Nurses as Patient Advocates in Preventing Nosocomial Infections: A Determinative Study of Potentially Pathogenic Bacterial Vital Signs-Taking Paraphernalia

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Abstract

Sphygmomanometers and stethoscopes are important vital signs taking paraphernalia for monitoring patient's condition in the hospital wherein thorough disinfecting of these paraphernalia are sometimes neglected. Swab samples were taken from sphygmomanometer inner cuffs and stethoscope bells and diaphragms from the different special areas in Gregorio T. Lluch Memorial Hospital (GTLMH), Iligan City, namely the Outpatient Department (OPD), Emergency Room (ER), Delivery Room (DR) and Recovery Room (RR). Morphological, colonial and biochemical tests were done to identify the bacteria present in the samples. . Out of the 29 selected bacterial isolates, 13.8% were presumptively identified to be *Staphylococcus* sp., *Bacillus* sp., and *Lactobacillus* sp., respectively. *Streptococcus* sp., *Micrococcus* sp, Neisseria sp., and *Pseudomonas* sp. comprised 10.3% of the total isolates and only 3.4% was classified as

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coagulase-negative staphylococcus whereas the remaining 3.4 % was unidentified. Accordingly, the most common causes of nosocomial infections are *Escherichia coli, Staphylococcus aureus, and Pseudomonas* sp., all of which are found significantly in the samples taken from GTLMH. In the sphygmomanometer cuffs, a high number of *Microbacillus* sp. was found in the OPD, while *Lactobacillus* sp. was found to be higher in number in the ER and DR. In the stethoscopes, bacteria were found to be evenly distributed in the four areas. Of these areas, the OPD was found to have the most number of identified bacteria which may be attributed to the number of patients going there for consultation. ER and RR have the least number of bacteria identified possibly because they accommodate lesser number of patients. With this study, health care workers would be aware of the on-going problem and be able to act on them.

Keywords: sphygmomanometers, stethoscopes, nosocomial infection, bacteria, fomites

Introduction

Monitoring the vital signs of patients and obtaining baseline data are the crucial responsibility of health care workers, especially nurses, as basis of assessment of the patients' overall health status. Blood pressure apparatus and stethoscopes are the common medical devices used for assessing and monitoring patients' vital signs in the hospital where disease-causing microorganisms are prevalent. This prevalence is particularly true when hospitals are overcrowded, lacks adequate ventilation, and the staff is overworked. As former student nurses, the researchers have been exposed to different hospital settings and have observed and practiced passing on of medical devices from one patient to another, sometimes not disinfected prior to using them for another patient, placing patients at higher risk for contracting nosocomial infections or hospital-acquired infections.

As noted by the Center for Diseases Control and Prevention, about 5-15% of all hospitalized patients acquire nosocomial infections (Tortora, et al., 2007). Under the chain of infection, indirect contact transmission occurs when the agent of disease is transmitted from its reservoir to a susceptible host by means of a non-living objects. The previously mentioned inanimate objects, known as fomites, are capable of harboring potentially harmful microorganisms transmitted indirectly from one person to another (Tortora, et al., 2007). In this study, the fomites are the

cuff of the blood pressure apparatus and the bell and diaphragm of the stethoscope. A stethoscope is used both for blood pressure and heart rate measurements. In measuring for the blood pressure, a blood pressure cuff, a sphygmomanometer, and a stethoscope are used (Kozier, et al., 2004). The blood pressure cuff is wrapped around the upper arm of the patients when their blood pressure is checked. Contamination of the cuff is unavoidable since it is in contact with the skin and is usually exposed to blood and other bodily fluids making it a potential cause of cross-infection if reused. Same is true with the use of the stethoscope.

Immunocompromised patients including women in delivery, newborn infants, post-operative, cancer, diabetic, paralyzed, elderly, and burn patients who are in the hospital are highly susceptible to nosocomial infections which may even worsen their present medical condition. These pose a major concern to healthcare workers including student nurses being promoters of health.

