), is the difference between Muslims and All Others insignificant. This, however, is not of any importance as the latter forms a negligible 2% of the slum population.

Table 1. Results of generalized ordered logit of contraceptive use by slum dwellers

CPR	Model 1			Model 2			Model 3			Model 4		
	RRR	Z	Prob									
NO USE VERSUS OTHER METHODS												
No children	0.10	-5.75	0.00	0.07	-6.20	0.00	0.07	-6.13	0.00	0.05	-6.51	0.00
Only girl	0.42	-2.87	0.00	0.37	-3.19	0.00	0.38	-3.15	0.00	0.34	-3.41	0.00
Only boy	0.93	-0.26	0.80	0.82	-0.68	0.49	0.81	-0.70	0.48	0.71	-1.13	0.26
Both girl and (RC)	1.00			1.00			1.00			1.00	1.00	
Muslim (RC)	1.00			1.00			1.00			1.00	1.00	
Hindu – FC	2.68	3.85	0.00	2.52	3.52	0.00	2.47	3.42	0.00	1.97	2.34	0.02
Hindu – BC	3.10	3.26	0.00	3.33	3.42	0.00	3.30	3.38	0.00	2.87	2.85	0.00
All others	6.89	2.54	0.01	5.85	2.30	0.02	5.76	2.28	0.02	4.54	1.94	0.05
Age	1.64	4.49	0.00	1.64	4.41	0.00	1.64	4.40	0.00	1.58	3.92	0.00
Square of age	0.99	-4.79	0.00	0.99	-4.72	0.00	0.99	-4.70	0.00	0.99	-4.46	0.00
Respondent's education: illiterate				0.63	-1.72	0.09	0.66	-1.30	0.19	1.01	0.03	0.97
Respondent's education: primary				0.34	-3.31	0.00	0.34	-3.11	0.00	0.41	-2.48	0.01
Respondent's education: above primary (RC)				1.00			1.00			1.00		
Partner's education: Illiterate							0.80	-0.68	0.50	0.88	-0.34	0.73
Partner's education: below primary							1.20	0.52	0.60	1.20	0.49	0.62
Partner's education: above primary (RC)							1.00			1.00		
Partner's education: secondary							0.96	-0.13	0.90	0.81	-0.64	0.52
Respondent is employed										0.86	-0.49	0.63
Wealth index score										1.00	2.14	0.03
Bengali speaking										2.13	2.88	0.00
Hindi-Urdu speaking (RC)										1.00		
Goes alone for healthcare										0.36	-0.62	0.54
Accompanied during healthcare										0.40	-0.56	0.58
Not allowed to go for healthcare (RC)										1.00		
Last delivery not in public sector unit										0.58	-1.64	0.10
NO USE VERSUS MODERN METHODS												
No children	0.04	-8.70	0.00	0.04	-8.67	0.00	0.04	-8.66	0.00	0.03	-8.79	0.00
Only girl	0.26	-5.11	0.00	0.26	-5.07	0.00	0.26	-5.06	0.00	0.23	-5.32	0.00
Only boy	0.48	-2.84	0.01	0.47	-2.87	0.00	0.47	-2.87	0.00	0.43	-3.15	0.00
Both girl and boy (RC)	1.00			1.00			1.00			1.00		
Muslim (RC)	1.00			1.00			1.00			1.00		

Table 1. Continued.

CPR	Model 1			Model 2			Model 3			Model 4		
	RRR	Z	Prob									
Hindu – FC	1.79	2.65	0.01	1.80	2.61	0.01	1.79	2.59	0.01	1.44	1.47	0.14
Hindu – BC	2.87	3.53	0.00	2.96	3.60	0.00	3.01	3.64	0.00	2.60	3.02	0.00
All others	3.16	1.53	0.13	3.10	1.50	0.13	3.12	1.51	0.13	2.40	1.15	0.25
Age	1.41	3.82	0.00	1.41	3.76	0.00	1.40	3.73	0.00	1.31	2.80	0.01
Square of age	0.99	-4.25	0.00	0.99	-4.20	0.00	0.99	-4.18	0.00	1.00	-3.46	0.00
Respondent's education: illiterate				0.98	-0.07	0.95	1.02	0.07	0.95	1.24	0.72	0.47
Respondent's education: primary				0.74	-1.17	0.24	0.75	-1.02	0.31	0.84	-0.58	0.56
Respondent's education: above primary (RC)				1.00			1.00			1.00		
Partner's education: Illiterate							0.98	-0.07	0.95	0.92	-0.29	0.78
Partner's education: below primary							1.14	0.42	0.67	1.02	0.07	0.94
Partner's education: above primary (RC)							1.00			1.00		
Partner's education: secondary							1.17	0.52	0.61	1.02	0.06	0.95
Respondent is employed										1.48	1.56	0.12
Wealth index score										1.00	1.68	0.09
Bengali speaking										1.59	2.02	0.04
Hindi-Urdu speaking (RC)										1.00		
Goes alone for healthcare										0.23	-1.06	0.29
Accompanied during healthcare										0.16	-1.31	0.19
Not allowed to go for healthcare (RC)										1.00		
Last delivery not in public sector unit										0.75	-1.00	0.32
Observations	789.00			789.00			789.00			789.00		
LR Chi2	200.48			214.67			216.50			248.47		
Pseudo R2	0.12			0.13			0.13			0.15		

BC = backward castes (scheduled castes or tribes); CPR = contraceptive prevalence rate; FC = forward castes; LR = likelihood ratio; RC = reference category; RRR = relative risk ratio; Z = Z-Ratio (standard normal statistic).

Age and its square are both statistically significant, though of opposite signs (positive and negative, respectively). This implies that while women are more likely to adopt contraceptives as their age increases (because they have reached fertility targets), the adoption rate declines as they approach the end of their reproductive phase. This is expected.

The findings with respect to education of the respondent are less clear and fail to confirm earlier findings reporting a positive relation between education and adoption of contraceptives (Gubhaju 2010; Kamal 2007; Kamal and Huda 2008). In Model 2, top panel, illiterate respondents and

those with only primary education are less likely to adopt traditional/folkloric methods compared to respondents with higher levels of education. However, the difference is insignificant when modern methods are compared against no use (bottom panel). A possible reason may be correlation between socio-religious identity and education – the Pearson  $\chi^2$  value of 63.43 for the contingency table indicates that there may be some association between the two variables. Education of partner is also strongly correlated with education of respondent. Not surprisingly, therefore, addition of this variable in Model 3 does not “improve” the model, as the coefficients of the dummies are insignificant.

In Model 4, where all control variables are incorporated, coefficients of two variables (wealth index score and language dummy) are statistically significant. While Bengali is the local *lingua franca*, the Hindi- or Urdu-speaking population mostly consists of interstate migrants from Bihar, Jharkhand and Uttar Pradesh. The latter are expected to be more conservative than the local population. Predictably, therefore, we find that the Bengali-speaking population is more likely to adopt contraceptives. Similarly, respondents possessing a higher wealth index score are more likely to adopt contraceptives.

