OTOSCOPE AND STETHOSCOPE:

A VEHICLE FOR MICROBIAL COLONIZATION,

AT TIKUR ANBESSA SPECIALIZED REFERRAL HOSPITAL,

ADDIS ABABA, ETHIOPIA

By

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ABBREVIATIONS

AAU	Addis Ababa University
AIDS	Acquired Immuno-defiency Disease Syndrome
ATCC	American Types Culture Collection
CFU	Colony Forming Unit
CoNS	Coagulase Negative *Staphylococci*
DMIP	Department of Microbiology, Immunology and Parasitology
EHNRI	Ethiopian Health and Nutrition Research Institute
ESBL	Extended spectrum Beta Lactamase
HAIs	Hospital Associated Infections
HCWs	Health Care workers
ICU	Intensive Care Unit
LPCB	Lacto Phenol Cotton Blue
MDR	Multi-Drug Resistance
MRCoNS	Methicillin Resistance Coagulase Negative *Staphylococci*
MRSA	Methicillin-Resistant *Staphylococcus aureus*
NCCLS	National Committee for Clinical Laboratory Standards
NIs	Nosocomial Infections
OPD	Out Patient Department
VRE	Vancomycin-Resistant *Enterococci*

ABSTRACT

Background: Nosocomial infections (NIs) remain a significant cause of morbidity and mortality both in developed and developing countries. NIs is caused by the microorganisms that are commonly found around the hospitals. In the hospital environment, medical equipments carried by HCWs such as otoscopes and stethoscopes may serve as the reservoir for microorganisms.

Objectives: This study was undertaken to determine microbial colonization of otoscopes and stethoscopes used by HCWs at Tikur Anbessa Specialized Referral Hospitals, Addis Ababa, Ethiopia, between November 2011 and April 2012.

Materials and Methods: 130 stethoscopes and 6 otoscopes were sampled from different health personnel of five wards. Cleaning trends of stethoscopes and otoscopes by HCWs were assessed through the prepared questionnaire. Swab sample was taken by rubbing the diaphragm and bells of stethoscopes as well as handles and tips of otoscopes with sterile cotton tip applicator moistened in sterile saline. The swabbed sample was inoculated immediately on blood agar and Sabouraud dextrose agar for bacterial and fungal growth respectively. Identification of bacteria were done using gram staining, colony morphology, biochemical tests include catalase and coagulase tests (for gram positive bacteria), oxidase test and API 20E (for gram negative bacteria). Germ tube test, LPCB staining, gram staining and thermo tolerant growth test were done for identification of fungal species. For bacterial isolates, antibiotic susceptibility test were done by disc diffusion method according to the preset criteria and the result were interpreted as susceptible, intermediate and resistance by measuring the growth inhibition zone.

Results: From the total of 136 medical devices (6 otoscopes and 130 stethoscopes) sampled, 82(60.3%) were colonized with different species of bacteria (n=99) and fungi (n=12). From the total of bacterial colonization, gram positive bacteria accounted for 94(94.9%) where as gram negative bacteria accounted for 5(5.1%) and fungi accounted for 12(10.8%). Among the bacteria isolates, *CoNS* were dominated and of fungi, *Candida albicans* were dominated. Of the 130 stethoscopes sampled, 70(53.8%) showed bacterial colonization and 9(6.9%) were showed fungal colonization. Among different HCWs, 31(70.5%) of stethoscopes from

resident medical doctors and also among the five wards, 25(71.4%) of stethoscopes from ICU were showed high rates of microbial colonization. Five (45.5%) and 74(62.2%) of stethoscopes that cleaned and not cleaned between patients examination respectively were showed microbial colonization. And also 60 (57.1%) and 19(76.0%) of stethoscopes that cleaned with disinfectant and not cleaned with any disinfectants respectively were showed microbial colonization.

S.aureus and *CoNS* isolates were showed low level of resistance (<60%) for Oxacillin, Erythromycin, Penicillin G, Trimethoprim-sulphamethoxazole, Ampicillin, Chloramphenicol, and Ceftriaxone antibiotics. For Clindamycin and Vancomycin, *S.aureus* was showed 100% susceptible but *CoNS were* showed low level of resistance. Isolates of gram negative bacteria were showed intermediate level of resistance (60-80%) for Ampicillin, Erythromycin and Trimethoprim-sulfamethoxazole, and low level of resistance (<60%) for Chloramphenicol, Ceftriaxone, Ciprofloxacin and Nalidixic Acid, but 100% susceptible for Gentamicin.

Conclusion: Otoscopes and stethoscopes might be a vehicle for both pathogenic and non-pathogenic microorganisms. Microbial colonization rate was reduced by regular cleaning of Otoscopes and stethoscopes. Clindamycin and Vancomycin antibiotics were effective against gram positive where as Gentamicin was effective against gram negative bacteria isolate from otoscopes and stethoscopes.

Recommendations: Efforts should be directed towards standard cleaning strategy and continued re-evaluation of the microbial profile and their resistant patterns. In addition, health care workers should be informed that these devices might be act as a vehicle for microbial colonization.

***Keywords*:** Otoscope, Stethoscope, Microbial Colonization, Tikur Anbessa Specialized Referral Hospital, Ethiopia.

CHAPTER I: INTRODUCTION

1.1. Background

Nosocomial infections(NIs) are a significant cause of morbidity and mortality in hospitalized patients and remain a health problem throughout the world (Emori and Gaynes, 1993). NIs are becoming increasingly common worldwide and occur in more than 2 million hospitalizations in the United States each year (Haley *et al*.,1985). They are the result of increased number of immune-compromised hosts with increased prevalence of disease causing microorganisms in the health care settings. As reviewed in previous study (Kilic *et al*., 2011),it was observed that hospital infections prolong the duration of hospital stay, directly caused 60,000 deaths and resulted in spending over 10 billion USD per year. These nosocomial infections are important since they cause high mortality, and one third of them are caused by microorganisms found around the hospital and are preventable (Guinto *et al*., 2002).

It is estimated that more than 1.4million people world-wide are suffering from infections acquired in hospitals (Vincent, 2003). These health care associated infections occur world-wide and affect both developed and developing countries. In developed countries, between 5% and 10% of patients acquire one or more infections, and 15%-40% of patients admitted to critical care thought to be affected (Klevens *et al*., 2007). Many of the pathogens that cause nosocomial infection have a high level of resistance for antibiotic therapy; some of the major concerns are Methicillin resistant *Staphylococcus aureus* (MRSA), Vancomycin-Resistant *Enterococci* (VRE), Extended spectrum beta lactamase resistance (ESBL) Enterobacteriaceae, and *Clostridium difficle* (Devrajani *et al*., 2009).

Microorganisms responsible for this NIs can colonize different medical equipment used in the hospital environment. Besides of devices used in invasive interventions, such as ventilators and catheters, the equipments commonly used in the hospital, such as sphygmomanometers, thermometers and stethoscopes bear a high risk of transmitting infections from patient to patient (Zachary *et al*., 2001; Maluf *et al*., 2002). Among those

equipments, stethoscopes are the most frequently used medical devices as reviewed in previous study (Kilic *et al*., 2011). Because stethoscopes have always been part of the physicians' basic paraphernalia when examining patients, it has recently been shown to harbor various organisms on their diaphragm surfaces with coagulase negative *Staphylococci* as the predominant isolate (Marie *et al*., 2000).

In previous study it was indicated that, stethoscopes and otoscopes, universal tools of the medical profession may be a vectors for nosocomial infections and similar microorganisms were isolated from both devices (Cohen *et al*., 1997). And also stethoscope usage, handling and cleaning practices were related to bacterial contamination (Cohen *et al*., 1997; Maluf *et al*., 2002). As indicated in previous study, bacterial colonization was related to the last time the stethoscope was cleaned prior to the survey, the most bacterial colonization was found on stethoscopes that had never been cleaned, while the least was found on stethoscope cleaned one week or less before the study (Uneke *et al*., 2008).

Although many studies have been done in different countries of the world, to the best of our knowledge, in Ethiopia, there were no published reports available which revealed microbial colonization rate of otoscopes and stethoscopes. Therefore this study was undertaken to determine microbial colonization and susceptibility pattern of bacterial isolates of otoscopes and stethoscopes used by different HCWs.

1.2. Literature Review

1.2.1. Medical Devices and Microbial colonization

Medical devices are classified as critical items (objects that enter patient's vascular system or sterile tissue such as scalpels, surgical instruments, implants, needles e.t.c.), semi-critical (instruments that contact mucous membranes such as endoscopes, sigmoidoscopes, laryngoscopes, endotracheal tubes) , and non-critical (items or surfaces that come in contact with intact skin such as light fixtures, clinical and lab countertops, telephones, office machines, stethoscopes, foot stirrups, tourniquets, blood pressure cuffs, baby scales, bandage, scissors, otoscopes, ophthalmoscopes) (OSHAWatch, 2005).

And although non-critical items come into contact with intact skin unlike the critical and semi-critical medical devices, transmission of nosocomial infections on contamination of these medical devices is possible. Therefore, multiple studies have demonstrated that portable equipment carried by HCWs, such as stethoscopes, tourniquets, sphygmomanometer cuffs, otoscopes, and pagers, becomes contaminated like hands, and may serve as a potential vector for the transmission of infection including antibiotic-resistant pathogens to patients, either via direct contact or by contamination of HCWs' hands as reviewed in other study (Muto *et al*., 2003).

1.2.2. Stethoscope

Stethoscope is defined as a medical instrument used for listening to breathing, heartbeats, and other sounds made by the body. The stethoscope is commonly described as an instrument used by physicians and other health professionals to hear the sounds made by the heart, lungs and various other body organs. Stethoscopes used in hospitals by medical doctors, medical students and other health practitioners for assessing patient health have been reported as a potential vector for transmitting infections in the hospital environment of various parts of the world as reviewed in other reports (Uneke *et al*., 2008).

Cleaning stethoscopes with isopropyl alcohol dramatically reduces the number of bacterial colonies on the diaphragm by 94–100%, however regular cleaning has little impact on the

colonization of the earpieces. But how often a stethoscope must be cleaned to limit contamination is not well established although there is a correlation between degree of contamination and frequency of cleaning (Cohen *et al*., 2003).