Looking into these factors the researchers are motivated to investigate what specific pathogens are found in these paraphernalia which could cause nosocomial infections in different special areas (Delivery Room, Operating Room, Emergency Room, and the Outpatient Department) of Gregorio T. Lluch Memorial Hospital. This study allows the health care workers, especially nurses, to be aware of an existing problem regarding risks of acquiring nosocomial infections, as well as protect the welfare of patients, employees and visitors of the said institution by coming up with ways to manage such problem.

Conceptual Framework

To explain their approach to their study a framework as shown in Figure 1 was formulated by the researchers. This is based on the ideas and research of others and on what the researchers themselves would like to discover and explore and which will complement the objectives of the said study.

In taking the vital signs of patients, nondisposable blood pressure cuffs and stethoscopes, specifically the bell and diaphragm, are used for all patients confined to a specific special area regardless of their medical

diagnosis. Because of this, there may be a possibility that these paraphernalia cause indirect contact transmission as fomites. In addition, each special area caters to different types and number of patients which greatly contribute to the number of potentially pathogenic microorganisms present in these paraphernalia. Eventually, when these factors meet in a negative way there would be an increased number of potentially pathogenic microorganisms in the vital signs taking paraphernalia of the special areas in Gregorio T. Lluch Memorial Hospital Iligan City, placing patients at higher risk for acquiring nosocomial infection.

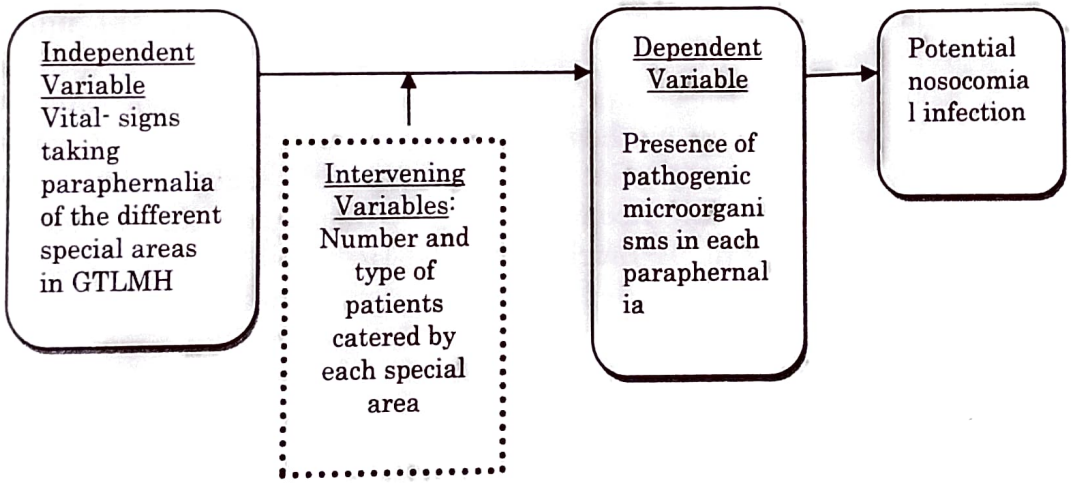

Figure 1. Conceptual Framework

Objectives of the Study

The hospital is an environment where microorganisms, especially pathogenic ones, are prevalent. This study aimed to do the following:

1. Determine the presence of potentially pathogenic bacteria in paraphernalia used in vital signs taking of patients confined in Gregorio T. Lluch Memorial Hospital Iligan City.
2. Detect which among the stethoscope bells, diaphragms and blood pressure cuffs contain the highest number of pathogens.
3. Identify which among the different special areas (Delivery Room, Operating Room, Emergency Room, and the Outpatient Department) of Gregorio T. Lluch Memorial Hospital in Iligan City has the most types of potentially pathogenic bacteria

Scope and Limitations

The study is limited only to identification of bacterial isolates using conventional methods of bacterial identification namely: Gram staining, Catalase, MSA (Mannitol Salt Agar), EMB (Eosine Methylene Blue), Coagulase and TSI (Triple Sugar Iron) tests.