We had also included the place of last delivery as an explanatory variable, motivated by anecdotal evidence that slum dwellers with more than two or three children are persuaded to get sterilized if they deliver in public sector health units. However, this variable is not significant. The coefficient of participation in labour market is also not significant. Alternatively, opportunity costs of withdrawing from the labour market may be low due to three reasons:

- Women may withdraw from the labour market only at late stages of pregnancy and rejoin soon after delivery, leaving the newborn under the care of its older sister. Incidentally, this may also explain the desire to have at least one girl.
- Women may work at home. In such cases they need not withdraw from the labour market.
- The lack of employment opportunities for women residents of Calcutta may also reduce the importance of this variable in the decision to adopt contraceptives. Census figures reported that only 12% of the female population in Calcutta slums work. Similarly, DHS data show that only 23% of slum dwellers work throughout the year.

## Conclusion

To sum up, analysis of contraceptive use by slum dwellers in Calcutta reveals the importance of culture-related factors in influencing contraceptive use. Non-Bengali migrants and Muslims are reluctant to adopt contraceptives. The government should therefore consider targeting these communities. Given the prevailing lack of confidence in the state among migrants and, particularly, Muslims, such efforts should involve community-based organizations, rather than imposing them from outside. This will reduce the probability of controversy emerging over issues like whether contraceptives are permissible in Islam.

Fertility preference, however, is still a major barrier to the adoption of contraceptives. Preference for more children, particularly boys, reduces demand for contraceptives. This implies the persistence of patriarchal attitudes within Calcutta's slum population that grass-root arms of political parties (the Bustee Committees) have been unable to remove. Economic forces and desire to ensure security in old age, too, play an important role in creating son preference. Males constitute the majority of both workers and main workers<sup>6</sup> in not only slum but also non-slum areas. Within the Calcutta Municipal Corporation, males constitute 84.5% of total workers and 85.5% of main workers. Thus, sons rather than daughters are more likely to get employment and be able to provide economic security. The microeconomics of fertility decisions in Calcutta, therefore, creates a son preference that has a major impact on contraceptive use. This can be tackled by reducing differential returns from having a boy and girl child. The role of employment-generation schemes like Swarna Jayanti Sahari Swarojar Yojana, Pradhan Mantri Rojgar Yojana and others is important in this context.

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### Notes

1. Slums have been defined in the 2001 census as "A compact area of at least 300 population or about 60 to 70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities" (Office of the Registrar General and Census Commissioner of India 2005). In Calcutta there are 2011 registered and 3500 unregistered (occupied by squatters) slums.
2. A small proportion of migrants from the neighbouring country of Bangladesh have settled in the city at various times following India's independence in 1947.
3. Kundu and Sarangi (2007) estimates that about three quarters of the slum population are below the poverty line; the low workforce participation levels have been noted earlier.
4. At the first stage, respondents belonging to Calcutta were selected, dropping the rest. In the second stage, non-slum dwellers were dropped to arrive at the final sample of Calcutta slums dwellers.
5. DHS classifies respondents into four groups – no education, completed primary, completed secondary and higher levels. Since only 55 respondents are in the last group, it is merged with "completed secondary." On the other hand, partners' education is classified as no education, incomplete primary, incomplete secondary, complete secondary and higher levels. There is also a residual category, "Don't know," consisting of 10 respondents, which is merged with no education (illiterate). Based on a comparison of frequency distribution, this classification is modified to form the four groups described above.
6. The Indian census defines main workers as persons who are engaged in economic activities for the greater part of the year. Persons who have some other occupation (students, housewives, etc.) but occasionally participate in the labour market are called marginal workers by the census authorities. The union of these two groups is considered to be the group "workers."

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# Measuring Physical Accessibility to Health Facilities – A Case Study on Khulna City

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## **Abstract**

Improving health services is a crucial issue and an immense challenge for the government of any Third World country. Bangladesh lacks healthcare services, one of the basic necessities of life. This paper demonstrates a method for estimating the geographical accessibility of health facilities by population coverage, average travel time and distance to the closest hospital. This analysis was applied to community units in the research area, allowing geographical access to be linked to people. The study area was divided into hexagons of equal size, and accessibility was measured from the centre of each hexagon. Despite the abundance of evidence on the inadequacy of health services in Khulna City, this study has given us a diverse dimension of possibilities. The study found that even with existing health facilities, discontent about the unavailability of health services can be mitigated in most areas. Exceptions are some peripheral areas, where average travel time to reach the city centre and distance from hospital services is greater.

## **Introduction**

Healthcare is a significant indicator of social development. Access to facilities is an important component in the overall healthcare system and has a direct impact on the burden of disease that encumbers health conditions in many developing countries. Therefore, measuring access to healthcare facilities

contributes to a wider understanding of health systems' performance within and between countries and facilitates the development of evidence-based health policies (Mainardi 2007).

Accessibility to healthcare is the ability of a population to obtain a specified set of health care services. In this context, geographic accessibility is often referred to as spatial or physical accessibility (Halden et al. 2000). Physical accessibility addresses the complex relationship between the distribution of the population and the supply of healthcare facilities (Ebener et al. 2005). This paper presents a methodology for measuring physical accessibility to healthcare facilities based on the user's home location, availability of public transport and impediments to travel.

Accessibility to healthcare facilities has been measured in different ways, depending on the context of the application. A study in New Zealand estimated the geographical accessibility of public hospitals. Cost–path analysis was used to determine the minimum travel time and distance to the closest hospital via a road network. Local average time and distance statistics were calculated by modelling the total travel time of an individual, assuming that everybody visited a hospital at least once. These types of statistics can be generated for different population groups, and comparisons can be made between regions (Brabyn and Skelly 2002). The World Health Organization (WHO) has been involved in measuring accessibility to healthcare facilities in developing countries, working in collaboration with a number of academic institutions (Black et al. 2004). They used AccessMod software to calculate accessibility which determines the geographic extent of the catchment areas corresponding to an accumulated cost surface, using the standard CostDistance function available in the Spatial Analyst extension for ArcView 3.x. (and also available in ArcGIS 9) (Esri, Redlands, CA). (Also see McLafferty (2003) for GIS applications.) This CostDistance function is an isotropic algorithm, meaning that each cell within the cost surface used as the input grid to the function contains a single value representing the cost of movement across that location (cell) in any direction.

Again, definitions and aspects of the concept of access to health facilities can be reviewed and integrated into a framework that views health policy as designed to affect characteristics of the healthcare delivery system and of the population at risk. The purpose is to improve the utilization of healthcare services and the consumer's satisfaction with those services (Aday and Andersen 2005). Two main aspects of accessibility are involved: socio-organizational and geographic. The socio-organizational component includes all attributes of the resources – other than spatial attributes – that either facilitate or impede the efforts of the client to get to healthcare facilities. They embrace aspects such as the sex of the individual medical care provider, the provider's fee scale and specialization, and others. Geographic accessibility, on the other hand, refers to the "friction of space" that is a function of the time to get to and physical distance from healthcare facilities. Thus, it can be argued that accessibility is more than the existence or availability of resources: it involves a web of complex socio-cultural factors that intrinsically shapes the ultimate healthcare situation of an area.