There are increasing reports of the risk of transmitting antibiotic resistant microorganisms from one patient to another through stethoscopes. These antibiotic-resistant organisms are capable of initiating severe infections in a hospital environment and could require contact isolation and aggressive treatment to prevent the spread of the organisms. Examples of such antibiotic-resistant organisms are Ceftazidime-resistant *Klebsiella pneumoniae*, Vancomycin-resistant *Enterococci*, Methicillin-resistant *staphylococci*, Ciprofloxacin-resistant *Pseudomonas aeruginosa*, Gentamicin-resistant *Pseudomonas aeruginosa*, and penicillin-resistant *Pneumococci* as reviewed in previous study(Uneke *et al*., 2010). As reviewed by Marie *et al*., (2000) stethoscopes have always been part of the physician's basic paraphernalia when examining patients. It has recently been shown to harbor various organisms on their diaphragm surfaces with coagulase negative staphylococci as the predominant isolate. And other organisms isolated were *Staphylococcus aureus, Corynebacterium spp., Bacillus spp., Neisseria spp.*, alpha-hemolytic *Streptococci, Micrococcus luteus, Enterococcus spp., Candida spp,* and *Aspergillus spp*.

Some health personnel have difficulty in accepting that the stethoscope, the symbol of their professional status, may actually be a vector of disease. In a study of 150 health care providers, comprising emergency medicine house staff and attending physicians (n=50), Emergency Department nurses (n = 50), and pre-hospital personnel working in Kent County, Michigan (n=50), *Staphylococcus species* (mostly coagulase negative) were cultured from 89% of the participants' stethoscopes, the mean number of colony forming units increasing the longer the stethoscopes were not cleaned. Overall, 48% of health care providers cleaned their stethoscopes daily or weekly, 37% monthly, 7% yearly, and 7% had never cleaned them. Cleaning the stethoscope's diaphragm resulted in an immediate reduction in the bacterial count—by 94% with alcohol swabs, 90% with a non-ionic detergent, and 75% with antiseptic soap (Jones *et al*., 1995).

Another also study showed that, from samples collected from 43 stethoscopes belonging to senior physicians, residents, interns and medical students, *Staphylococcal* species were the most common contaminants; mainly coagulase-negative *Staphylococc*i (38%) and *S. aureus* (4 cases – 9.5%). One case of Methicillin resistant *S. aureus* was also encountered (Youngster *et al*.,2008).

There was evidence that, 125 different organisms were isolated from 50 different stethoscopes. Fifteen of these organisms (*Staphylococcus aureus* and gram negative bacilli) were classified as potential pathogens. The numbers of colonies present seemed to be varying with the duties of the owner of the stethoscope and were highest in the intern group, intermediate in the resident and faculty group and lowest in the two nurses groups (Mangi and Andriole, 1972).

In another study, 355 stethoscopes were sampled, 78% of which were used by physicians, students, or nurses. One hundred ninety-two stethoscopes (54%) were colonized with 20CFUs per membrane, and 63 (18%) carried >100 CFU per membrane. Three hundred stethoscopes (85%) were colonized with nonpathogenic or weakly pathogenic bacteria, mainly coagulase-negative *Staphylococc*i, *Micrococcus luteus*, and *Bacillus* species. Potentially pathogenic bacteria were found on 31 stethoscopes (9%): which include *Staphylococcus aureus*; *Acinetobacter, Enterobacter, Escherichia coli, Klebsiella, Stenotrophomonas maltophilia.* All four gram-negative bacteria tested (*Pseudomonas aeruginosa, Klebsiella pneumoniae, Escherichia coli,* and *Acinetobacter baumannii)* disappeared within 6 hours, whereas gram-positive bacteria (*Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus faecalis)* could survive for up to 18 hours (Bernard *et al*., 1999).

In study done in Turkey, they found bacterial and fungal contamination in 92 (76%) of the stethoscopes. Fifteen out of 92 (16.3%) had potential pathogens including Methicillin sensitive *S. aureus* (n=5), Methicillin resistance *S. aureus* (n=4), *Escherichia coli* (n=3), *Acinetobacter baumannii, Acinetobacter haemolyticus* and *Enterococcus* spp. Of the 121 health-care persons, only 61 regularly cleaned their stethoscopes by using alcohol, and various disinfectant substances. In this study, microorganisms on stethoscope diaphragm

used by hospital personnel were detected. These were non-pathogen or slightly pathogen bacteria: *Staphylococcus epidermidis, Bacillus* spp., *Sarcinia* spp. and *Corynebacteria spp*., and pathogen bacteria: *E. coli, A. baumannii, A. hemoliticus, S. aureus* (four of them were MRSA) and *Enterococcus* spp. Apart from these, fungi: *Candida* spp., *Aspergillus* spp. and *Penicillium spp.* were also detected. It is not surprising that gram positive bacteria were isolated more than gram negative bacteria through normal skin flora which contains mostly gram positive bacteria (Kilic *et al*., 2011).

Study done in Canada were also showed that isolation of other potentially pathogenic microorganisms such as *Staphylococcus aureus*, *Acinetobacter spp*. and *Enterobacter agglomerans*, suggests that the stethoscope should be considered a transmitter of infection, not only in the Emergency Department, but also in the rest of the hospital wards and out-patient clinics. This was especially relevant in Surgical and Internal medicine wards, since health care givers in these areas had stethoscopes that were contaminated with the same microorganisms. Poor cleaning of the stethoscope can turn this tools into a vector of infection and could causes nosocomial outbreaks (Nunez *et al*., 2000).

It was observed that stethoscopes get contaminated by the organisms colonized on the patients' skin, or those residents on the hands of the health care providers, or when they come in contact with blood and other biological secretions. The universal use of the stethoscope and its direct contact with multiple patients makes it an important potential factor in the dissemination of microorganisms from one patient to another. In hospitalized patients, this means an exposure of an already susceptible host to a higher microbial overload and for the patients attending Out Patient department(OPD), an exposure to the threatening antibiotic-resistant hospital-flora (Parmar *et al*., 2004).

In another study, out of 110 randomly selected stethoscopes at various clinical departments, microbial colonization was not proved to be present only in nine cases (8%). *Staphylococcus* species were present on 94 stethoscopes (85%), out of which 20% (19cases) were Methicillin resistant *Staphylococcus* of various species and *Staphylococcus aureus* was

found in 14% (16) of swabbed membranes, out of which the Methicillin resistance strain made up 12% (2) (Madar *et al*., 2005).

As study done in Nigeria showed, of the 107 stethoscopes, 73 of which were from physicians (medical doctors) and 34 from nurses and other health workers surveyed, 84 (78.5%) had bacterial contaminants. A total of 59 (80.8%) of the doctors' and 25 (73.5%) of other health workers' stethoscopes were contaminated. The bacteria isolated included *Staphylococcus aureus* (53.6%), *Pseudomonas aeruginosa* (19.0%), *Enterococcus faecalis* (14.3%), and *Escherichia coli* (13.1%) (Uneke *et al*., 2010).

A similar spectrum of microbial contamination of stethoscope membrane was indicated in other published reports (Smith *et al*., 1996; Zachary *et al*., 2001). Some of them detected also *Neisseria spp*., *Micrococcus luteus*, as well as *Candida spp*., and *Aspergillus spp* (Madar *et al*., 2005).

It has also been shown that bacteria are quite capable of surviving up to 18 hours on this surface**.** Therefore, it has been demonstrated experimentally that stethoscopes are able to transfer bacteria to human skin**.** The cultivation of swabs taken from stethoscope membranes showed that non-critical health-care tools might play a role in the spread of microbial flora including Methicillin resistance *Staphylococci*. Their importance is emphasized by the fact that they are used on a daily basis in examination of a number of patients. Therefore, hospital control measures focused on nosocomial infections prevention should not exclude non-critical health care tools (Madar *et al*., 2005).

1.2.3. Otoscope

Otoscope is an instrument incorporating a light and a magnifying lens, used to examine the external canal of the ear and the eardrum. Like other medical devices, it is exposed to different microbial colonization while used for examination purposes, hence, may be act as a vehicle for their transmissions. There was study that indicated from swab sample taken from forty-two otoscopes of physicians, 90% of the otoscopes were found to be contaminated with microorganisms. About 45.2% of the isolated microorganisms were

found to be *Staphylococcus aureus.* Therefore, there was evidence that medical device such as otoscopes has been demonstrated to be contaminated with bacteria species and has been implicated as potential vectors of cross transmission (Cohen *et al*., 1997).

1.2.4. Other Medical Devices

Like otoscopes and stethoscopes, in study done in Nigeria, 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 (Uneke and Ijeoma, 2011). And also ready-to-use 'disinfected thermometers and probes were found to be colonized with multi-drug resistant *Enterobacter cloacae*. Disinfection procedure and laboratory investigation revealed that 'rushed disinfection with alcohol 80% led to a 1 in 10 chance of thermometers still being contaminated(Berg *et al*., 2000).

In study done in Canada, 27 ultrasound probes exposed to patients with disrupted skin grew *Staphylococcus epidermidis (*Muradalis *et al., 1995).* In study done in Australia also indicated that 12 (27%) of the 44 ultrasound transducer heads sampled were contaminated with micro-organisms. And colonization was highest with coagulase-negative *Staphylococci* (80%) followed by *Micrococcus spp* (7.7%). Other organisms identified included coagulase-positive staphylococci, *Bacillus spp*, environmental fungi and other environmental contaminants (Schabrun, 2006).

In other study done in Iran, endotracheal tube were contaminated commonly by bacterial species include *Staphylococcus aureus* (23.6%), *Klebsiella* spp. (23.3%), *Acintobacter* spp. (20.7%), *Pseudomonas aeroginosa* (18.2%), *Escherichia coli* (7.7%), and *Enterobacter* spp. (5.7%) (Amini *et al*.,2009). Other study done in Taxes also revealed that 90 isolates (87.4%) of *CoNS,* 51 isolates (49.5%) of bacillus species, 13 isolates (12.6%) of fungal species, 8 isolates (7.8%) of non-hemolytic *Streptococcus* species, 7 isolates (6.8%) of a-hemolytic

Streptococcus species, 1 isolate (1.0%) of *MSSA*, and 1 isolate (1.0%) of *MRSA* were isolated from bed handsets (Young *et al*., 2005).

1.2.5. Standard/Universal Precaution

Hand decontamination

According to the Center for Disease Control and Prevention (CDC), hand washing is the single most important means of preventing the spread of infection in the health care setting. It is an extremely effective procedure in preventing many infections that are acquired from the transmission of organisms on the hands (CDC, 2002).

The role of hands in the transmission of hospital infections has been well demonstrated, and can be minimized with appropriate hand hygiene. Hands should be washed between patient contacts and after contact with blood, body fluids, secretions, excretions and equipment or articles contaminated by these. For decontamination purposes, antiseptics recommended are: 2- 4% chlorhexidine, 5-7.5% povidone iodine, 1% triclosan or alcoholic rubs. Alcoholic hand rubs are not a substitute for hand washing, except for rapid hand decontamination between patient contact (WHO, 2002).