The investigation of the microorganisms present was performed on 1 stethoscope (bell and diphragm) and 1 blood pressure cuff used on patients' vital signs taking from each of the 4 different special areas (Delivery Room, Operating Room, Emergency Room, and the Outpatient Department) of Gregorio T. Lluch Memorial Hospital in Iligan City. Only those which are most commonly used were swabbed and vital signs-taking paraphernalia of the affiliating students in the said hospital were not included. Swabbing of the vital signs – taking paraphernalia was done once during afternoon shifts in the said hospital. The study was conducted

for a period of three months from October to December 2009. Investigation on actual cases of nosocomial infections was not done due to the lack of relevant data such as the medical diagnosis of patients that confirms nosocomial infection.

Related Studies

The following foreign studies eventually served as a basis for the researchers in initiating the investigation and determination of potentially harmful bacteria found in vital-signs taking paraphernalia particularly the blood pressure cuffs and stethoscopes used in the hospital:

A research study authored by Cohen, et al. in 1997 aimed to determine whether stethoscopes and otoscopes used in community pediatric clinics harboured pathogenic microorganisms, and, if so, which measures could prevent this. Results show that all the stethoscopes and 90% of the otoscope handles were colonized by microorganisms. *Staphylococci* were isolated from 85.4% of the stethoscopes and 83.3% of the otoscopes, with 54.5% and 45.2% respectively being *Staphylococcus aureus.* Methicillin-resistant *Staphylococcus aureus* were found in four each of the stethoscopes (7.3%) and otoscopes (9.5%). Cleaning with alcohol reduced the colony count by an average of 96.3%. The results eventually led them to the conclusion that fomites particularly in stethoscopes and otoscopes can harbour potentially pathogenic bacteria, and with the increasing trend for children with more complex medical problems to be managed in an ambulatory setting, often by physicians who also work in hospitals, there is a real risk of spreading potentially serious infections to such patients.

In 2002, Maluf along with other medical biologists verified the presence of bacteria, fungi, and yeasts on stethoscope diaphragms and test their resistance to antimicrobial drugs since stethoscopes are in constant use among health professionals, often passed from one professional to another and is always in direct contact with patients. Based on the results of the total of 300 stethoscopes sampled, 87% were contaminated. Among the contaminated stethoscopes, 96% presented more than one microorganism. The microorganisms isolated were the

following: *Staphylococcus aureus* (n=176), *Staphylococcus* negative coagulase (n=153), yeasts (n=148), *Sarcina* (n=64), *Bacillus sp* (n=45), *Streptococcus species* (n=7), *Acinetobacter species* (n=2), *Pseudomonas putida* (n=1) and *Klebsiella pnemoniae* (n=1). The study led the previously mentioned researchers to conclude that stethoscopes presented a high rate of contamination and because of their universal use among health professionals; they can be potential vectors in the dissemination of hospital infections.

In addition, a comprehensive study by De Gialluly et al. conducted in the year 2003 tried to find out if blood pressure cuffs can contribute in the spread of bacterial infections in hospitals. They quantitatively and qualitatively evaluated the bacterial contamination on blood pressure cuffs of 203 sphygmomanometers used in 18 hospital units for three months in a university hospital. Their study showed a level of contamination reaching 100 or more colony-forming units per 25 cm^2 on 92 (45%) of inner sides and 46 (23%) of outer sides of 203 cuffs. Blood pressure cuffs kept in intensive care units with (20 [83%] of 24) and on nurses' trolleys with (27 [77%] of 35) have the highest levels of contamination. None of the 18 blood pressure cuffs presumed to be clean (those that have not been used since the last decontamination procedure) had a high level of contamination. Potentially pathogenic microorganisms were isolated from 27 (13%) of the 203 BP cuffs: 20 of these microorganisms were *Staphylococcus aureus*, including 9 methicillin-resistant strains. (Infection Control Hospital Epidemiology 2006:27:940–943). Blood pressure cuffs in intensive care units and on nurses' trolleys were found to have the highest levels of contamination with potentially pathogenic microorganisms.