Luo and Wang (2003) measured accessibility by incorporating two methods. They synthesized two geographical information system (GIS)-based accessibility measures into one framework and applied methods to examine spatial accessibility to primary healthcare in the 10-county Chicago region. The floating catchment area (FCA) method defines the service area of physicians by a threshold travel time while accounting for the availability of physicians by their existing demand. The gravity-based method considers a physician in close proximity who is more accessible than a remote one and discounts a physician's availability by a gravity-based potential. This research assessed the variation of spatial accessibility to primary healthcare in the Chicago region and analyzed the sensitivity of the domino effect by experimenting with ranges of threshold travel times in the FCA method and travel friction coefficients in the gravity model (Luo and Wang 2003). Lee and McNally (1998) used a GIS-based algorithm for measuring physical accessibility. It is based on concepts of space–time prisms that can identify feasible opportunities under different scenarios of complex travel behaviour. They seek to determine if a location can be physically reached or not. If a facility is not available on the shortest path, it can be assumed out of reach within the budgeted time (Lee and McNally 2002).

In the proposed approach, individual home location and travel characteristics have been incorporated in the measure of accessibility. Services and facilities provided by the government are spatially

dispersed. City centres are magnets for amenities and the hub of commercial activities. Many people who live in the periphery of the city lack efficient transportation; and in emergencies, time required to reach a hospital becomes a major issue. One of the major reflections of social well-being is an improved healthcare system. Hence healthcare is an essential component of social development. In an attempt to alleviate the difficulties of underprivileged people in accessing healthcare facilities, this study recommends measures to improve physical accessibility based on individuals' demand for health facilities in Khulna City, Bangladesh.

### **Context**

Providing medical care is the constitutional obligation of the Government of Bangladesh (GoB). The Constitution mandates that

... it shall be a fundamental responsibility of the state to attain, through planned economic growth, a constant increase of productive forces and a steady improvement in the material and cultural standard of living of the people, with a view to securing to its citizens- (a) the provision of the basic necessities of life, including food, clothing, shelter, education and medical care (GoB 1944, 2005: 15).

In Khulna city there are only two general government hospitals with a total capacity of 600 beds, which is insufficient to accommodate the growing population. To ameliorate the situation, the government has undertaken several initiatives. It has established urban primary healthcare centres in every city ward, increased the capacity of hospitals, and so on. Realizing the importance of healthcare, the Khulna Development Authority (KDA) is establishing new general hospital in Noapara and Labanchora. The KDA is increasing the capacity of the medical college hospital to 1000 beds and the general hospital to 500 beds. The KDA 2001 master plan says that it requires one bed for every 250 people in Khulna (KDA 2001). In Khulna City there are only 25 hospitals (10 government and 15 private) for about 1.49 million people. The recommendations of the master plan have not yet implemented, and, regrettably, from survey on hospitals and other healthcare services we found Khulna City is far behind to ensure one bed for every 250 people. In this study, we have attempted to develop a methodology to estimate the gaps between people and hospital beds. Another thing we addresses is how geographical access to hospitals is different from place to place within a city.

### **Methods and Data**

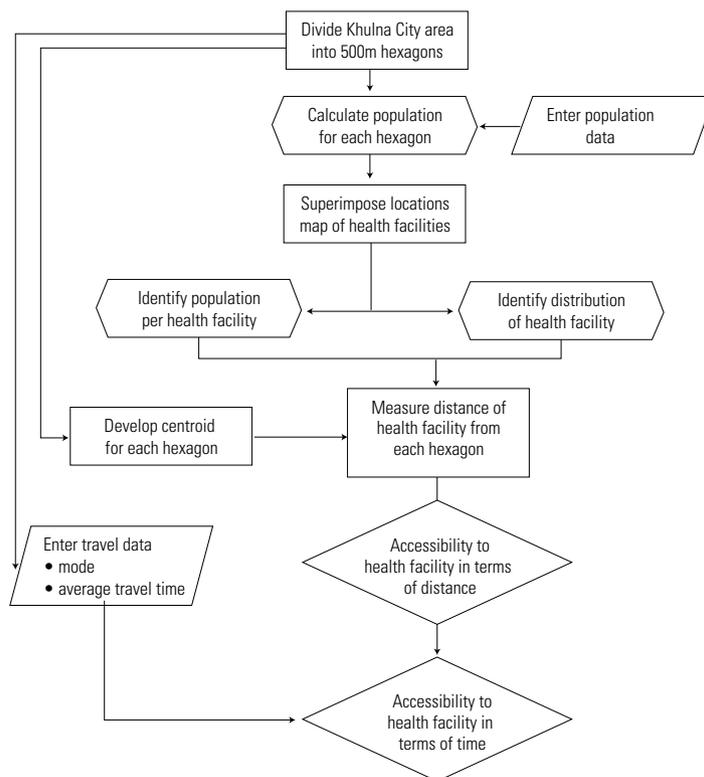
Physical accessibility is termed as a measurement of opportunities available to people in a geographical region (Lee and McNally 1998). The primary concern of this study is to measure physical accessibility to healthcare services in Khulna City. Access to healthcare services denotes people's ability to employ available facilities at the time of need. Here, we used two main parameters to measure accessibility: distance from health facilities and the time required to reach the nearest health facility. Healthcare facilities in Khulna City include urban primary healthcare centres (UPHCCs), which provide some basic health services; government hospitals, which provide all types of services, from treating normal diseases to major surgical facilities; and private hospitals, which provide similar types of services to those at government hospitals.

In this study we considered facts such as the distribution of the population per unit of Khulna City area, location of health facilities, average travel time for the patient to reach the nearest facility, and a specific scenario regarding the transportation mode used by the patient to get to the nearest health facility. Data collection was performed (please see Figure 1) at five levels:

- Khulna City was divided into hexagons of equal size. The median area of the wards (the smallest administrative unit of the city) of Khulna City is 0.97 km<sup>2</sup>. We divided the city area into 79 hexagons (each arm of the hexagon is 500 m, and the area of each hexagon is 0.93 km<sup>2</sup>). This enabled us to measure accessibility equally in each portion of Khulna City.

- The population of different hexagons was calculated based on the population of different wards of Khulna City. Such distribution was performed through GIS software, using “Union,” one of the geoprocessing operations.
- The location of health facilities was then superimposed on the population map to measure population per number of health facilities (Figure 2).
- Available hospital beds per population was calculated for each hexagon (Figure 3). The geographical location of all government and private hospitals in different hexagons was identified. The population of each hexagon was then divided by hospital(s) bed capacity. Hexagons 500 m and 1 km from the hospitals were also identified to show the spatial distribution of hospitals in Khulna City.
- The transportation type that people used and average travel time to facilities was also measured.

Figure 1. Steps for measuring physical accessibility to health facilities



The notion behind using this method is to define accessibility in an equitable way, regardless of affordability. This study failed to compare accessibility with any established standards, as the required data are not available for this particular domain. Nevertheless, we compared accessibility of each unit with average accessibility. This study considers equity in three dimensions: (1) number of service providers per population, (2) distance between service provider and residence, and (3) travel time required (vehicle availability and traffic system on road to reach the nearest hospital).