Devices decontamination

Non-critical items may be reprocessed between patients with intermediate-level or low-level disinfection or detergent and water washing, depending on the nature of the surface and the degree and nature of the contamination. Sterilization is required for instruments that are classified as critical and semi-critical (CDC, 2003).

If possible sharing of patient care equipment between patients should be avoided. If sharing is necessary, the equipment should be adequately cleaned and disinfected before using on another patient. Pre-cleaning of any medical device is an essential step prior to disinfection (WHO, 2002).

Devices such as stethoscopes and otoscopes should be cleaned with detergent and water and dried and then should be wiped with 70% alcohol (Saloojee and Steenhoff, 2001).

Thermometers should be covered with disposable sleeve before use and stored dry in individual holder. In between patients, should be cleaned and wiped with 70% isopropyl alcohol (swab). If disposable sleeve not used, in between patients, should be washed in general purpose detergent and tepid water then wiped with 70% alcohol (swab). Sphygmomanometer cuffs should be kept in isolation after use, and should be laundered in washing machine. Detergent with enzyme will be used for cleaning endoscopes, surgical instruments before disinfection(WHO, 2002). Ultrasound probes should be simply wiped with a clean, dry, non-sterile paper towel between procedures, but after the final procedure of the day, probes should be cleaned with a liquid cleaning solution such as 0.05% chlorhexidine weight/volume to remove all traces of coupling gel, which could support the overnight growth of bacteria. This would decontaminate the probes and prevent the overnight growth of bacteria *(*Muradalis *et al.*, 1995).

1.3. Significance of the Study

Nosocomial infections (NIs) transmission in the hospital environment remains a significant hazard for hospitalized patients, and healthcare workers are a potential source of these infections, with many pathogens transmitted by hand and stethoscope (WHO,2009). And outbreaks of nosocomial infections have been linked to devices like electronic thermometer, blood pressure cuffs, stethoscopes and otoscopes when they are contaminated (Marie *et al*., 2000; Uneke *et al*., 2008; WHO,2009). Many of the pathogens that cause nosocomial infection have a high level of resistance to most antibiotic therapy (Devrajani *et al*., 2009).

From the medical devices stethoscopes are commonly used to assess the health of patients and have been reported to be potential vectors for nosocomial infections in various parts of the world (Uneke *et al*., 2008 Youngster *et al*.,2008; Maluf *et al*.,2002). Following contact with infected skin, pathogens can attach and establish themselves on the diaphragms of stethoscopes and subsequently be transferred to other patients if the stethoscope is not disinfected (Uneke *et al*., 2010;Madar *et al*.,2005; Whittington *et al*., 2009).

Both the diaphragm and earpieces of physician's personal stethoscopes and bedside stethoscopes are frequently colonized with a variety of pathogenic organisms including Methicillin-resistant *Staphylococcus aureus* (MRSA) and Vancomycin-resistant *Enterococci* (VRE) which cause significant morbidity and mortality on the intensive care unit (ICU) (Bernard *et al*., 1999; Jones *et al*., 1995;Whittington *et al*., 2009; Zachary *et al* 2001) .

Another study also showed that *Staphylococci* were isolated from 47 (85.4%) of stethoscopes and 35 (83.3%) of the otoscopes: *S. aureus* was isolated from 54.5% and 45.2% of the stethoscopes and otoscopes respectively. Of the 19 otoscopes contaminated with *Staphylococcus aureus*, for 16(84.2%) of the stethoscope of the same physician was also positive for that microorganisms. Four isolates (7.3%) from the stethoscopes and four (9.5%) from the otoscopes yielded *Staphylococcus aureus* resistant to Methicillin (Cohen *et al*., 1997).

Even though the transmission of microorganisms to patients via contaminated stethoscope does not necessarily present an immediate high risk for a patient, skin colonization may be lead to potentially serious of wound infections, catheter-related infection or a patient may become a source of infection for other high risk patients, contamination for health care workers, and nosocomial environment contamination (Madar *et al*., 2005).

Many studies have been done regarding the importance of medical devices especially stethoscopes, in harboring different microorganisms and act as a source of nosocomial infections in different part of the world, but no published reports/data are available in Ethiopia to know what types of microbial can colonize otoscopes and stethoscopes in different health institutions.

Therefore, this study was undertaken to determine the bacterial and fungal isolates from otoscopes and stethoscopes used by health care workers at Tikur Anbessa specialized referral hospitals. Findings from this study will be used by HCWs in order to clean otoscopes and stethoscopes effectively to reduce the microbial colonization that responsible for NIs.

1.4. Objectives of the Study

General Objective

- To determine microbial colonization of otoscopes and stethoscopes used by health care workers at Tikur Anbessa Specialized Referral Hospital, Addis Ababa, Ethiopia.

Specific Objectives

- To determine the bacterial and fungal isolates from otoscopes and stethoscopes used by HCWs.
- To assess cleaning trend of otoscopes and stethoscopes used by healthcare workers.
- To determine antibiotic sensitivity pattern of bacterial isolates from otoscopes and stethoscopes.

CHAPTER II: MATERIALS AND METHODS

2.1. Study Design and Area

A hospital based cross-sectional prospective study was conducted at Tikur Anbessa Specialized Referral Hospital, Addis Ababa, Ethiopia. Tikur Anbessa (Black Lion) Hospital is the largest of all the Hospital in Ethiopia and provides a tertiary level treatment and is also open 24 hours for emergency services. This hospital gives services approximately for 370,000- 400,000 patients a year but the exact number is not known and also the Emergency Department gives services for around 80,000 patients per year. They have 560 beds, with 130 specialists, 50 non-teaching doctors. This is the largest teaching hospital for about 300 medical students and 350 Residents every year for the AAU Medical School in Ethiopia (http://www.ethiomedic.com, 2009, accessed on October 25, 2011).

2.2. Sampling technique and sample size of medical devices

Convenient non-probabilistic sampling technique was used in the study to select otoscopes and stethoscopes used by health care workers working at ICU, OPD, Pediatrics Ward, Gynecology Ward and Emergency Department in Tikur Anbessa Specialized Referral Hospital. All stethoscopes (n=130) and otoscopes (n=6) available during the study period (November 2011-April 2012) from the specified department or ward were swabbed and investigated for microbial colonization.

2.3. Sample collection and transport

I. Stethoscope

Swab samples from stethoscope were taken by rubbing the diaphragm as well as the two bells of the stethoscopes with the sterile cotton tip applicators moistened with 2ml of sterile saline solution and put into test tube by the principal investigator. Then the samples were transported immediately to the teaching microbiology laboratory for bacterial and fungal culture.

II. Otoscope

Swab samples from otoscope were taken by rubbing the handle as well as the tips of the otoscopes with the sterile cotton tip applicators moistened with 2ml of sterile saline solution and put into test tube by the principal investigator. Then the samples were transported immediately to the teaching microbiology laboratory for bacterial and fungal culture.

2.4. Bacterial culture and identification

All the swabs were streaked on 5% sheep blood agar (Oxoid Ltd, UK), and MacConkey agar (Oxoid). Blood agar and MacConkey agar plates were incubated at 37°C for 24 to 48 h under aerobic conditions. Organisms were identified by standard microbiological methods, which include colony morphology, as well as gram staining, for all bacterial isolates.

For gram positive bacteria isolates, biochemical tests including catalase and coagulase tests were used for their identification.

For gram negative bacteria isolates biochemical tests such as oxidase tests and API-20E/NE (Biomerieux, France) were used for their identification.

API 20 E is a standardized identification system for Enterobacteriaceae and other non-fastidious, gram negative rods which uses 21 miniaturized biochemical tests and a database. The API 20 E strip consists of 20 microtubes containing dehydrated substrates. These tests are inoculated with a bacterial suspension that reconstitutes the media. During incubation, metabolism produces color changes that are either spontaneous or revealed by the addition of reagents. The reactions are read according to the reading table and the identification is obtained by referring to the Analytical Profile Index or using the identification software.

2.5. Fungal culture and identification

For culturing of fungi, swabs were inoculated on Sabouraud Dextrose Agar (Oxoid Ltd, UK) supplemented with antibiotics (Chloramphenicol) and incubated at room temperature for molds and at 37^{o}c for yeast for 3 to 10days. Once fungal growth was observed, identification of colonies was commonly made using combination of macroscopic &

microscopic examination of growth. Macroscopic examination includes texture, color (surface and reverse), and rate of growth… etc.

For microscopic examination method, gram staining and germ tube test was done for *Candida* species. And also growth of *Candida* species at 45^0Cwas checked for identification of *Candida albican* which is germ tube positive and grow at this temperature. Lacto Phenol Cotton Blue (LPCB) reagent was used to stain mycelia, conidia, and spores of the *Aspergillus* species culture for their microscopic examination. And also growth of these molds was checked at 37^0C and 45^0C for the identification of *Aspergillus flavus*.

2.6. Antimicrobial Susceptibility Testing (AST)

Bacteria isolates was subjected to antibiotic sensitivity tests using disc diffusion method according to the criteria set by the Clinical and laboratory Standards Institute (CLSI) (CLSI,2009) formerly known as the National Committee for Clinical Laboratory Standards (NCCLS). From a pure culture, 3-5 selected colonies of bacteria were taken and transferred to a sterile tube containing 5ml sterile normal saline and shaken gently to make a homogenous suspension and the turbidity of the suspension become adjusted to a McFarland standard of 0.5 by adding more organism if the suspension was too light or diluting with sterile saline if the suspension was too heavy.

This suspension was inoculated within 15 minutes of preparation on Mueller-Hinton agar (MHA) plates (Oxoid Ltd, UK). The inoculated plates were left at room temperature to dry for 3-5 minutes and a set of 12 antibiotic discs (Oxoid) were then delivered on the surface of the plate manually with forceps.

The drugs for the disc diffusion testing used were in the following concentration:- For gram positive bacteria isolates: Ampicillin (AMP) (10 µg), Oxacillin(OX) (1µg), Chloramphenicol (C) (30 µg), Erythromycin (E) (15 µg), and, Vancomycin (VA)(30µg), Trimethoprim+ Sulfamethoxazole (SXT) (25µg), Ceftriaxone (CRO) (30µg), Penicillin G (P) (10units) and Clindamycin (DA) (30µg) antibiotics discs were used..

For gram negative bacteria isolates, Ampicillin (AMP) (10 µg), Chloramphenicol (C) (30 µg), Ciprofloxacin (CIP) (5 µg), Erythromycin (E) (15 µg), Gentamicin (CN) (10 µg), Nalidixic Acid (30µg), Trimethoprim + Sulfamethoxazole (SXT) (25µg) and, Ceftriaxone (CRO) (30µg), (Oxoid Ltd, UK) antibiotics discs were used.