Moreover, according to Layton et al. in 2006, presumed "clean" blood pressure cuffs in critical areas [OR (Operating Room), MICU (Medical Intensive Care Unit), SICU (Surgical Intensive Care Unit), CICU (Cardiac Intensive Care Unit), NSICU (Neurosurgical Intensive Care Unit), BSICU (Burn Special Intensive Care Unit), ER (Emergency Room), and PACU (Post-anesthesia Care Unit)] were investigated to determine if they were contaminated with bacterial colonization of organic and inorganic materials in 707-bed, tertiary level, level-one trauma centers. Results have shown that bacterial colonization, in 70 separate cultures obtained over six weeks, were present on 57 (81%) of the blood pressure cuffs. Blood pressure cuffs obtained from the OR,

PACU, BSICU, and the ER were 100% colonized, while cuffs from the SICU were 90% colonized, and cuffs from the MICU were 80% colonized. Blood pressure cuffs from NSICU and CICU showed no bacterial growth. Organic and inorganic contamination was found on 32 (45.7%) of the presumed "clean" cuffs. Furthermore, it was found out that the patient contact side of the cuff was found to be twice as contaminated as the nonpatient side. Therefore, frequent bacterial colonization and significant contamination of organic and inorganic materials are present on presumed "clean" blood pressure cuffs. Microorganisms found on these cuffs may have the potential to produce opportunistic infection when introduced to critically ill patients who are susceptible to disease. Education and infection control practices amongst healthcare providers may decrease morbidity, mortality and unnecessary healthcare costs.

Research Design

The investigators used descriptive comparative survey research design such that after determining the presence of different bacterial pathogens in the vital signs taking parapphernalia, they compared the abundance of pathogen in stethoscope bells and diaphragms and blood pressure cuffs in different areas of the hospital and compared which among the reservoir, namely the stethoscope bells and diaphragms and blood pressure cuffs, has the highest number of pathogens.

Research Locale

The study was done at Gregorio T. Lluch Memorial Hospital, which is located at Pala-o, Iligan City across COOP Lab. It is a tertiary level hospital with 75 beds. It is a government-run hospital providing health services not only in Iligan City but to Lanao del Norte as well. The hospital has a total of 88 nursing staff; 18 regular nurses and 70 nursing volunteers.

The following are its officials: Eustiquio T. Olivero Jr., M.D., MHA, FICS is the chief of the hospital; Myrna P. Suan is the chief nurse;

Leonila L. Barbosa serves as the training coordinator; Maria Shiela P. Magallanes is the Delivery room Coordinator; Belen Joy C. Patindol is the Operating Room Supervisor; Eugenia E. Hamo is the Supervising Nurse clinical area in the hospital; Mila T. Libot is the ER-OPD nurse coordinator.

Method of Data Collection

A. Collection of Samples

Collection of samples (4 blood pressure cuffs, 4 stethoscope bells, and 4 stethoscope diaphragms) was done in each sampling site (Emergency Room, Operating Room, Outpatient Department, and Delivery Room) in Gregorio T. Lluch Memorial Hospital during two (2) sampling periods. The first sampling period was done in the Outpatient Department and in the Operating Room, while, the second sampling period was done in the Emergency Room and in the Delivery Room. Before going to the sampling site, corkscrew test tubes filled with 10-ml distilled water were sterilized. The sterile corkscrew test tubes were labeled accordingly and were kept in vertical position while transporting it to the sampling site to prevent the water from being tilted to the edge of the tube and be contaminated. They were then kept inside an ice bucket submerging them in ice, still in vertical position. Each sample, particularly the inner cuff of the blood pressure cuff and the bell and diaphragm of the stethoscope, in each sampling site was swabbed with a sterile cotton applicator observing aseptic technique to eliminate unnecessary contaminants. Every after swabbing, the swabbed cotton applicator was put into its respective sterile corkscrew test tube dipping it into the 10-ml sterile water and, still keeping it in vertical position, was shook carefully to allow the bacteria to disintegrate into the medium, which is the sterile water. The tube was then submerged back into the ice keeping it cool to prevent the bacteria from dying. The tubes with the swabs were transported carefully back to the laboratory where they were subjected for serial dilution for the bacteria to be grown, cultured, observed, and identified.