In Khulna City the number of hospitals and clinics are increasing rapidly to cope with the demands of the growing population. In spite of these positive initiatives, however, overall, health-care in this area has not improved because of the selection of location for healthcare facilities. The authorities are unconcerned about this fact. Survey results reveal that there are 29 UPHCCs, 15 private hospitals (private health facilities that have at least ten beds are counted only because several

physicians provide consultation service, but there are no residence facilities) and ten public hospitals. The 2009 field survey counted 19 hospitals with fewer than 50 beds, 4 hospitals with between 50 and 100 beds, and only two hospitals with more than 100 beds in Khulna City.

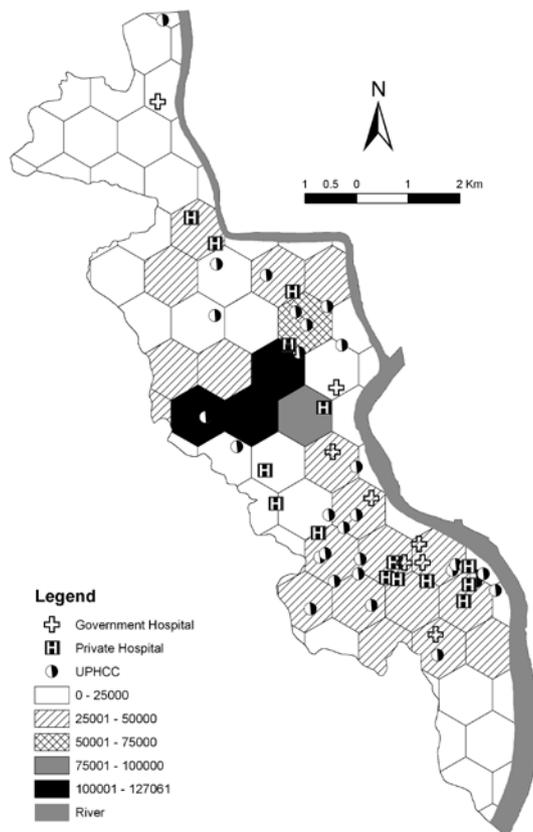
UPHCCs provide only basic health services; comprehensive medical assistance is available at hospitals. UPHCCs provide services such as reproductive healthcare, child health, treatment of communicable diseases, limited curative care, primary eye care, treatment for reproductive tract infections and sexually transmitted diseases, HIV/AIDS care and few laboratory services. The public and private hospitals in Khulna City provide outdoor facilities for treating routine diseases.

**Results and Analysis**

The statistical relation between population and number of health facilities is linear meaning that, increase of population causes increase of health facilities in Khulna City. The relationship between number of health facilities and population coverage has been seen on a scree plot. Although not a strong relationship, there is a dependency between the population density and number of health facilities. The value found was 0.59 which indicates a positive moderate correlation.

The population of Khulna City is 1.49 million (KCC 2007). Distributing the population in hexagons gives an average of 18,656, with a high standard deviation of 24,019. This is because of uneven hexagons at the city boundaries. More than half (68%) of the hexagons have population under 25,000, and the rest 32% of the hexagons’ population is more than 25,000. Four percent of hexagons have more than 100,000 people and 28% have 25,000 to 100,000 people (Figure 2). Hexagons at the city boundary have a smaller population and also a smaller number of health facilities. Subsequently, residents of these areas have greater difficulty accessing healthcare facilities.

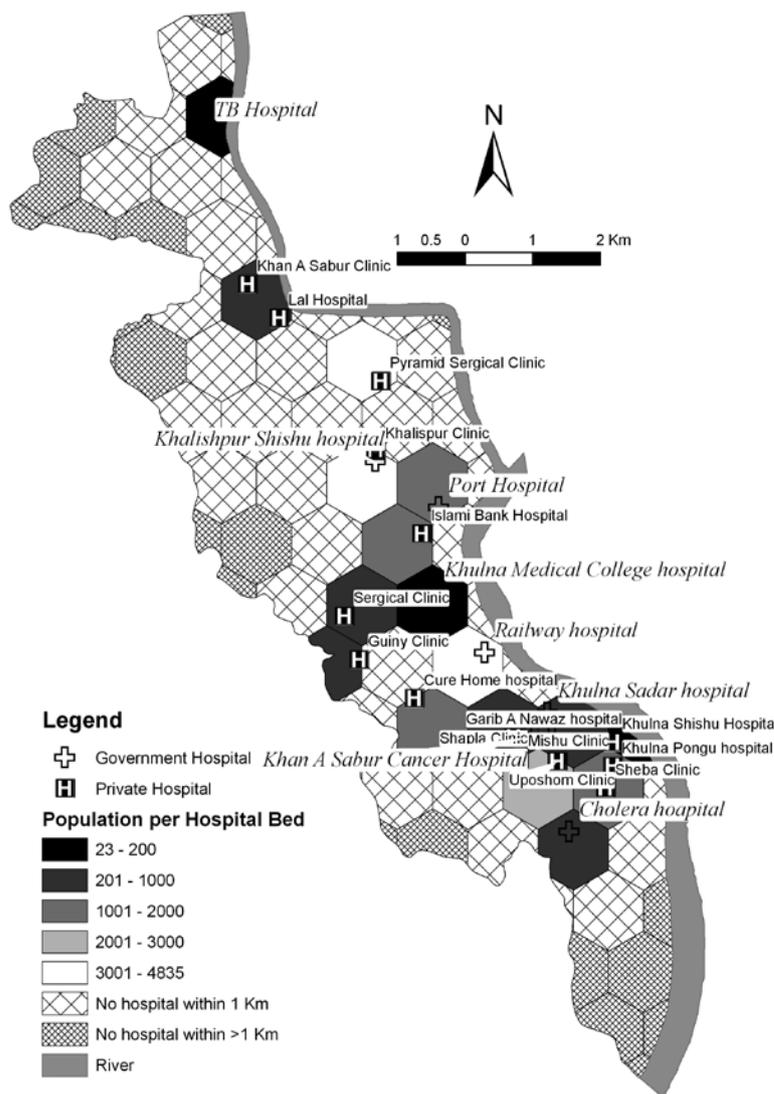
**Figure 2. Population and location of health facilities in Khulna City (Urban and Rural Planning Discipline 1999; KCC 2007; validated by Field Survey 2009)**



UPHCC = urban primary healthcare centre.

The study found that about 75% of hexagons have no healthcare centres or hospitals, and people living in these areas struggle to get the bare minimum level of healthcare. Eighteen percent of hexagons have a single centre, and others have two or more. Some areas (4%) have more than two hospitals. Government hospitals have an average of 785 beds, and private hospitals an average of 395 beds. Calculating population per hospital bed for each hexagon was complex, because people from different areas go to different hospitals. The hypothesis of this study is that hospital beds are available for the population of that specific hexagon (Figure 3). The average population for each hospital in Khulna City is 1,250. The calculation based on population distribution reveals that in some areas one bed is available for 23 people and in others this figure is 5,000. In some places, people must travel more than 3 km to a healthcare facility, an almost-impossible undertaking considering the lack of transportation options.