The plates were then incubated at 35^{o}C for 16-18 hours and the diameter of growth inhibition around the discs were measured to the nearest millimeter using a graduated caliper and the isolates were classified as susceptible, intermediate and resistance based on the Clinical and laboratory Standards Institute (CLSI) standardization (CLSI,2009). High, intermediate and low level of resistance is defined when the percentage of resistance is >80%, 60-80% and <60% respectively (CLSI,2009).

2.7. Reference Strains

P.aeruginosa (ATCC-27853), *S.aureus* (ATCC-25923) and *E.coli* (ATCC-25922) were used as a quality control throughout the study for culture and antimicrobial susceptibility testing. All the strains were obtained from Ethiopian Health and Nutrition Research Institute (EHNRI).

2.8. Variables

I. Independent variables

Ward

Gender

Professional rank

Frequency of cleaning

Disinfectant used

II. Dependant variables

Microbial colonization

Antimicrobial Susceptibility pattern

Cleaning habit of medical devices by HCWs

2.9. Statistical analysis

The collected data from each swab culture of otoscopes and stethoscopes and those from study questionnaires were entered in to a Microsoft Excel and analyzed with SPSS version 20.0 software. The level of significance was set at 0.05 in order to consider a p-value <0.05 as indicator of a statistically significant. Difference between proportions of microbial profile among the gender of the owners of stethoscopes and otoscopes, within department, professional ranks of HCWs used the devices, disinfectant used for cleaning and frequency of cleaning of the equipments was analyzed by Pearson Chi-square test/Fisher exact test. Other data collected from otoscopes sampled were analyzed by descriptive statistics.

2.10. Ethical consideration

The M.Sc. research project proposal was ethically cleared by the Department Research and Ethical Review Committee (DREC) and approved by Department of Microbiology, Immunology and Parasitology, School of Medicine, Addis Ababa University. Official permission from the different study site was obtained. Verbal informed consent was obtained from the users of otoscopes and stethoscopes to be involved voluntarily in the study (see Annex III). After obtaining informed consent, study questionnaire was administered to obtain information on otoscopes and stethoscopes (see Annex I).

CHAPTER III: RESULTS

3.1. Sources of Medical Devices

a. Stethoscopes

Sources of stethoscopes investigated for microbial colonization are presented in Table 3.1a. A total of 130 stethoscopes were included in this study. Of the 130 stethoscopes, 88 (67.7%) were from male and 42 (32.3%) were from female health care workers. The owners of the stethoscopes were included nurses 18(13.8%), general practitioners 25(19.2%), resident medical doctors 44(33.8%), interns 28 (21.5%) and other health care workers 15(11.5%). Five departments were included in the study; from Emergency Department 39 (30%), Gynecology ward 21(16.2%), ICU 35(26.9%), OPD 14(10.8%) and Pediatrics wards 21(16.2%) stethoscopes were investigated for microbial colonization.

Table 3.1a. Sources of stethoscopes investigated for microbial colonization in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012).

Professional ranks	Departments/Wards from which the stethoscopes were sampled (No. (%))					Total No. (%)
	Emergency No. (%)	Gynecology No. (%)	ICU No. (%)	OPD No. (%)	Pediatrics No. (%)	
Nurses	6(33.3)	1(5.6)	5(27.8)	4(22.2)	2(11.1)	18(13.8)
General practitioners	10(40.0)	2(8.0)	5(20.0)	3(12.0)	5(20.0)	25(19.2)
Resident medical doctors	8(18.2)	10(22.7)	16(36.4)	7(15.9)	3(6.8)	44(33.8)
Interns	7(25.0)	8(28.6)	5(17.9)	-	8(28.6)	28(21.5)
Others	8(53.3)	-	4(26.7)	-	3(20.0)	15(11.5)
Total	**39(30)**	**21(16.2)**	**35(26.9)**	**14(10.8)**	**21(16.2)**	**130(100.0)**

(**Key**: **Others** in professional rank category represents fifth year Medical students (n=7), Emergency Medicine and Critical care students (n=6) and Anesthesiologist (n=2) health professionals)

b. Otoscopes

Sources of otoscopes investigated for microbial colonization are presented in Table 3.1b**.** A total of 6 otoscopes were included in this study. Of the 6 otoscopes, 2 (33.3%) were from male and 4 (66.7%) were from female health care workers. The owners of the otoscopes were included nurses 5(83.3%), and general practitioners 1(16.7%). Four Departments were included in the study; from Emergency Department 1(16.7%), ICU 1(16.7%), OPD 1(16.7%) and Pediatrics wards 3(50%) otoscopes were investigated for microbial colonization.

Table 3.1b. Sources of otoscopes investigated for microbial colonization in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012).

Professional ranks	**Departments/Wards from which the otoscopes were sampled (No. (%))**					**Total No.(%)**
	Emergency No. (%)	**Gynecology No. (%)**	**ICU No. (%)**	**OPD No.(%)**	**Pediatrics No.(%)**	
Nurses	1(20.0)	-	1(20.0)	1(20.0)	2(40.0)	5(83.3)
General practitioners	-	-	-	-	1(100.0)	1(16.7)
Resident medical doctors	-	-	-	-	-	-
Interns	-	-	-	-	-	-
Others	-	-	-	-	-	-
Total	**1(16.7)**	**-**	**1(16.7)**	**1 (16.7)**	**3(50.0)**	**6(100.0)**

(**Key**: Others in professional rank category represents fifth year Medical students (n=7), Emergency Medicine and Critical care students (n=6) and Anesthesiologist (n=2) health professionals)

3.2. Microbial Colonization of Medical Devices

I. Overall colonization

Of the total of 136 medical devices (6 otoscopes and 130 stethoscopes) sampled, 82 (60.3%) were colonized with different species of bacteria (n=99) and fungi (n=12). From the total of bacterial colonization, gram positive bacteria accounted for 94/99(94.9%) whereas gram negative bacteria accounted for 5/99(5.1%) ($p<0.05$).

II. Stethoscope

Bacterial colonization of stethoscopes

From the 130 stethoscopes sampled and cultured, 70 (53.8%) were positive for bacterial colonization. A total of 95 bacteria were isolated. Out of these, 50 (52.6%) were isolated from the diaphragm and 45 (47.4%) were recovered from the bell of the stethoscope. There was not statistically significant difference in bacterial colonization of bells and diaphragm of stethoscopes ($p>0.05$).

Among the bacteria isolates from the diaphragm and bell of stethoscope, coagulase negative *Staphylococci* (*CoNS*) accounted for 72/95 (75.7%) followed by *S. aureus* 18/95 (18.9%) and *Klebsiella terrigena* 2/95(2.1%), *Erwina species, Flavimonas oryzihabitans* and *Pantoea species* accounted for 1/95 (1.1%) each (Table 3.2).

Fungal colonization of stethoscopes

From the 130 stethoscopes sampled and cultures, 9(6.9%) were positive for fungal colonization. A total of 11 fungi were isolated. Out of the 11 fungi, 5 (45.4%) were isolated from the diaphragm and 6(54.5%) were recovered from the bell of the stethoscope. There was not statistically significant difference in fungal colonization of bells and diaphragm of stethoscopes ($p>0.05$).

Among the fungal isolates from the diaphragm and bell of stethoscope, *Candidia albicans* accounted for 6/11 (54.5%) and *Aspergillus flavus* accounted for 5/11 (45.4%) (Table 3.2)

III. Otoscope

Bacterial colonization of otoscopes

From the 6 otoscopes sampled and cultured, 3 (50%) were positive for bacterial colonization. A total of 4 bacteria were isolated. Out of these, 2 (50 %) were isolated from the handle and the remaining 2 (50%) were recovered from the tips of the otoscope.

Among the bacteria isolates from the handle and tips of otoscopes, coagulase negative *Staphylococci* (*CoNS*) and *S. aureus* accounted for 2/4 (50%) each (Table 3.2).

Fungal colonization of otoscopes

From the 6 otoscopes sampled and cultured, 1 (16.6%) were positive for fungal colonization. The fungus (*Candia albicans*) was isolated only from the tips of otoscope (Table 3.2).

Table 3.2. Type of microorganisms isolated from stethoscopes and otoscopes in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012).

Isolates	Stethoscopes (n=130)			Otoscopes (n=6)		
	Bells	Diaphragm	**Total**	Handle	Tips	**Total**
1. Bacteria	No. (%)	No. (%)	**No. (%)**	No. (%)	No. (%)	**No. (%)**
Coagulase Negative *Staphylococcus*	36(37.9)	36(37.9)	**72(75.7)**	1(25.0)	1(25.0)	**2(50.0)**
Staphylococcus aureus	8(8.4)	10(10.5)	**18(18.9)**	1(25.0)	1(25.0)	**2(50.0)**
Klebsiella terrigena	1(1.1)	1(1.1)	**2(2.1)**	-	-	-
Erwina species	-	1(1.1)	**1(1.1)**	-	-	-
Pantoea species	-	1(1.1)	**1(1.1)**	-	-	-
Flavimonas oryzihabitans	-	1(1.1)	**1(1.1)**	-	-	-
Total No. (%)	**45(47.4)**	**50(52.6)**	**95(100)**	**2(50.0)**	**2(50.0)**	**4(100)**
2. Fungi						
Candida albicans	3(27.3)	3(27.3)	**6(54.5)**	-	1(16.7)	**1(16.7)**
Aspergillus flavus	3(27.2)	2(18.2)	**5(45.4)**	-	-	-
Total No. (%)	**6(54.5)**	**5(45.4)**	**11(100)**	-	**1(16.7)**	**1(16.7)**

3.3. Sources of Medical devices and Microbial colonization

I. Health Care Workers (HCWs)

a. HCWs versus stethoscopes microbial colonization

Microbial colonization rate of stethoscopes obtained from different health care workers (HCWs) in Tikur Anbessa Specialized Referral Hospital are presented in Table 3.3a. Of 88 stethoscopes swabbed from male HCWs, 56/88(63.6%) were positive for microbial culture and from that of 42 stethoscopes swabbed from female HCWs, 23/42(54.8%) were positive for microbial culture. Microbial colonization rate of stethoscopes among the gender of HCWs were similar ($p>0.05$).

Of the total of stethoscopes sampled (n=130) and became culture positive for microbial colonization (n=79), 10/18(55.6%) were from nurses, 13/25(52.0%) were from general practitioners, 31/44(70.5%) were from resident medical doctors, 16/28(57.1%) were from interns and, 9/15(60.0%) were from other HCWs. The difference in microbial colonization rate among different professional ranks of health care personnel was not statistically significant ($p>0.05$).