B. Isolation and Purification of Bacteria

Serial dilutions are a series of dilutions done when initial concentrations of bacteria are orders of magnitude too high to perform a plate count (Fankhauser, 1994). From the 10-ml medium having microorganisms from the swabs collected from the samples, 1-ml was aspirated using a micropipettor and was transferred into a 9-ml sterile water inside a plugged test tube. From that test tube, 1-ml was aspirated again using a micropipettor and was transferred into a 2nd 9-ml sterile water inside a plugged test tube. From that 2nd test tube, 1-ml was aspirated using a micropipettor and was transferred into a 3rd 9-ml sterile water inside a plugged test tube. These series of dilutions were done in each collected sample.

The 1st plugged test tube was aspirated with 0.1-ml of liquid, which was transferred to a plate with nutrient agar, and was spread using an L-rod, a process known as spread plating as shwon in Figure 2. This process was done twice in each plugged test tube. The plates were incubated at room temperature allowing the bacteria to grow and form colonies.

After 24 hours of incubation, the plates were checked for bacterial growth and colonial formation. The colonies formed were observed for its morphology (shape, elevation, margin, and color) and counted to determine its number. A representative of each colony was isolated, selected based on its morphology as seen in Figure 3. Isolation was done by picking up a loopful of the selected colony using an inoculating needle and streaking it on a nutrient agar.

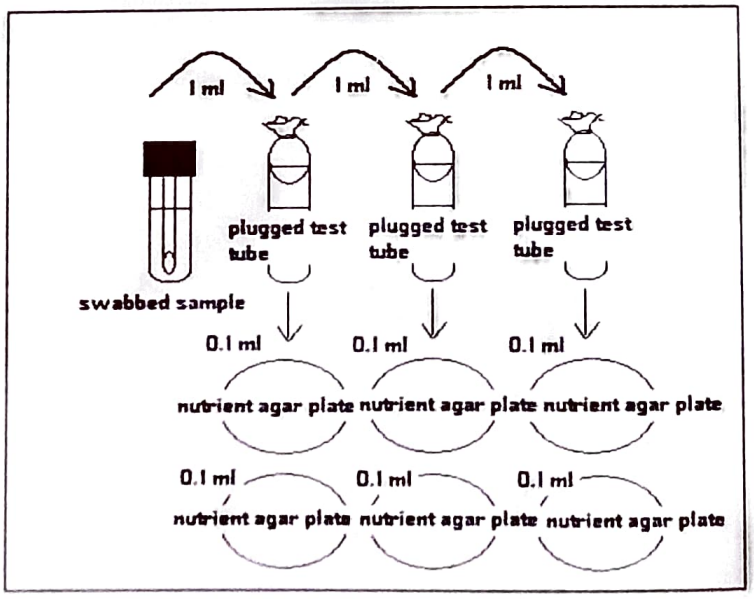

Figure 2. Serial dilution scheme with plating.