Figure 3. Population per hospital bed in Khulna City (Urban and Rural Planning Discipline 1999; KCC 2007 and validated by Field survey 2009)



A study conducted by the World Bank and others found that only 8% of people in Khulna City go to private hospitals for treatment, whereas 34% depend on government hospitals (World Bank, Proshika and Survey & Research System 2002). The number of private clinics is gradually increasing; on the other hand, the number of government facilities remains static.

Travel distance was calculated from the centre of each hexagon to the location of the facility. Results showed that 40% of the population are within 500 m of a UPHCC; 15.25% are within 500 m of a government hospital, and 22.64% are within that distance from a private hospital. Most of the population are within 1.5 km of a healthcare facility (88.99% for a UPHCC, 70% for a government hospital and 73.69% for a private hospital) (Table 1).

**Table 1. Accessibility to health facilities by distance**

Distance (m)	UPHCC (% of population)	Government hospital (% of population)	Private hospital (% of population)
Less than 500	40	15.25	22.64
501–1000	71.6	43.29	48.79
More than 1000	88.99	70	73.69

UPHCC = urban primary healthcare centre.  
Source: Field Survey 2009.

For transportation to a health facility, most people in Khulna City (61%) depend on non-motorized vehicles; rickshaw is their main mode of transportation media. The remaining 39% use motorized vehicles, mostly ambulances (Table 2).

**Table 2. Transportation mode used by patients**

Vehicle type	Percentage (%)	
Rickshaw	36.01	Non-motorized vehicle (61.03%)
Van	17	
On foot	8.02	
Car	7	Motorized vehicle (38.97%)
Auto-rickshaw	9.01	
Micro bus	3.03	
Motor cycle	2.75	
Bus	3.07	
Ambulance	14.11	

Source: Field survey, 2009

The UPHCCs are more accessible in terms of travel time. Average travel time to them is 19 minutes. It has been observed that average travel time increases with the type of facility (Table 3). People travel 31 minutes to hospitals with 10 to 50 beds and 46 minutes to hospitals with more than 100 beds. In New Zealand, Brabyn and Skelly (2002) found average travel time to reach to any health facility was 18 minutes.

Table 3. Travel time and service coverage

Travel time (minutes)	Percent of hospitals can be reached		
	UPHCC	Government hospital	Private hospital
Less than 15	18	10	11
16–30	64	41	38
31–45	93	79	81
46–60	100	97	98
More than 60		100	100

UPHCC = urban primary healthcare centre.  
Source: Field survey, 2009

Outcomes of our study were derived through a deliberate process of extensive field-level research. For analysis purposes, we divided our study area into 79 census points that contain both travel distance and time information; all demographic information was gathered from the population census. This method has shown that physical accessibility to hospitals varies considerably in the areas near to the city boundary. The majority of people can get facilities within 30 minutes' travel distance. Some areas have greater travel distance and require more time because the population density is not evenly spread across the city and the hospitals are centrally located. The characteristic of the population distribution varies noticeably throughout the city and is related to the dominant traditional settlement patterns.

### Discussion and Conclusions

This study of accessibility of hospitals in Khulna City would certainly facilitate policy development at the national level. In our study we have described and demonstrated a method for calculating physical accessibility that can provide the framework for further research in the field. The aim of the Government of Bangladesh (GoB 2008) is to ensure health services for all at a reasonable cost and distance; provision of healthcare is one of its primary responsibilities. However, the current state of the health sector in Bangladesh is not very favourable. To attain the government's goal, the current accessibility to health facilities must be understood. Although this study is based only on Khulna City, we believe it can be replicated throughout the country. Such a study would enable the GoB to identify precise locations where healthcare services need to be delivered to ensure optimum level of outcome.

As stated in the introduction, accessibility has many dimensions. There can be a difference between actual and perceived accessibility, and it requires close monitoring. The physical accessibility results from this study could be compared with qualitative studies of the public perception of hospital accessibility. Our study shows that GIS can be used to assess accessibility over large networks. This research has raised the awareness within the policy environment about the potential for network models to provide quantified travel time and distance data for other health services, such as mental health centres, general practitioners, eye specialists, and oncologists. Greater emphasis is now being placed on the need to maintain geographical databases relating to such services.

The idea of calculating population per hospital considering home-to-service distance and travel time could be replicated in many developing countries, where delivery of the meagre healthcare services available for the population is severely impeded by lack of good planning and initiatives. Findings of our study will help address these shortcomings by providing useful information to policy makers to aid them in an effective decision-making process.

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# Assessing the Progress of Malaria Control in Nigeria

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## **Abstract**

One third of the world's malaria deaths occur in Nigeria. It is doubtful whether Nigeria will meet the malaria control target of the Millennium Development Goals by 2015, having failed to meet the Abuja target to halve the burden of malaria by 2010. This paper assesses the current malaria burden and progress toward malaria control. Substantial data were obtained from the 2008 Nigeria Demographic and Health Survey and other secondary sources. Data showed that the malaria burden is still enormous because of inadequate control efforts. In 2008, only 17% of Nigerians owned at least one net, compared with 12% in 2003. Eight percent owned an insecticide-treated mosquito net (ITN), but only 6% of under-five children and 5% of pregnant women slept under an ITN. Only one third of under-five children with fever received antimalarial drugs, while one fifth of pregnant women took antimalarial drugs for prevention. Chloroquine is still the most common drug used in malaria treatment, despite its ban in first-line treatment since 2005. The paper concludes that scaling up home management of malaria and a community-centred approach to ITN and artemisinin-based combination therapy provisioning should be prioritized.

## **Introduction**

Despite some levels of commitment to malaria control, malaria still remains a major public health problem worldwide. Malaria takes the lives of more than one million people annually, 90% of whom live in sub-Saharan Africa (SSA), and it causes 300 to 500 million people to fall ill (Bloland et al. 2000; Nuwaha 2001; Agyepong and Kankeya-Kayonda 2004; Barat et al. 2004; Breman et al. 2004; Moree and Ewart 2004; World Health Organization [WHO] 2005; United Nations Children's Fund [UNICEF] 2007). Malaria is one of the leading causes of morbidity and mortality among the

Nigerian population, especially in under-five children. The World Bank (WB; 2009) reported that up to one third (300,000) of all world malaria deaths occur in Nigeria. Malaria also exacts a heavy socio-economic burden on Nigerian households and health systems (WHO 2008; WB 2009). Due to the burden of disease over many decades, Nigeria had been a signatory at the African Roll Back Malaria (RBM) summit held in Abuja in 2000 (often called Abuja summit), which arrived at the declaration to achieve universal coverage of insecticide-treated mosquito nets (ITNs) and ensure prompt treatment of vulnerable populations (especially under-five children and pregnant women). Unfortunately, the history of malaria control in Nigeria since the summit is one of insufficient effort and funding to achieve the targets. This is why the progress has been too slow.

It is therefore doubtful whether Nigeria will meet the malaria control target of the Millennium Development Goals (MDGs) (to alleviate 80% of the burden of malaria by 2015). As at 2005, one third of children with fever received no antimalarial drugs, less than 20% of households had at least one mosquito net and only 6% of children under-five slept under an ITN (National Malaria Control Program [NMCP] in Nigeria 2005). In most resource-constrained countries like Nigeria, up to 50% of the population has no access to modern healthcare facilities, and this is the reason for the global trend to scale up home management of malaria (Gyapong and Garshong 2008). Nigeria has also adopted home management of malaria and ITN to protect the vulnerable population from malaria.