Table 3.3a. Microbial colonization rate of stethoscopes obtained from different HCWs in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012)

Professional rank	Gender				**Total**	
	Male		Female			
	No.	No. (%) Culture +ve	No.	No. (%) Culture +ve	**No.**	**No. (%) Culture +ve**
Nurses	9	4(44.4)	9	6(66.7)	**18**	**10(55.6)**
General practitioners	20	11(55.0)	5	2(40.0)	**25**	**13(52.0)**
Resident medical doctors	36	26(72.2)	8	5(62.5)	**44**	**31(70.5)**
Interns	12	7(58.3)	16	9(56.3)	**28**	**16(57.1)**
Others	11	8(72.7)	4	1(25.0)	**15**	**9(60.0)**
Total	**88**	**56(63.6)**	**42**	**23(54.8)**	**130**	**79(60.8)**

(**Key**: Others in professional rank category represents fifth year Medical students (n=7), Emergency Medicine and Critical care students (n=6) and Anesthesiologist (n=2) health professionals)

b. **HCWs versus otoscopes microbial colonization**

From the total of 6 otoscopes, 4 otoscopes were swabbed from female HCWs. Out of this 3/4(75%) were positive for microbial culture. The remaining 2 otoscopes were swabbed from male HCWs and none of them was positive for microbial culture ($p<0.05$). Of the 5 otoscopes swabbed from nurses, 3(60%) were positive for microbial culture and from one otoscope swabbed from general practitioners, no microbial growth was observed. The difference was not statistically significant ($p>0.05$) (data not shown).

II. Wards

a. Wards versus Stethoscopes microbial colonization

Microbial colonization rate of stethoscopes in different wards of Tikur Anbessa Specialized Referral Hospital are presented in Table 3.3b. Of the total of stethoscopes sampled (n=130) and became culture positive for microbial colonization (n=79), 26/39(66.7%) were from Emergency Department, 12/21(57.1%) were from Gynecology ward, 25/35(71.4%) were from ICU, 6/14(42.9%) were from OPD and, 10/21(47.6%) were from Pediatrics ward. The difference in microbial colonization of stethoscopes among different wards or departments were not statistically significant (P>0.05).

Table 3.3b. Microbial colonization rate of stethoscopes from different wards in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012)

Departments or wards	Stethoscopes sampled from each ward (No.)	Stethoscopes with positive culture from each ward (No. (%))
ED	39	26(66.7%)
Gynecology ward	21	12(57.1%)
ICU	35	25(71.4%)
OPD	14	6(42.9%)
Pediatrics ward	21	10(47.6%)
Total	**130**	**79(60.8)**

Key: ED: Emergency Department, ICU: Intensive Care Unit, OPD: Out patients Department

b. Wards versus Otoscope microbial colonization

Of the 3 otoscopes swabbed from Pediatrics ward, 1/3(33.3%) was positive for microbial culture. Each otoscope swabbed from OPD and ICU was culture positive for microbial culture. One otoscope swabbed from Emergency Department was culture negative for microbial colonization. The difference among the interdepartmental was not statistically significant for microbial colonization of otoscopes (P>0.05) (data not shown).

3.4. HCWs cleaning habit of medical devices between patients examination

Microbial colonization rate of stethoscopes in relation to cleaning practice between patient examinations by HCWs in Tikur Anbessa Specialized Referral Hospital are presented in Table 3.4a. Of the 11 stethoscopes cleaned between patients examination and swabbed, 5(45.5%) was culture positive and of the 119 stethoscopes not cleaned between patients examination and swabbed, 74(62.2%) was culture positive for microbial growth. The difference in microbial colonization rate between stethoscopes that cleaned and not cleaned between patients examination was statistically significant (P<0.05).

Of the total of 130 health care workers from which 130 stethoscopes were sampled, 1/28 (3.6%) of interns, 1/25(4%) of general practitioners, 3/44(6.8%) of resident medical doctors, 3/18(16.7%) of nurses and 3/15(20%) of other HCWs were cleaned their stethoscopes between each patient examination. The difference between professional rank for cleaning stethoscopes was statistically significant (p<0.05) (data not shown).

Of the 6 otoscopes sampled, 3(50%) were cleaned between patients examination, of them 1/3 (33.3%) was culture positive. The rest 3(50%) otoscopes were never cleaned, of them 2(66.7%) were culture positive. The difference was statistically significant (p<0.05) (data not shown).

Table 3.4a. Microbial colonization rate of stethoscopes in relation to cleaning practice between patient examinations by HCWs in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012)

cleaning between patient examination	Stethoscopes sampled No. (%)	Stethoscopes with positive culture No. (%)
Yes	11 (8.5)	5(45.5)
No	119(91.5)	74(62.2)
Total	**130(100)**	**79(60.8)**

Frequency of cleaning versus microbial colonization of otoscopes and stethoscopes

Of the total of 130 stethoscopes sampled for this study from different health care personnel, 27/130(20.7%) were cleaned daily, 22/130(16.9%) were cleaned weekly, 35/130(26.9%) were cleaned monthly, 26/130(20.0%) were never cleaned and 9/130(6.9%) were cleaned irregularly. The remaining 11(8.5%) stethoscopes were cleaned between different patient's examinations. From the stethoscopes swabbed, 13/27 (48.1%), 12/22 (54.5%), 24/35(68.9%),19/26 (73.1%), and 6/9(66.7%) were culture positive for microbial growth for that cleaned daily, weekly, monthly, never cleaned and that cleaned irregularly respectively. The difference in microbial colonization rate of the stethoscopes in relation to frequency of cleaning was statistically significant ($p<0.05$).

Table 3.4b. Microbial colonization rate of stethoscopes in relation to frequency of cleaning of stethoscopes by HCWs in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012)

Frequency of stethoscopes cleaning	Stethoscopes sampled from different HCWs No. (%)	Stethoscopes with culture positive No. (%)
Between patient examination	11(8.5)	5(45.5)
Once daily	27(20.7)	13(48.1)
Once weekly	22(16.9)	12(54.5)
Once monthly	35(26.9)	24(68.6)
Never cleaned	26(20.0)	19(73.1)
Other	9(6.9)	6(66.7)
Total	**130(100)**	**79(60.8)**

(Key: Others under the frequency of cleaning represent cleaning irregularly).

Of the 6 otoscopes sampled, 3(50%) were cleaned between patients examination, of them 1/3 (33.3%) was culture positive. Two otoscopes (33.3%) were never cleaned and all were

culture positive and the remaining 1/6 (16.7%) was cleaned daily and no growth was observed. The difference was statistically significant ($p<0.05$) (data not shown).

Reason not for cleaning otoscopes & stethoscopes between patients examinations

Of the 119/130(91.5%) HCWs, who were not practiced cleaning of stethoscopes between patients examinations; from the reason not for cleaning they answered to the questionnaire, because of work overload accounted for 50 (38.5%), antiseptic shortage accounted for 18 (13.8%) and negligence accounted for 51(39.2%).

Of the 6 otoscopes sampled from 6 health care workers, 3(50%) were cleaned between patients examinations and the 3(50%) were not cleaned between patients examinations. From the reason not for cleaning between patients examinations, work overload accounted for 1(16.7%) and negligence accounted for 2(33.3%).

3.5. Disinfectant used versus microbial colonization of medical devices

a) Stethoscope

Microbial colonization rate of stethoscopes in relation to use of disinfectant are presented in Table 3.5. Of 130 stethoscopes sampled, 105(80.8%) were cleaned with disinfectant, out of this, 60(57.1%) was culture positive.

Of 130 stethoscopes sampled, 25(19.2%) were not cleaned with any disinfectant, out of this 19(76.0%) were culture positive. The difference in culture positivity of those cleaned and those not cleaned with disinfectant were statistically significant ($p<0.05$).

Of the 94 stethoscopes cleaned with alcohol, 53/94(56.4) were culture positive and of 11 stethoscopes cleaned with soap and water, 7/11(63.6) were culture positive. The difference between alcohol and (soap and water) was not significant for colonization ($p>0.05$).

b) Otoscope

Of the 6 otoscopes sampled, 4(66.7%) were cleaned with alcohol, of them 1/4(25%) was culture positive and of 2 otoscopes that were not cleaned with any disinfectant, 2/2 (100%) were culture positive. The difference in microbial colonization between those cleaned with alcohol and not cleaned with any disinfectant was statistically significant ($p<0.05$) (data not shown).

Table 3.5. Microbial colonization rate of stethoscopes in relation to use of disinfectant in Tikur Anbessa Specialized referral Hospital (November 2011-April 2012)

Types of disinfectant used for cleaning stethoscopes	Stethoscopes sampled from different HCWs No. (%)	Stethoscopes with positive culture No. (%)
Alcohol 70%	94(72.3)	53(56.4)
Soap and water	11(8.5)	7(63.6)
Nil	25(19.2)	19(76.0)
Total	**130(100)**	**79(60.8)**

3.5. Antimicrobial susceptibility of bacterial isolates

I. Gram positive bacteria isolated from otoscope and stethoscope

The antibiotic sensitivity testing indicated that all *S. aureus* isolated were tested 100% susceptible for Clindamycin and Vancomycin, and showed low level of resistance (<60%) for Oxacillin, Erythromycin, Penicillin G, Trimethoprim-sulfamethoxazole, Ampicillin, Chloramphenicol, and Ceftriaxone antibiotics. And all *CoNS* isolated were showed low levels of resistant (<60%) against all tested antibiotics. The most effective antibiotics for almost all gram positive isolates were Clindamycin and Vancomycin (Table 3.6a).

Multi drug resistance (resistance to two or more drugs) was observed in all isolates of *S.aureus* against all antibiotics except for Clindamycin and Vancomycin. All isolates of *CoNS* were showed multi drug resistance for all antibiotics tested against them.

II. Gram negative bacteria isolated from stethoscope

Gram negative bacteria isolated were showed intermediate level of resistance (60-80%) for Erythromycin, Ampicillin and Trimethoprim-sulfamethoxazole, and low level of resistance (<60%) for Chloramphenicol, Ceftriaxone, Ciprofloxacin and Nalidixic Acid, but susceptible for Gentamicin. Therefore, for gram negative isolates of bacteria, Gentamicin was effective (Table 3.6b). All gram negative bacteria isolated from stethoscopes were showed multi drug resistance for all antibiotics except for Gentamicin.