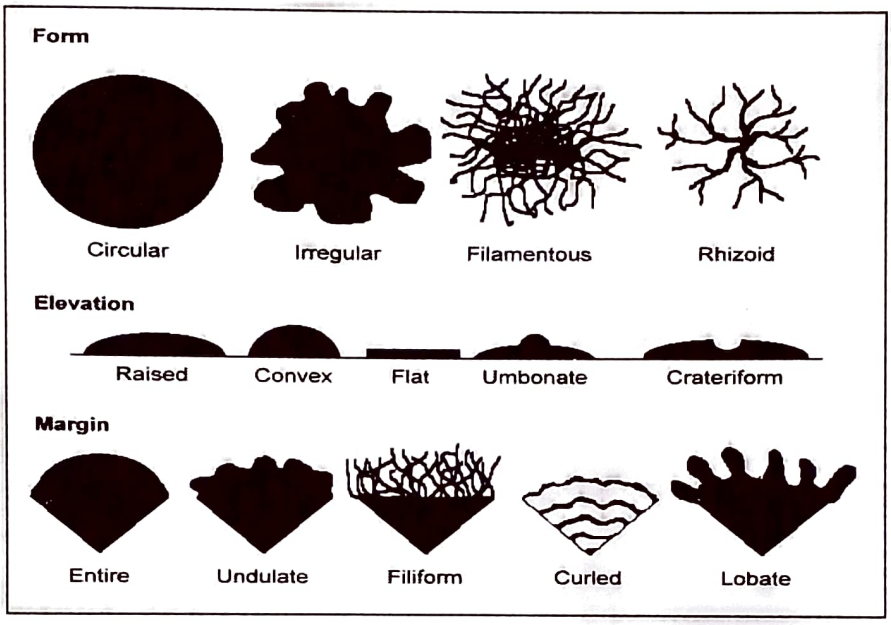

Figure 3. Examples of form, elevation, and margin for the colonial Morphology (Hurlbert,1999)

C. Culture and Identification

Bacteria are characterized and classified mostly by their enzyme or biochemical reactions. As they grow on various types of media, they produce certain types of metabolites that are detected by their interaction with test reagents which may result in a color change (Hurlbert, 1999).

1. Morphological Test

The isolates were subjected to Gram staining in order to assess gram reaction (Hurlbert, 1999). The selected colony underwent a Gram stain test, wherein the Gram staining protocol was followed. A loopful of the selected colony was picked up using an inoculating needle and was placed at the center of a slide. One (1) to two (2) drops of crystal violet was

poured on the colony then the slide was tipped from side to side to allow the crystal violet to spread over the colony. After thirty (30) seconds, the crystal violet was washed off with ethanol. One (1) to two (2) drops of safranin was poured on the colony and the slide was tipped from side to side to allow the safranin to spread over the colony. After one (1) minute, the safranin was washed off with water. The slides were then air-dried.

2. Biochemical Analyses

Bacteria are among the most diverse organisms with respect to the types of enzymes they contain. A variety of specialized media are designed to facilitate determining the biochemical reactions of bacteria. (http://biology.fullerton.edu)

a. Catalase Test

The related, essential physiological information about the organism can be more clearly determined by running the catalase test, which can be used to detect the enzyme catalase (Murray, 2009). The enzyme catalase is responsible for protecting bacteria from hydrogen peroxide (H_2O_2) accumulation, which can occur during aerobic metabolism. If hydrogen peroxide accumulates, it becomes toxic to the organism. Catalase breaks hydrogen peroxide down into water and oxygen. It is found in almost all cells except certain anaerobic bacteria. All bacterial isolates were tested for catalase enzyme. Three (3) to four (4) drops of hydrogen peroxide were added to a bacterial colony in a nutrient agar plate. Presence of bubbling within ten (10) seconds indicates positive (+) catalase or presence of catalase in the bacteria. No bubbling suggests (-) catalase or presence of catalase in the bacteria

b. Mannitol Salt Agar (MSA)

Mannitol Salt Agar is a selective medium used for the isolation of *staphylococci. Staphylococci* can grow in the presence of high salt concentration and *S. aureus* can frment mannitol, producing yellow colonies on this agar (Murray et al., 2009). Nonpathogenic *staphylococci* produce small red colonies with no color change to the surrounding medium. MSA is highly selective and specimens from heavily contaminated sources may be streaked onto this medium without danger of overgrowth. MSA is recommended for isolating pathogenic *staphylococci* from clinical specimens, cosmetics, and microbial limit tests (Acumedia Product Information 7143, Rev 05, 2008).