Apart from the declaration of the MDGs in 2000, the Abuja summit witnessed the launch of ITNs as the major effective preventive device, with the promise to cover all vulnerable groups (especially under-five children and pregnant women) by 2010. All these promises make it imperative to evaluate malaria control performance a decade after the Abuja summit and the declaration of the MDGs. Therefore, the objective of this paper is to assess Nigeria's progress toward malaria control, specifically by looking at the current incidence of malaria and prompt treatment among vulnerable populations.

## Methods

The major source of data for this study is the 2008 Nigeria Demographic and Health Survey (NDHS).<sup>1</sup> Other available secondary data were used to complement NDHS data. The fourth NDHS was conducted in 2008 as a national representative survey of 33,385 women aged 15 to 49 years and 15,486 men aged 15 to 59 years. Household size was 4.4 persons in 2008, as against 5.0 in 2003. The sample had 11,027 women with a live birth in the two years preceding the survey and 24,975 under-five children. The 2008 NDHS sample was selected using a stratified two-stage cluster design consisting of 888 clusters, 286 in urban and 602 in rural areas. A representative sample of 36,800 households was selected for the 2008 NDHS survey, with a minimum target of 950 completed interviews per state (of the 36 states and Federal Capital Territory). During the fieldwork, only 34,644 households were occupied, out of which 34,070 were interviewed, which represents a 98% response rate. A complete listing of households was made and a mapping exercise was carried out for each cluster, with the resulting lists of households serving as the sampling frame. In the second stage of selection, an average of 41 households were selected in each cluster, using probability systematic sampling. The 2008 NDHS utilized a questionnaire to collect data on malaria and other health- and population-related issues from respondents. This study extracted information on groups vulnerable to malaria, especially on the use of nets, prompt treatment and intermittent preventive treatment during pregnancy (IPTp), and the coverage of malaria prevention programs. All households in the 2008 NDHS were asked whether they owned a mosquito net especially for the protection of pregnant women and under-five children. Use of sulfadoxine-pyrimethamine (SP) for prevention of malaria during pregnancy was also surveyed. The survey also asked questions regarding access to prompt treatment for under-five children with fever.

Data were presented and analyzed using quantitative methods. This study collated data from the 2008 NDHS and other secondary sources to make inferences on the state of malaria control efforts in order to determine the progress toward elimination of the malaria burden in Nigeria. Secondary data were analyzed and discussed.

## Results

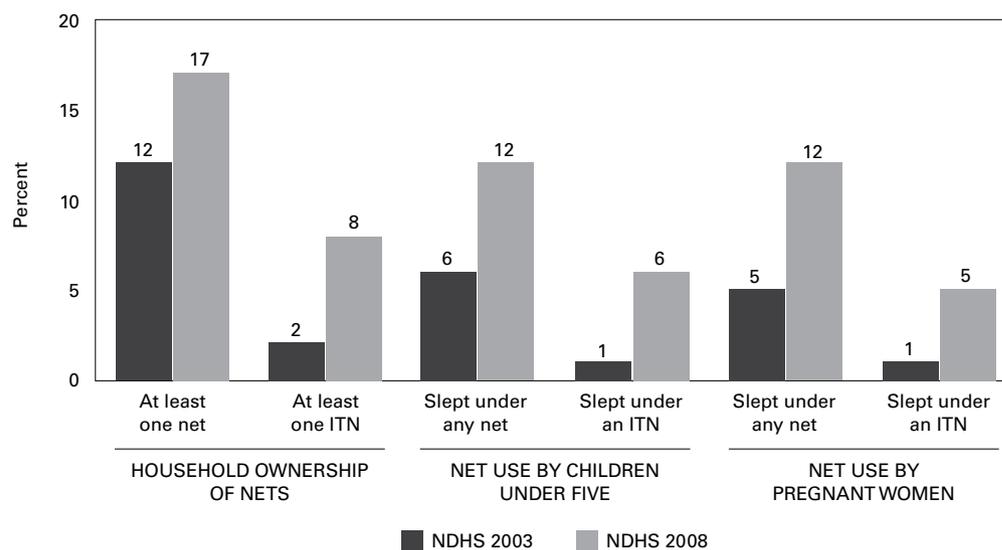
### Incidence of Malaria

The projected population of Nigeria as at 2010 is 158.9 million (RBM 2010), with a national growth rate estimated at 3.2% per annum (National Population Commission [NPC] 2006); hence, Nigeria is the most populous nation in Africa. The burden of malaria is worrisome in Nigeria as it accounts for the highest number of malaria cases in the WHO African Region (WHO 2008a). Transmission occurs in the south throughout the year but is more seasonal in the north. Almost all cases are caused by *Plasmodium falciparum* – the deadliest of the four malaria parasites. Results of the 2005 national malaria survey showed four major critical points: (1) one third of children with fever received no antimalarial drugs, (2) about 20% of households had at least one mosquito net, (3) about 7% of pregnant women slept under an ITN, and (4) about 6% of under-five children slept under an ITN (NMCP 2005). Over the years, there have been no significant improvements, as the pernicious burden of malaria is still very high. In 2006, the WHO estimated about 57.5 million malaria cases and 225,000 deaths from malaria in Nigeria, with more than 97% of mortality occurring among under-five children (WHO 2008). The upsurge in cases is due to an increasing rate of reported malaria over the years.

Nigeria bears the greatest burden of malaria in the world. Malaria contributes to infant and under-five mortality, which now stand at 75 deaths per 1000 live births and 157 per 1000 live births, respectively, (NPC and ICF Macro 2009). Almost half of childhood deaths occur during infancy, with one quarter taking place during the first month of life. NDHS 2008 estimated that:

1. Malaria is responsible for 25% and 30% of total infant and child mortality, respectively
2. Over 110 million clinically diagnosed malaria cases are recorded annually,
3. Malaria accounts for 60% of outpatient visits,
4. It is also responsible for 30% of hospitalizations,
5. 11% of maternal mortality is due to malaria, and
6. 300,000 children die yearly due to malaria in Nigeria alone (NCP and ICF Macro 2009).

Figure 1. Trends in net ownership and use in Nigeria.



Source: National Population Commission and ICF Macro 2009: 192.  
ITN = insecticide-treated net; NDHS = Nigeria Demographic and Health Survey

The malaria burden highlighted in the 2008 NDHS is similar to the report of Federal Republic of Nigeria (FRN) in 2007. Malaria also slows economic growth due to high treatment and preventive costs, and lost work hours and productivity. Funds that would have been used for development projects are usually diverted to malaria control. In short, malaria is the greatest public health challenge in Nigeria.

### Current Level of Prevention and Control of Malaria

There have not been significant improvements in the use of ITNs in Nigeria. Figure 1 shows the use of mosquito nets in Nigeria. It is severally reported that millions of ITNs have been distributed annually since the Abuja summit. Only 17% of Nigerians owned at least one net (but not necessarily an insecticide-treated one) in 2008, compared with 12% in 2003. While 8% of surveyed households owned an ITN, only 6% of under-five children slept under one (NPC and ICF Macro 2009). This represents an improvement of five percentage points from 1% in 2003. Among pregnant women, 5% slept under an ITN in 2008. All this shows a considerably low performance in scaling up ITN usage in Nigeria. It can therefore be observed that mosquito net usage is low among young children and pregnant women.