Table 3.6a. Antimicrobial susceptibility of gram positive bacteria isolated from otoscopes and stethoscopes in Tikur Anbessa Specialized Referral Hospital (November 2011 –April 2012)

Isolates		**Antimicrobial agents (%)**								
		AMP	C	CRO	DA	E	OX	P	SXT	VA
S.aureus(n=20)	I	30	20	65	-	5	5	10	10	-
	R	10	5	15	-	10	10	30	30	-
	S	60	75	20	100	85	85	60	60	100
CoNS(n=74)	I	47.3	-	12.2	-	4.1	2.7	39.2	6.8	-
	R	28.4	28.4	25.7	2.7	20.3	28.4	44.6	27.0	1.4
	S	24.3	71.6	62.2	97.3	75.7	68.9	16.2	66.2	98.6
Total (n=94)	**I**	**43.6**	**4.3**	**23.4**	**-**	**4.3**	**3.2**	**32.9**	**7.5**	**-**
	R	**31.1**	**23.4**	**23.4**	**2.1**	**18.1**	**24.5**	**41.5**	**27.6**	**1.1**
	S	**31.9**	**72.3**	**53.2**	**97.9**	**77.7**	**72.3**	**25.5**	**64.9**	**98.9**

I=Intermediate, R=Resistant, S=Susceptible,
CoNS=Coagulase Negative Staphylococci,
DA=Clindamycin, VA=Vancomycin, OX= Oxacillin, P=Penicillin G,
AMP=Ampicillin, C= Chloramphenicol, E=Erythromycin,
SXT= Trimethoprim- Sulfamethoxazole, CRO=Ceftriaxone

Table 3.6b. Antimicrobial susceptibility of gram negative bacteria isolated from stethoscopes in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012).

Isolates		Antimicrobial agents (%)							
		AMP	C	CIP	CN	CRO	E	NA	SXT
Erwina species	I	100	100	-	-	-	100	-	-
(n=1)	R	-	-	-	-	-	-	-	-
	S	-	-	100	100	100	-	100	100
F. oryzihabitans	I	-	100	-	-	100	-	-	-
(n=1)	R	100	-	100	-	-	100	100	100
	S	-	-	-	100	-	-	-	-
K.terrigena (n=2)	I	-	-	100	-	-	-	100	-
	R	100	100	-	-	100	100	-	100
	S	-	-	-	100	-	-	-	-
Pantoeas species	I	-	-	-	-	-	-	-	-
(n=1)	R	100	-	100	-	-	100	100	100
	S	-	100	-	100	100	-	-	-
Total (n=5)	**I**	**20**	**40**	**40**	**-**	**20**	**20**	**40**	**-**
	R	**80**	**40**	**40**	**-**	**20**	**80**	**40**	**80**
	S	**-**	**20**	**20**	**100**	**60**	**-**	**20**	**20**

I=Intermediate, R=Resistant, S=Susceptible,
AMP=Ampicillin, C= Chloramphenicol, E=Erythromycin, CIP=Ciprofloxacin, SXT= Trimethoprim- Sulfamethoxazole, CN=Gentamicin, CRO=Ceftriaxone NA=Nalidixic Acid,

CHAPTER IV: DISCUSSION

It is known that in health institutions, hands of the hospital staff, medical equipment such as endoscopes, thermometers, ultrasound probes, stethoscopes, otoscopes, etc. may all serve as the reservoir for microorganisms which may be responsible for nosocomial infections (Cohen *et al*.,1997; Parmar *et al*., 2004;Maluf *et al*.,2002;Zachary *et al* 2002). Especially, stethoscopes are the most frequently used medical devices as reviewed in previous reports (Kilic *et al*., 2011). Because stethoscopes have always been part of the physicians' basic equipment when examining the patients, it has recently been shown to harbor various organisms on their diaphragm surfaces with coagulase negative *Staphylococci* as the predominant isolate (Marie *et al*., 2000). Many of the pathogens that cause nosocomial infection have a high level of resistance to an antibiotic therapy; some of the major concerns are Methicillin Resistant *Staphylococcus aureus* (MRSA), Vancomycin-Resistant *Enterococci* (VRE), and Extended spectrum beta lactamase resistance (ESBL) *Enterobacteriaceae* (Devrajani *et al*., 2009). Therefore knowledge of the pattern of microbial isolates and antimicrobial susceptibility pattern of bacteria isolates from medical devices is useful to prevent nosocomial infections.

Although some research report is available worldwide (Uneke *et al*., 2010; Kilic *et al.*, 2011; Cohen *et al*., 1997; Nunez *et al*., 2000), but no reports are available on microbial profile of otoscopes and stethoscopes in Ethiopia. The present study was undertaken to highlight the pattern of microbial isolates from otoscopes and stethoscopes at Tikur Anbessa Specialized Referral Hospital. An attempt also has been made to know antimicrobial susceptibility pattern of bacteria isolates and cleaning trends of otoscopes and stethoscopes by HCWs.

In the present study, out of 136 of the medical devices (6 otoscopes and130 stethoscopes) sampled, 60.3% of them were colonized by microbial. This is in agreement with other study (Genné *et al.*, 1996).

Of the 60.3% total colonization, gram positive bacteria accounted for 94.9% whereas gram negative bacteria accounted for 5.1% and fungi accounted for 10.8%. This result is comparable with other studies (Genné *et al*., 1996; Kilic *et al*., 2011; Pimenfez, 2006).

In the present study, out of 130 stethoscopes, 60.8% of them were colonized by microbial. This is comparable with other study (Genné et al., 1996). But the present study result was showed lower contamination (60.8%) of stethoscopes than the previous studies results which were showed 76% (Kilic *et al*., 2011) and 79% (Uneke *et al*., 2010) colonization of stethoscopes. This is probably due to single study site as well as different HCWs rank were included in the present study when compared with previous study that involved different study sites but only nurses and doctors were involved.

Of the total 60.8% colonization of stethoscopes, bacteria accounted for 53.8% and fungi accounted for 6.9%. Among the bacteria isolates of the stethoscopes, 52.6% were isolated from the diaphragm and 47.4% were recovered from the bells parts of the stethoscopes. The difference in the colonization of diaphragm and bells parts is comparable with previous study in which 89.65% of diaphragm and 65.65% of bells were showed colonization (Bhatta *et al*., 2011). Among the bacterial isolates from stethoscopes, coagulase negative *Staphylococci* (*CoNS*) accounted for 75.7% followed by *S.aureus* 18.9% and few gram negative bacteria. This result is comparable with other studies (Genné *et al*., 1996; Kilic *et al*., 2011; Pimenfez, 2006). Of the total 6.9% of stethoscopes fungal colonization, 45.4% were isolated from the diaphragm and 54.5% were isolated from bells which include 54.5% *Candida albicans* and 45.4% *Aspergillus flavus*. This result is in agreement with other study (Kilic *et al*., 2011).

In the present study, 50% of otoscopes were colonized by gram positive bacteria and fungi. Of the 50% of otoscopes microbial colonization, 50% *Staphylococcus aureus*, 50% *Coagulase negative Staphylococcus* and 16.7% of *Candida albican* were isolated. The colonization rate of otoscopes was showed lower (50%) in contrast to the previous study done in which 90% of otoscopes sampled were colonized. But types of bacteria isolates in the present study are in agreement with the study (Cohen *et al*., 1997). In previous study, the otoscopes were sampled only from Pediatrics physician who might be used it frequently. But in the present study, otoscopes were sampled from different HCWs and this might bring the low colonization of stethoscopes.

In this study, microbial colonization of 63.6% and 54.8% of stethoscopes sampled from male and female health care workers respectively, were investigated. This result is in agreement with previous study done in Turkey (Kilic *et al*., 2011).

Among different professional ranks of HCWs for microbial colonization of stethoscopes, 55.6% were from nurses, 52.0% were from general practitioners, 70.5% were from resident medical doctors, 57.1% were from interns and 60.0% were from other HCWs. This is comparable with previous study done in Canada which revealed that degree of contamination of stethoscopes according to professional rank was not microbiologically different (Nunez *et al*., 2000). Even though not significant in the present study result, microbial colonization of stethoscopes among residents was somewhat higher than others. This difference may be explained in the future study.

In the present study, of the total microbial colonization, 66.7% of stethoscopes from Emergency Department, 57.1% of stethoscopes from Gynecology Ward, 71.4% of stethoscopes from ICU, 42.9% of stethoscopes from OPD and, 47.6% of stethoscopes from Pediatrics ward were showed microbial colonization. The predominant type of bacteria isolated were *CoNS* for all wards. This is in agreement with the study done in India in which the predominant type of organisms isolated on the stethoscope was not dependent upon the department (Parmar *et al*., 2004). Although not significant among different wards, more colonization of stethoscopes was observed in ICU followed by Emergency Department in the present study. This is probably due to frequent contact of critically ill patients admitted in ICU and Emergency Department with stethoscopes for their follow up case by HCWs.

In this study, of the total 50% colonization of otoscopes, all were from female HCWs. And also all 50% colonization was observed from otoscopes sampled from nurses. Regarding different wards, one otoscope from ICU, OPD and Pediatrics ward (one from each) were showed microbial colonization. To compare the results, no published reports are available.

From the present study, microbial colonization of 45.5% of stethoscopes cleaned between patients' examination and 62.2% of stethoscopes not cleaned between patients examination were investigated. This is, in line with study done in Nigeria, of which 25.0% of

stethoscopes that cleaned and 87.9% of that not cleaned between patients examination were colonized by bacteria (Uneke *et al*., 2010).

In this study, among different HCWs rank, more proportion of nurses (16.7%) and other HCW (20.0%) were cleaned their stethoscopes between each patient examination than others HCWs. This is in agreement with previous study done in Canada that revealed nurse staff cleaned it more frequently than other HCWs (Nunez *et al*., 2000). In contrast to this result, residents practices disinfection of their stethoscopes more frequently than other groups in other study (Marie *et al*., 2000). The explanation for the difference will need further studies.

In this study, microbial colonization of 48.1%, 54.5%, 68.6%, 73.1%, 66.7% of stethoscopes that cleaned daily, weekly, monthly, never cleaned and cleaned irregularly respectively, were investigated. And for otoscopes all (33.3%) that were never cleaned were colonized. This is in agreement with other study that for more than one day without cleaning of the stethoscope, the level of contamination rose from 0% to 69% (Genné *et al*., 1996).

In the present study, many HCWs did not clean their stethoscopes between patients examination because of the reason ranked as 39.2% were due to negligence, 38.5% were due to work overload, and 13.8% were due to antiseptic shortage. And for otoscopes the reason not for cleaning ranked as 33.3% were due to negligence and 16.7% were due to work overload. This is comparable with other study (Grecia *et al*., 2008). In contrast to the present study result, in previous study done; lack of formal education ,hospital protocol on the subject matter and shortage of positive role models were identified as a reason (Burrie, 2011).

According to the present study result, 56.4% of stethoscopes cleaned with alcohol, 63.6% of that cleaned with soap and water and 76.0% of that not cleaned with any disinfectant were colonized. In addition, 25.5% of otoscope cleaned with alcohol and 33.3% of otoscopes that were not cleaned with any disinfectant were colonized. This is in agreement with previous study (Wood *et al*., 2007). The present study result also in agreement with other study

report, in which alcohol reduced significantly bacterial colonization of stethoscopes and otoscopes (Cohen *et al*., 1997; Uneke *et al*., 2010; Kilic *et al*., 2011).