A Mannitol Salt Agar was used as a culture medium. 111-g of the Mannitol Salt Agar powder was mixed thoroughly with 1-L of purified water. It was heated and boiled for at least one (1) minute to completely dissolve the powder (Hitchens, et al., 1995). The solution was then poured on sterile petri dishes. All positive catalase bacteria were streaked on this agar. The plates were incubated at room temperature for 24-48 hours. Presenvce of yellow discoloration denotes positive (+) mannitol fermentation. Bacterial growth on the agar signifies positive (+) salt tolerance. Negative growth suggests *Micrococcus* sp.

c. Coagulase Test

Among *Staphylococcus* sp. associated with human infections, *S. aureus* is unique in its ability to clot plasma. Coagulase is an enzyme used by *S. aureus* to induce coagulation and convert soluble fibrinogen into fibrin which will protect bacteria from the human immune system (Morse, 1981).

Blood agar was used as a culture medium. 10-ml of human blood was aspirated and mixed with a 350-ml of sterile water with nutrient agar powder with two (2) marbles, which was used to let the clots stick there. Coagulase test uses blood as selective medium to identify *Staphylococcus aureus.*

d. Eosin Methylene Blue (EMB)

Eosin Methylene Blue Agar, Levine is a slightly selective and differential plating medium for the isolation of gram-negative enteric bacteria. The use of Eosin and Methylene Blue enable differentiation between lactose-fermenting and non-fermenting organisms. When the bacteria ferment the lactose, the pH decreases in the medium and the medium changes to a purple color. Gram-negative bacteria that ferment lactose appear with a green metallic sheen. Those that cannot ferment lactose appear clear on the medium. (Jett, et al., 1994).

Eosin Methylene Blue (EMB) agar was used as culture medium. 37.5-g of EMB agar powder was mixed thoroughly with 1-L distilled water. It was heated and boiled for at least one (1) minute to dissolve the powder completely. The solution was poured into vials and was sterilized. The vials were tilted and let dry to form a slanting agar. Gram negative rods were streaked on this agar and incubated at room temperature for 24-48 hours. Purple growth on this agar suggests *Pseudomonas* sp. While, colorless growth in this agar implies *Proteus* sp. whereas, positive growth with green metallic sheen suggests *Escherichia coli.*

e. Triple Sugar Iron (TSI)

Triple Sugar Iron medium is a differential medium that can distinguished between a number of gram-negative enteric bacteria based on their physiological ability (or lack thereof) to metabolize lactose and/or sucrose, conduct fermentation to produce acid, and produce gas during fermentation and generate H_2S. Carbohydrate fermentation is indicated by a yellow coloration of the medium. If the medium in the butt of the tube becomes yellow (acidic), but the medium in the slant becomes red (alkaline), the organism being tested only ferments dextrose (glucose). A yellow (acidic) color in the slant and butt indicates that the organism being tested ferments dextrose, lactose and/or sucrose. A red (alkaline) color in the slant and butt indicates that the organism being tested is a nonfermenter. Hydrogen sulfide production results in a black

precipitate in the butt of the tube. Gas production is indicated by splitting and cracking of the medium (PI 7162, Rev 01, 200).

Triple Sugar Iron (TSI) was used as as culture medium. 65-g of Triple Sugar Iron (TSI) powder was mixed thoroughly with 1-L of purified water. It was heated and boiled for at least 1 minute to dissolve the powder completely. The solution was poured into test tubes and was sterilized. The sterile test tubes were tilted and cooled in slanting position so that deep butts were formed. Gram negative rods were streaked on this agar. Inoculation was done by carefully touching only the center of an isolated colony on an enteric plated medium with a cool, sterile needle, stab into the medium in the butt of the tube, and then streak back and forth along the surface of the slant. The tubes were incubated with plugs loosened at room temperature for 18-24 hours (Forbes, et al., 1998).