As well as from ITN usage, prompt treatment is poor among most vulnerable groups. Table 1 presents findings about prevalence and prompt treatment of fever/convulsions among under-five children. NDHS 2008 reported that of the 15.9% of under-five children with fever in the two weeks preceding the survey, only 33.2% received antimalarial drugs. The use of artemisinin-based combination therapy (ACT) is still very low. ACT usage is 2% in urban areas compared with 1% in rural areas. The surveys indicated that chloroquine (CQ) is still the most common drug used in malaria treatment in Nigeria, despite the fact that malaria parasite resistance to CQ is widespread. This accounts for the high rate of treatment failure and subsequent increase in under-five mortality rate. Among under-fives with fever, only 15.2% received antimalarial drugs the same or next day. This signifies delay in treatment, as mothers may wait between two and four days before starting any form of treatment.

Mother's level of education played a significant role in administration of antimalarial drugs. Table 1 shows that the percentage of children with fever was lowest among those whose mothers had more than secondary education. Women with secondary education and above were twice as likely to administer antimalarial drugs as their counterparts with less education. Also, 2008 NDHS also showed that the percentage of children with fever was lower in households in the highest wealth quintile, coupled with a greater propensity to administer antimalarial drugs, than those from lower wealth quintiles.

NDHS 2008 further reported that among women who had their last birth in the two years before the survey, 18% took an antimalarial drug during pregnancy: 11% of all pregnant women took at least one dose of an SP drug, while 7% took two or more doses. Only 8% of the women participated in IPTp as part of antenatal care. IPTp usage shows no improvement from the 20% reported in NDHS 2003.

At the level of control activities, Nigeria has adopted a number of malaria control strategies. Home management of malaria (HMM) was adopted in 2005 as part of control strategies. Other strategies include (1) free distribution of long-lasting insecticide-treated nets (LLINs) among under-five children and pregnant women since 2001, (2) free distribution of LLINs extended to all age groups in 2009, (3) indoor residual spraying for prevention and control of epidemics since 2007, (4) intermittent preventive treatment with the use of SP for prevention of malaria during pregnancy since 2001, and (5) free ACT for under-five children and highly subsidized ACT for other age groups in the public sector since 2006. Oral monotherapies banned in first-line treatment since 2005 and rapid diagnostic tools (RDTs) have been used in areas without microscopy since 2006.

Unfortunately, the strategies have not been effective enough to yield deserving results. From 2005 to 2007, the National Malaria Control Program distributed over 11.5 million LLINs and 7.3 million ITNs, but this could only cover 5% of the at-risk population (WHO 2008, 2009). It is further observed that 8 million courses of ACTs delivered in 2006, 9 million in 2007 and 12 million in

2008 are far below total requirements. There have not been dedicated efforts in scaling up HMM.

**Table 1. Prevalence and prompt treatment of fever/convulsions**

<b>Percentage of children under age five with fever in the 2 weeks preceding the survey, and among children with fever, the percentage who received antimalarial drugs and the percentage who received the drugs the same or next day following the onset of fever, by background characteristics, Nigeria 2008</b>					
<b>Background characteristics</b>	<b>Under-five children</b>		<b>Under-five children with fever</b>		
	<b>Percentage with fever in the 2 weeks preceding the survey</b>	<b>Number of children</b>	<b>Percentage who took antimalarial drugs</b>	<b>Percentage who took antimalarial drugs same or next day</b>	<b>Number of children</b>
<b>Age (in Months)</b>					
<12	14.3	5729	32.3	14.9	820
12–23	21.3	4945	31.4	13.7	1054
24–35	17.8	4633	34.8	16.0	826
36–47	13.7	5013	32.6	14.0	688
48–59	12.4	4653	36.0	18.3	579
<b>Residence</b>					
Rural	12.8	7690	41.1	19.1	987
Urban	17.2	17,284	30.5	13.8	2981
<b>Region</b>					
North central	9.6	3434	47.3	21.1	331
North east	21.9	3989	21.8	11.5	872
North west	15.7	7594	29.2	12.9	1189
South east	22.9	2428	21.5	10.4	555
South south	20.6	3310	47.1	21.1	682
South west	8.1	4221	53.6	22.3	340
<b>Mother's education</b>					
No education	16.3	11,342	25.8	11.2	1846
Primary	15.4	5805	31.1	15.5	893
Secondary	16.0	6385	44.9	20.8	1022
More than secondary	14.4	1441	50.0	21.1	207
<b>Total</b>	<b>15.9</b>	<b>24,975</b>	<b>33.2</b>	<b>15.2</b>	<b>3968</b>

Source: National Population Commission and ICF Macro 2009: 195.

Considering the targets to be met by 2010 and 2015, Nigeria has fared poorly in malaria control, especially from 2000 to 2009. There has been a rush toward meeting the RBM target by 2010.

Table 2 presents expected intervention needs (presented in the second column), actual needs already covered and most deliveries that were to be made between September 2009 and December 2010.

Table 2 shows that 62.9 million (m) LLINs, calculated at two per five-person household, were needed between 2009 and 2010. Therefore, over 40 m LLINs, 94 m ACT doses and 34 m RDTs were supposed to be delivered and distributed in 2010. These supplies are 10 times greater than those delivered since the declaration of the targets in 2000. It is evident that even if the 2010 deliveries were made, their effective distribution to meet the RBM 2010 target within a few months was unrealistic. This is partly because problems of community mobilization and other community issues (such as local understanding of malaria, awareness of ITNs, community acceptability and delay in seeking treatment) still need to be addressed before such deliveries can translate to alleviation of the malaria burden. Apart from community issues, Table 2 also indicates gaps that would not be covered – 35 m courses of ACT and 29 m of RDTs. It is therefore obvious that funding shortfalls and a sapped political will over the years have stymied progress in malaria control, culminating in the uphill struggle at the eleventh hour to meet the targets. These prevailing shortcomings have been responsible for the failure to reach targets; hence, the enormous burden of malaria still persists.

**Table 2. Nigeria: Roadmap to achieve 2010 RBM targets, September 2009 to December 2010**

Intervention	Need to 2010	Already covered	Funded and expected to be distributed before end 2010	Gap
Long-lasting insecticide-treated nets (LLINs)	62.9 m LLINs: (22.3 m from Sept. 2009; 40.5 m in 2010 @ 2 LLINs/HH with 5 persons/HH + wastage)	4.4 m	49,378 m	9.2 m
Artemisinin-based combination therapy	129,194,824 doses: Sept, 2009: 28,175,491; 2010: 101,019,333 (80% coverage)	8.3 m	94,267,437	34,927,387
Indoor residual spraying	2,540,843 HHs – 2009: 280,000; 2010: 2,260,843		840,000 280,000 (2009) 560,000 (2010)	4.24 m
Rapid diagnostic tools	59,202,251 tests – 2009: 29,135,153 tests (30% coverage); 2010: 30,067,098 tests	0	34,353,875 m	28,848,376
Intermittent preventive treatment during pregnancy	18.3 m doses Sept. to Dec. 2009: 2,340,830; 2010: 16 m		18.3 m	0
<b>Population at risk: (projected) (158.9 m in 2010)</b>				

Source: Roll Back Malaria 2010.  
HH = household.