In the present study, *S.aureus* isolated from otoscopes and stethoscopes were tested 100% susceptible for Clindamycin and Vancomycin, and showed low level of resistance (<60%) for Oxacillin, Erythromycin, Penicillin-G, Trimethoprim-sulfamethoxazole, Ampicillin, Chloramphenicol, and Ceftriaxone antibiotics. Similar findings were also observed in the previous study done in Nigeria in which *S.aureus* showed the least resistance, being susceptible to other antibiotics (Uneke *et al*. 2010).The present study is also in agreement with other study done in Australia in which all *S. aureus* isolates were found to be susceptible to Vancomycin (Schabrun,2006).

In contrast to the present study results, about 96.1% of *Staphylococcus aureus* were susceptible to Erythromycin and their susceptibility against Cotrimaxazole is less (Farzana *et al*.,2004). This is probably due to strain difference of *S.aureus* in different countries. In addition to this, all *CoNS* isolated were showed low levels of resistant (<60%) against all tested antibiotics and about 68.9% of isolates were susceptible for Oxacillin. The present study is in agreement with other study that indicated 68% *CoNS* isolates were sensitive for Cloxacillin (Parmar *et al*., 2004).

Multidrug resistance was observed in all isolates of *S. aureus* for all antibiotics except for Clindamycin and Vancomycin. And all isolates of *CoNS* were showed multi drug resistance for all antibiotics tested against them. Similar findings were indicated in other study done in Nigeria that *Staphylococcus* species isolated from the environment showed multiple antibiotic resistance against Cotrimoxazole, Chloramphenicol, and Erythromycin (Fagade *et al*. 2010). But for Vancomycin, only 1.4% of *CoNS* were showed resistance in the present study. In line with study done in West India in which no Vancomycin resistance was found in *CoNS* (Akpaka *et al*., 2006). In contrast to the present study, in other study, no strain of *S.aureus* was sensitive to all 16 antibiotics (Chigbu and Ezeronye, 2003). This difference is probably due to variation in prevalence of resistance strains between different countries.

Gram negative bacteria isolated from stethoscopes were showed intermediate level of resistance (60-80%) for Ampicillin, Erythromycin and Trimethoprim-sulfamethoxazole, and low level of resistance (<60%) for Chloramphenicol, Ceftriaxone, Ciprofloxacin and Nalidixic Acid, but 100% susceptible for Gentamicin. Similarly, in study done in France, *Erwina persicina* conferred resistance or intermediate susceptibility to Ceftriaxone (Vimont *et al*., 2002). The present result is also in agreement with other study done in Taiwan in which all *Flavimonas oryzihabitans* isolates were susceptible to Gentamicin, and ciprofloxacin (Lin *et al*.,1997). Similarly, in study done in Italy, *Pantoea agglomerans* isolates were showed susceptible for Gentamicin (Liberto *et al*.,2009).

Generally, it is difficult to compare antibiotic resistance pattern between countries because of the difference in strains of bacteria isolates and variability in drugs used. And also only few studies have been done on susceptibility tests of bacterial isolates from stethoscopes as well as from otoscopes.

CONCLUSION AND RECOMMENDATIONS

Both pathogenic and non-pathogenic microbial were colonized otoscopes and stethoscopes. The isolates of both otoscopes and stethoscopes include *CoNS, S.aureus*, few gram negative bacterial and fungal species of *Candida albicans* and *Aspergillus flavus.* More microbial colonization was detected on the stethoscopes and otoscopes cleaned less frequently by HCWs. Microbial colonization of otoscopes and stethoscopes among different wards and HCWs were similar. All *CoNS and S. aureus* isolated were showed low levels of resistant (<60%) against all tested antibiotics (except for *S. aureus*, 100% susceptible for Clindamycin and Vancomycin). For almost all isolates of gram positive bacteria, Clindamycin and Vancomycin were effective according to the present study result. Gram negative bacteria isolated were showed intermediate level of resistance (60-80%) for Ampicillin, Erythromycin and Trimethoprim-sulfamethoxazole, and low level of resistance (<60%) for Chloramphenicol, Ceftriaxone, Ciprofloxacin and Nalidixic Acid, but susceptible for Gentamicin. According to the present study result for gram negative isolates of bacteria, Gentamicin was effective.

Based on the findings of the present study, the following recommendations are made: -

- There is a need for formulating standards schedule for cleaning the stethoscopes and otoscopes by health care personnel
- There is a definite need for further studies which will cover large sample size with different study sites in the country to generalize the microbial colonization of otoscopes and stethoscopes and susceptible patterns of their bacterial isolates.
- There is a definite need for the prevention of NIs related to these devices. Therefore, the users of otoscopes and stethoscopes should take into consideration that these device could serve as a vehicle for microbial colonization.

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ANNEX I: QUESTIONNAIRE

Questionnaire for investigation of the microbial profile and pattern of antimicrobial resistance of bacteria colonization of Otoscopes, and Stethoscopes at Tikur Anbessa Specialized Referral Hospital, Addis Ababa, Ethiopia:

Part one: To be filled by Health care workers

I. Users of the stated devices Identification

Serial No …… Date…….

Sex: 1) Male 2) Female

Working site 1) Inpatient ward 2) Outpatient Dep't

A) ICU C) Pediatric ward

B) OPD D) Emergency Department

Other: Specify it ……

II. Professional rank:

A) General Practitioners/ (GP)

B) Specialists (Physician)

C) Nurses

D) Resident Medical doctor

Others: please specify: ----------

III. Do you have your own a) Stethoscope? Yes/No,

b) Otoscope? Yes /No,

IV. Do you clean your devices after examining each patient?

Yes/ No, if No, why? .....

- If your answer is "no" for question IV above, proceed to the question number V below!

V. How often do you clean your devices? Choose your answer!

A. Once daily
B. Twice a week
C. Once weekly
D. Once monthly
E. Never
F. Not known
Other: specify it----------

- If your answer is "never" for question V above, no need to answer the next question!

VI. If you clean, what agent/disinfectant did you use to clean your devices?

A. Soap and water
B. Alcohol 70%
C. Others: please specify----------

VII. Status of Stethoscope and Otoscope at the time of sample collection (i.e. whether it is cleaned or not when sampled by PI)

Have you been cleaned it now? Yes No

If **yes** with what agent did you cleaned it----------

Part two: Laboratory data

I. Type of sample and examination result

- Date of specimen collection……...Type of sample collected……
- Swabs from stethoscopes':

  Diaphragm……. ……Bell……..
- Swabs from otoscopes':

  Tips…….. Handle…….
- Result of Gram Staining: ……
- Lacto phenol cotton blue result……
- Germ tube test result ……
- Thermo-tolerant growth test…….

II. Culture of the microorganisms from:

A. Otoscopes

- Growth of Bacteria on Blood agar plate result ……
- Growth of Bacteria on MacConkey agar plate result……
- Growth fungi on SDA agar plate result……
- Name of bacteria isolated ……
- Name of fungi isolated ……

B. Stethoscopes

- Growth on Blood agar plate result …….
- Growth on MacConkey agar plate result……
- Growth of fungi on SDA agar plate result……
- Name of bacteria isolated …….
- Name of fungi isolated ……

III. Biochemical tests

No.	Types of biochemical test	Results (as +/-)	Name of isolate
1	Catalase test		
2	Coagulase test		
3	Oxidase test		
4	API 20E test for Enterobacteriaceae		

IV. Antimicrobial Susceptibility Testing (AST**)**

Name of bacteria isolated: ……

Drugs	Sensitive (mm)	Intermediate(mm)	Resistant(mm)
Ampicillin (AMP)(10µg)			
Ceftriaxone (CRO) (30µg))			
Chloramphenicol (C) (30µg)			
Ciprofloxacin (CIP)(5µg))			
Clindamycin (DA) (30µg)			
Gentamicin (CN) (10µg))			
Erythromycin (E)(15µg)			
Oxacillin (OX)(1µg))			
Penicillin G (P)(units)			
Vancomycin (VA)(30 µg)			
Trimethoprim-sulfamethoxazole (SXT)(25µg)			
Nalidixic Acid NA(30µg)			

Comment: ----------

Signature of principal investigator _____Date:_____

ANNEX II: INFORMATION SHEET FOR HCWs (English and Amharic Version)

You are kindly invited to participate in this study, which involves Otoscopes and Stethoscopes available at Tikur Anbessa Specialized Referral Hospital which you are using for patients' examination. The aim of this study is to assess microbial colonization of Otoscopes and Stethoscopes and susceptibility pattern of bacteria isolates from these devices. Colonization of these devices with different microorganism can make it a vehicle for nosocomial infectious diseases transmission in hospital. So that paying attention for proper disinfection of these devices will prevent cross infection between different patients in the health care settings.

A. Purpose: the purpose of this research study is to assess microbial colonization of Otoscopes and Stethoscopes and susceptibility pattern of bacteria isolates from these devices at Tikur Anbessa Specialized Referral Hospital, Addis Ababa, Ethiopia.

B. Duration: the duration of this study can probably take about four months.

C. Procedures to be carried on: the procedure of sample collection is easy and straight forward; **Swab** sample will be collected by Principal Investigator (PI) both from Otoscopes and Stethoscopes with cotton swab with tip applicators moistened in sterile physiological saline and then it will be analyzed in the microbiology laboratory of Tikur Anbessa Specialized Referral Hospital for the presence of bacteria and fungi.

D. Risk and discomfort: No risk at all; since sample will be collected from devices not from human being.

E. Expected benefits: from this study you are directly benefited to prevent yourself and your patient from device associated cross infection.

F. Confidentiality: All your personal information collected for the purpose of the present study will be kept confidential.