After all the tests were done, bacteria were identified following a dichotomous key which is used. A dichotomous key is used to identify living organisms in taxonomy constructed from a series of highly organized statements arranged into couplets. A couplet consists of typically two descriptions which should represent mutually exclusive choices which are read and compared with the specimen to be identified. Once a decision is made, that selection is directed to another couplet (either the next in order or one further on in the key), and this process is repeated until a conclusion is reached

Conclusion

There is presence of potentially pathogenic bacteria in paraphernalia specifically the stethoscope bell, diaphragm and blood pressure cuff used in vital signs taking of patients in the different special areas of GTLMH. With the previously mentioned tests based on cultural, cellular, and biochemical characterization, the following bacteria were presumptively isolated and were identified. 4 isolates were *Staphylococcus aureus,* 3 of which were classified under *Streptococcus* sp., 3 were *Micrococcus* sp., 4 were among the *Bacillus* sp., 3 were

Neisseria sp., 2 were *Pseudonomas* sp., 3 isolates for *Escherichia coli,* 4 were *Lactobacillus* sp., an isolate which was Coagulase negative *staphylococcus,* and another isolate was said to be an unidentified bacteria. These opportunistic bacteria were known for their capacity to cause harm to humans especially to those who are immunocompromised and may even cause nosocomial infections that could prolong the hospital stay of patients admittted in the hospital.

Among the vital signs taking paraphernalia included in the study and of which samples were taken, the bp cuffs (inner side) have the highest number of identified pathogenic bacteria (14), followed by the stethoscope's bell (8), and lastly would be the stethoscope's diaphragm (7). The most commonly found bacteria on the bp cuffs were the *Micrococcus* sp., *Lactobacillus* sp.whereas *Staphylococcus aureus (A)* was the most predominantly found in the stethoscopes . These findings eventually would give us the implication that the bp cuffs were probably least disinfected or cleaned thus tend to be a potential vector most capable of transmitting pathogenic bacteria from one person to another. Stethoscopes were also capable of infection transmission however the possibility would vary depending in the frequency of disinfection done by the staff.

Of the different special areas included in the study, the Outpatient Department presented the highest number of pathogens with 10 bacteria identified followed by the Delivery Room (7), Recovery Room (6) and the Emergency Room (6).The results, however, may vary depending on the number of patients being catered in each of the area. The Outpatient Department has the most number of identified bacteria which may be attributed to the number of patients going there for consultation.

Recommendations

After the results have been shown, it is suggested that the study would still be subjected to further investigations with regards to identification of other possible pathogenic bacteria present on vital- signs taking paraphernalia. Thus, the following suggestions are recommended to the:

- Health care institutions – standard protocol for cleaning vital signs-taking paraphernalia should be followed strictly to decrease, or possibly eliminate, the incidence of acquiring these kinds of microorganisms. A possible solution would be to provide each patient with a new disposable blood pressure cuff that remains with the patient during his/her hospital stay and disposed when the patient is discharged from the hospital. By providing a single patient use disposable blood pressure cuff, the possibility of an outbreak from cross contamination would be greatly reduced (Scwegman, 2008). Another solution would be to wash the non disposable cuffs that the institutions already has in a regular basis (e.g. once a day or every other day). An infection control staff could also be provided for the proper sdherence to prevention of nosocomial infections.
- Nursing supervisors - implement and adhere to transmission-based precautions as well as disseminate information, especially to the staff, on the importance of strict compliance to preventive measures for infection control;
- Staff nurses and other health care professionals – be more conscious with the cleaning and disinfecting of the vital signs-taking paraphernalia after use;
- Student nurses – institute proper precautionary measures regarding infection control and apply these measures to protect themselves against hospital-acquired infections during their clinical exposure; and
- Future researchers – utilize this study as their guide post in initiating a wider range of investigation of the presence of bacteria in vital signs-taking paraphernalia. Perform the study in the different hospitals other than Gregorio T. Lluch Memorial Hospital, such as the Mindanao Sanitarium and Hospital, Dr. Uy Hospital Inc., St. Mary's Hospital, might as well with the Barangay Health Centers and Private Clinics situated in Iligan City. Have different samples investigated other than the blood pressure cuff such as thermometers and with the other parts of the stethoscope specifically the earpiece of which is commonly neglected when it comes to cleaning or disinfection in between patient use. And finally, make comparisons based on the gathered results and determine if there is a significant difference between

the vital signs- taking paraphernalia used by student nurses with those used in the hospital.

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