## Discussion

Nigeria has specific malaria control goals. The major impediment to achieving them has always been frail or insubstantial action-oriented exertions. It is evident that the Abuja target (to halve the burden of malaria by 2010) has not been realized. In Nigeria, over a million children die each year from preventable diseases including malaria (Ngowu et al. 2008). Although funding for malaria control increased from \$17 million (US) in 2005 to \$80 million in 2008 (WHO 2009), the amount is unlikely to be sufficient to reach national targets for prevention and cure. Evidently, in Nigeria, there is no evidence of a systematic decline in malaria burden (WHO 2008, 2009).

Poverty exacts an influence on the prevalence of malaria (Yusuf et al. 2010), and malaria is in

part a cause of household poverty in SSA, as a poor household may spend up to 25% of its income in the prevention and treatment of malaria (WHO 2000). The household economies of most parts of SSA are not improving, yet there is an inevitable replacement of cheap CQ with a more expensive artemisinin-based combination therapy (ACT) (Amzat and Omololu 2009). The introduction of ACT further increases expenditures on malaria control, though the new drug invariably holds promise for malaria treatment in Nigeria and other endemic countries. The challenge of how to scale up the coverage of ACT is enormous. The Nigerian government banned the use of CQ in first-line treatment of malaria in 2005 (Gbenoba and Atolagbe 2005), yet problems of availability, affordability and adherence to effective ACT are still major challenges to malaria control in Nigeria. Up to 58% of pregnant women receive antenatal care, yet only one fifth of all pregnant women use IPTp (NPC and ICF Macro 2009). This shows that hospital-based IPTp is not effective. The program does not reach most rural communities (where over 60% of the population resides) because an urban implementation bias. These rural communities do not have appropriate health facilities and, hence, are cut off from health program coverage (Amzat 2010). This is part of the reasons why awareness of the new ACT and adoption of ITN are drastically low.

The local population continues to use CQ, despite resistance having been established. CQ use is responsible for the high rate of treatment failure, which has been implicated in the rise of malaria-related morbidity and mortality (Amzat 2009; WHO 2010). Continued CQ use has contributed to the lack of improvement in malaria control efforts, especially among under-five children. Like 2008 NDHS, a study by Adedotun and colleagues (2010) also indicates that only a small proportion of children (13.7%) and adults (5.3%) received prompt treatment in Nigeria. (A low level of access to effective treatment contributes to the high mortality rate among under-five children.)

Afolabi et al. (2009) also found low levels of ITN usage in Nigeria. Onwujekwe et al. (2005) reported that more than 80% of respondents had never purchased any form of ITN. While overall bed net possession was low, Yusuf et al (2010) reported less fever in households with an ITN (Yusuf et al. 2010). Jegede et al. (2006) revealed low levels of awareness of ITNs in Nigeria. ITNs are not widely available, despite claims that several million have been distributed. Most free ITNs are diverted to the market for sale, where vulnerable populations such as the poor cannot afford them. While there is significant improvement in ITN usage in Togo, Guinea-Bissau and Zambia, Nigeria is still trailing, as are Ghana, Senegal and Rwanda (UNICEF 2007). Nigeria accounts for 22.2 million (25%) of all African children (89.6 million) living under conditions of stable malaria transmission who were not protected by an ITN in 2007 (Noor et al. 2009).

Low levels of ITN ownership and access to malaria treatment are reflections of the poor public health system for implementation as well as inadequate political commitment. At the grassroots level, there is poor community mobilization. Many people still hold misconceptions about malaria (Afolabi et al. 2004; Brieger et al. 2001; Jegede et al. 2005; Oguonu et al. 2005; Opiyo et al. 2007; Simsek and Kurcer 2005). Brieger et al. (2001) reported beliefs that malaria in the dry season is attributed to intense heat or 'working in the sun,' while malaria in the rainy season is associated with 'stagnant water,' alcohol, too much fat, too much thinking and increased swampy areas. Such causal attributions represent misconceptions that discourage the use of appropriate preventive and curative measures among the local population. Such misconceptions are as a result of low literacy levels and grossly inadequate education programs. Also, many people resort to self-treatment because of the shortage of health facilities. Most primary health centres do not have adequate number of trained staff (Amzat 2010). Moreover, despite several summits on malaria, and pledged commitments, control programs instituted in Nigeria are deficient, ineffective and devoid of strong political will. For instance, a majority of the local population have no free access to ITNs as they are being sold at \$6 to \$10 (US) in pharmacies. This is a country where up to 60% of people live below the poverty line of \$1 a day (FRN 2007), and less than 5% are covered by the national health insurance scheme (Amzat 2010).

The NDHS also indicated that most mothers have leftover CQ at home for treatment of under-five children. Invariably, most Nigerians still engage in self-treatment and HMM. So there is a need

to scale up HMM in Nigeria to ensure appropriate treatment and referral of severe cases. Amzat and Omololu (2009) claimed that malaria control measures need to be incorporated at the community level in order to reduce malaria-related morbidity and mortality and as one effective way to bring treatment close to the people. This would involve training and engaging volunteers and community health workers (CHWs). Evidence from Burkina-Faso shows that caregivers provided most of the medicines as home treatment, and half of the children received some type of modern treatment within 24 hours of occurrence of first symptoms (Tipke et al. 2009). Nigeria can greatly benefit from training CHWs and other volunteers in malaria treatment, especially at the home level. Training drug vendors and other volunteers as a means of communication in the community is feasible and should be part of control strategies aimed at improving prompt and effective home treatment of malaria, with referral of severe cases (Chuma et al. 2009; Hawkes et al. 2009; Mukanga et al. 2010; Ogutu et al. 2010; Okeke and Uzochukwu 2009; Wakabi 2010; Yasuoka et al. 2010).

### Conclusion

Nigeria is trailing far behind in malaria control. The country has not achieved the Abuja target to halve the burden of malaria by 2010. It is also evident that the MDG target to shift the considerable burden of malaria by 80% might not be attained. Committed and gradual activities spread over time will strengthen malaria control, rather than engaging in an eleventh-hour rush that might be wasteful. There is a need to make considerable efforts to improve malaria management. In a resource-constrained nation, scaling-up HMM will complement case management in health facilities. A community-centred approach in ITN and ACT provisioning will be effective in malaria control. Promoting ITN usage by increasing awareness and availability to ensure wide coverage is a critical measure in malaria control. As in Tanzania (Widmar 2009), Nigeria needs to address community-specific practices and attitudes prior to ITN distribution to promote consistent and correct use and change of attitudes toward bed nets as a preventative health measure. The government needs strong political will and action-oriented policies backed with financial support in the fight against malaria. This will go a long way toward achieving the malaria targets of MDGs by 2015.

### Endnote

<sup>1</sup> 2008 NDHS is herein cited as National Population Commission (NPC) and ICF Macro 2009.

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