G. Compensation: No compensation will be provided by participating in this study.

H. Termination of the study: Participation in the study is voluntary, and refusal to participate involves no penalty or loss of benefits to which you are otherwise entitled. The owners of the study devices have a right to

- Keep hold information
- Decline to cooperate in the study
- To refuse provision of devices from which swab will be collected

I would also like to inform you that this study will be approved by Department Ethical and Review Committee, Faculty of Medicine Addis Ababa University. If you have any question about the right of the owners of study devices, the address is:

College Health Sciences, Addis Ababa University

Office of Associate Dean, Postgraduate Programs and Research

P.O. Box 9086. Addis Ababa, Ethiopia

Tel. 251-11-551-28-765

If you have question about the study, the address of the principal investigator is:

Regea Dabsu

Department of Microbiology, Immunology and Parasitology

College Health Sciences, Addis Ababa University

P.O.Box. 9086, Addis Ababa, Ethiopia

Tel: 251-917-844-345

የ ጥ ና ቱ ተ ሳ ታ ፊ ዎ ች የ መ ረ ጃ ቅ ጽ

ጥ ና ቱ የ ሚ ካ ሄ ደ ው በ ጥ ቁ ር አ ን በ ሳ ሆ ስ ፒ ታ ል ሲ ሆ ን ጥ ና ቱ የ ሚ ያ ተ ኩ ረ ው የ ጤ ና ባ ለ ሙ ያ የ ሚ ሰ ሩ በ ት ን በ አ ቶ ስ ኮ ፒ እ ና እ ስ ቴ ቶ ስ ኮ ፒ ላ ይ ሊ ኖ ሩ የ ሚ ች ሉ ት ን ተ ዋ ህ ሲ ያ ን ን ለ መ ለ የ ት እ ና የ ባ ክ ቴ ሪ ያ መ ድ ሃ ኒ ት መ ቋ ቋ ም ባ ህ ር ያ ቸ ው ን ማ ጥ ና ት ይ ሆ ና ል ፡ ፡

በ ዚ ህ መ ሳ ሪ ያ ላ ይ ሊ ኖ ሩ የ ሚ ች ሉ ተ ህ ዋ ስ ያ ን በ ጤ ና ተ ቋ ም ው ስ ጥ በ በ ሽ ተ ኞ ች ላ ይ ተ ጨ ማ ሪ በ ሽ ታ ን ሊ ያ ስ ከ ት ሉ እ ን ዲ ሁ ም ከ በ ሽ ተ ኛ ወ ደ ጤ ና ባ ለ ሙ ያ በ ሽ ታ ን ሊ ያ ስ ተ ላ ል ፍ ይ ች ላ ሉ ፡ ፡ ስ ለ ሆ ነ ም መ ሳ ሪ ያ ው በ አ ግ ባ ቡ ሁ ሌ ከ ታ ጠ በ ይ ህ ን ተ ህ ዋ ስ ያ ን ሊ ወ ገ ዱ ስ ለ ሚ ች ሉ በ ዚ ህ መ ን ገ ድ የ ሚ መ ጣ ው ን በ ሽ ታ ን ለ መ ከ ላ ከ ል ይ ረ ዳ ል ፡ ፡

ስ ለ ዚ ህ እ ር ስ ዎ ለ አ ን ዳ ን ድ ጥ ያ ቄ ዎ ች ም ላ ሽ እ ን ዲ ሰ ጡ እ ና የ ተ ጠ ቀ ሰ ው ን መ ሳ ሪ ያ በ ማ ቅ ረ ብ በ ጥ ና ቱ ተ ሳ ታ ፊ እ ን ዲ ሆ ኑ በ አ ክ ብ ሮ ት ተ ጠ ይ ቀ ዋ ል ፡ ፡

ሀ. የ ጥ ና ቱ ዓ ላ ማ ፡ የ ዚ ህ ጥ ና ት ዓ ላ ማ የ ጤ ና ባ ለ ሙ ያ የ ሚ ሠ ሩ በ ት ን በ አ ቶ ስ ኮ ፒ እ ና በ እ ስ ቴ ቶ ስ ኮ ፒ ላ ይ ሊ ገ ኙ የ ሚ ች ሉ ት ን ተ ህ ዋ ስ ያ ን ን መ ለ የ ት ና መ ድ ሐ ን ት የ መ ቋ ቋ ም ባ ህ ሪ ያ ቸ ው ን ማ ጥ ና ት ነ ው ፡ ፡

ለ. ***የ ሚ ፈ ጅ ው ጊ ዜ ፡*** ይ ህ ጥ ና ት እ ስ ከ አ ራ ት ወ ር ሊ ፈ ጅ ይ ች ላ ል

ሐ. ***አ ጠ ቃ ቀ ም ፡*** በ ዚ ህ ጥ ና ት የ ጤ ና ባ ለ ሙ ያ የ ሚ ሠ ሩ በ ት ን ከ አ ቶ ስ ኮ ፒ እ ና ከ እ ስ ቴ ቶ ስ ኮ ፒ የ እ ስ ዋ ፒ ና ሙ ና በ መ ወ ሰ ድ ተ ህ ዋ ስ ያ ን መ ኖ ሩ ን እ ን ዲ ሁ ም የ ባ ክ ቴ ሪ ያ የ መ ድ ሐ ን ት መ ቋ ቋ ም ባ ህ ሪ ያ ቸ ው ን ማ ጥ ና ት

መ. ***ሊ ደ ር ሰ የ ሚ ች ል አ ደ ጋ ፡*** በ ዚ ህ ጠ ና ት ው ስ ጥ አ ደ ጋ የ ሚ ያ ደ ር ሰ ድ ር ጊ ት የ ለ ም

ሠ. ***የ ሚ ገ ኝ በ ት ጥ ቅ ም ፡*** በ ተ ጠ ቀ ሰ ው መ ሠ ሪ ያ በ ኩ ል ሊ ተ ላ ለ ፰ የ ሚ ች ሉ ት ን ተ ህ ዋ ስ ያ ን ን ለ ማ ስ ወ ገ ድ መ ረ ጃ ይ ሠ ጣ ል

ረ. ***ሚ ስ ጥ ራ ዊ ነ ት ፡*** የ ማ ን ኛ ው ም የ ጥ ና ቱ ተ ሳ ታ ፊ መ ረ ጃ በ ሚ ስ ጥ ራ ዊ ነ ት ይ ያ ዛ ል

የ እ ያ ን ዳ ን ዱ ን ግ ለ ሰ ብ መ ረ ጃ ከ ዋ ና ው ተ መ ራ ማ ሪ ና አ ማ ካ ሪ ው በ ስ ተ ቀ ር ማ ን ም ሊ ያ ገ ኝ አ ይ ች ል ም

ሰ. ***ፍቃደኝነትን ሰለመቋረጥ፡*** የጥናቱ ተሳታፊዎች መረጃ ያለመስጠት፣ በጥናቱ ለመሳተፍ ፍቃደኝነት የማሳየት፣ እንዲሁም መሠሪያውን ለናመና ያለማቅረብ መብታቸው የተጠበቀውነው

አድራሻ ማወቅ ስፈለገም፡ -

የጤና ሳይንስ ኮሌጅ አዲስ አበባ ዩንቨርሲቲ

የድህረ ምረቃ ፕሮግራምና ምርምር የተባባሪ ዲን ቢሮ

የመ.ሳ.ቁ. 9086 አዲስ አበባ

ስልክ 251-11-551-28-765

የዋናውተመሪማሪ አድራሻ፡

ራጋአ ደብሱ

የማይክሮ ባዬሎጂ እምኖሎጂ እና ፓራሰይቶሎጂ ትምህርት ክፍል

የጤና ሳይንስ ኮሌጅ አዲስ አበባ ዩንቨርሲቲ

የመ.ሳ.ቁ. 9086 አዲስ አበባ

ስልክ 251-917-844-345

ANNEX III: CONSENT FORM FOR HCWS (English and Amharic Version)

Serial no…….

Name of owner's of the study devices: _____

I have read the information sheet (or it has been read to me); I have understood that this study is to assess microbial colonization and susceptibility pattern of bacteria isolates of Otoscopes and Stethoscopes used by health care workers at Tikur Anbessa Specialized Referral Hospital. I have asked some questions and clarification has been given to me. I have given my consent freely to participate in the study by providing the requested devices, and I herby to approve my agreement with my signature.

Participants signature _____Date_____

Investigators signature _____ Date_____

Witness signature 1. _____Date_____

2. _____Date_____

የ ፈ ቃ ደ ኛ ነ ት መ ጠ የ ቂ ያ ቅ ጽ

ተ ራ ቁ ጥ ር ፡ ……

ከ ላ ይ ያ ለ ው ን የ መ ረ ጃ ቅ ጽ አ ን ብ ቤ ወ ይ ም ተ ነ ቦ ል ኝ ተ ረ ድ ቼ ዋ ለ ሁ ፡ ፡ የ ጥ ና ቱ አ ላ ማ በ ጥ ቁ ር አ ን በ ሳ ሆ ስ ፒ ታ ል ው ስ ጥ የ ጤ ና ባ ለ ሙ ያ የ ሚ ሰ ሩ በ ት ን በ አ ቶ ስ ኮ ፒ እ ና እ ስ ቴ ቶ ስ ኮ ፒ ላ ይ ሊ ኖ ሩ የ ሚ ች ሉ ት ን ተ ህ ዋ ሲ ያ ኖ ች ለ መ ለ የ ት እ ና የ ባ ክ ቴ ሪ ያ የ መ ድ ሃ ኒ ት መ ቋ ቋ ም ባ ህ ሪ ያ ቸ ው ን ማ ጥ ና ት ይ ሆ ና ል ፡ ፡

በ ተ ጨ ማ ሪ ም አ ን ዳ ን ድ ጥ ያ ቄ ዎ ች ን ጠ ይ ቄ አ ጥ ጋ ቢ ገ ለ ፃ ተ ሰ ቶ ል ኛ ል ። ስ ለ ዚ ህ በ ፈ ቃ ደ ኛ ነ ት በ ጥ ና ቱ ለ መ ሳ ተ ፍ የ ተ ጠ ቀ ሰ ው ን መ ሳ ሪ ያ ዎ ች በ ማ ቅ ረ ብ እ ን ዲ ሁ ም ለ አ ን ዳ ን ድ ጥ ያ ቄ ዎ ች መ ል ስ ለ መ ስ ጠ ት መ ስ ማ ማ ቴ ን በ ፊ ር ማ ዬ አ ረ ጋ ግ ጣ ለ ሁ ፡ ፡

የ ተ ሳ ታ ፊ ው ፊ ር ማ _____ ቀ ን _____

የ ተ መ ራ ማ ሪ ው ፊ ር ማ _____ ቀ ን _____

የ ም ስ ክ ሮ ች /ነ ባ ሪ ዎ ች 1_____ ቀ ን _____

2_____ ቀ ን _____

DECLARATION

I, under signed, declare that this M.Sc. thesis is my original work, has not been presented for a degree in any other University and that all sources of materials used for this thesis have been duly acknowledged.

M.Sc. Candidate Regea Dabsu (B.Sc)

Signature _____

Date and place of submission _____

Addis Ababa, Ethiopia

Supervisor Yimtubezinash Woldeamanuel (MD, M.Sc., PhD)

Signature _____

Date and place of submission _____

Addis Ababa, Ethiopia

Supervisor Daniel Asrat (MD, M.Sc., PhD)

Signature _____

Date and place of submission _____

Addis Ababa, Ethiopia