Associated Microbial Flora Found in the Commonly Used Bath Basin in the Neonatal Intensive Care Unit of Gregorio T. Lluch Memorial Hospital, Iligan City: Implication for Disease and Infection Control

Miko C. Daligdig
Jessica May G. Gaite
Ricah Anne F. Gaite

Abstract

Newborn bathing for babies is considered to be an effective preventive measure to reduce infection caused by microorganisms. However, the sterility of these commonly used basins has been disregarded in some hospitals in Iligan City which could risk the newborn's health. any alteration and microbial invasion to the newborn's weak immune system. Bacteriological assessment was done for the bath basins of the Neonatal Intensive Care Unit (NICU) at Gregorio T. Lluch Memorial Hospital, Iligan City. Samples were obtained via swabbing at the lateral sides and center part of the basins that were used before and after newborn bathing. Swab samples were then placed in screw-capped tubes with 10 ml of nutrient broth and were immediately transported at the microbiological laboratory for characterization and identification of the bacterial isolates using the conventional methods. Among the identified bacteria isolated, *Neisseria spp.* was in great number constituting more than half of the samples (26 out of 44 isolates, 59.1%). These are gram-negative cocci that are obligate human pathogens with no other natural hosts. Results can be associated through

DALIGDIG took his Bachelor of Science in Nursing at Mindanao State University- Iligan Institute of Technology (MSU-IIT). He recently passed the July 2010 Nurse Licensure Examination and is now a registered nurse. GAITE took up BS Nursing at MSU IIT and recently passed the July 2010 Nurse Licensure Exam and is now a registered nurse. GAITE also finished her BS Nursing at MSU IIT. She recently took and passed the Nurse Licensure Examination in July 2010 and is now a registered nurse.

possible bacterial transmission during newborn delivery and newborn bathing whereby such bacteria are capable of residing on areas of the bath basin. Other bacterial isolates include *E. coli (4.55%), S. aureus (4.55%), Enterobacter (2.77%), Streptococcus (2.27%),* Coagulase Negative *Staphylococcus (4.55%), Bacillus spp. (4.55%),* other gram negative rods *(4.55%),* and other gram negative cocci *(11.36%).* Results implied that the presence of these identified bacteria have a higher possibility of disease transmission to the newborns, and that meticulous cleaning and disinfection of the bath basin is strongly recommended for prevention of diseases. The results obtained from this study provide awareness to the healthcare personnel at the NICU and suggest immediate action for disease prevention and health promotion among newborns.

Keywords: nosocomial infections, newborns, bath basin, NICU, bathing

Introduction

In this generation, many young women are becoming pregnant and as a result, the number of newborns relatively increases. In this case, health must be put into consideration and must not be overlooked. As defined by the World Health Organization (WHO), health is a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity (Kozier, 2004). From the definition given by the WHO, it implies health in the context of the environment, and everything that a person interacts with could affect his/her own health which consequently alters his/her state.

With the increasing number of newborns in the Neonatal Intensive Care Unit in different Philippine public hospitals resulting from rapid increases in birth deliveries, there is a high possibility of infections occurring in newborn babies. One way to reduce the incidence of acquiring infections is primarily to perform newborn bathing immediately after the delivery and after performing cord care. This preventive measure gives assurance to the newborns that microorganisms reduce in number, and is an effective way to prevent infections. However, the sterility of these commonly used basins has been disregarded especially in some hospitals in Iligan City by which, the health of a newborn is put at risk. Opportunistic microorganisms from those bath basins may invade the weak immune system of the newborn hence, the conduct of this study.

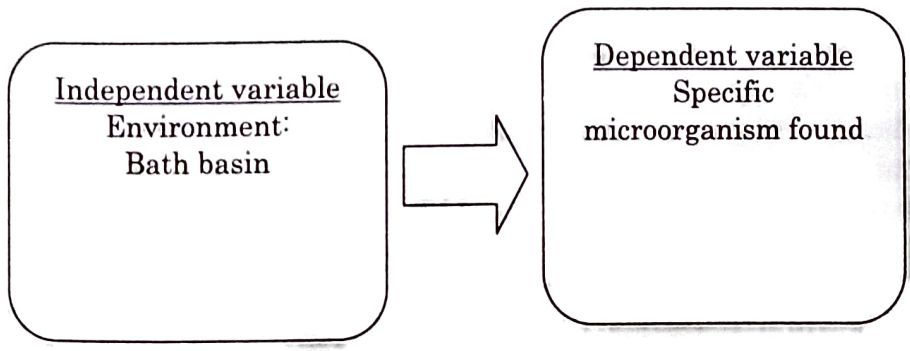
This study will achieve awareness to hospital institutions that bath basins which are used for newborn bathing may be a possible source of infection. This study also tries to determine the presence of harmful microorganisms causing infection, the type of microorganisms, and the untoward risks that can alter the health of every infant.

In general the study is to promote health at its highest level and to prevent any type of diseases among the newly born infants.

Conceptual Framework

There are several factors which greatly contribute to the proliferation of bacteria and the detection of microorganisms. An environment wherein aseptic technique is practiced and maintained is one of the factors that can prevent nosocomial infections. Any alterations in the environment can lead to a change in health status. In this case, bath basins are focused as potential sources of infection.

Asepsis is the freedom from disease – causing microorganisms. To decrease the possibility of transferring microorganisms from one place to another, asepsis is used. Meticulous use of medical and surgical asepsis is necessary to prevent transport of potentially infectious microorganisms (Kozier, 2004).



Conceptual Framework of Independent and Dependent Variables

Objectives of the Study

This study aims to determine the presence and the types of microorganisms on the commonly used bath basins in the Neonatal Intensive Care Unit (NICU) of Gregorio T. Lluch Memorial Hospital in Iligan City.

Specifically, this study aims to meet the following objectives:

1. To identify what microorganisms are present in the bath basin used in the NICU of Gregorio T. Lluch Memorial Hospital.
2. To find out if there is a significant relationship on the bath basin to the specific microorganisms found in them.

Scope and Limitation of the Study

Collection of samples was limited only to two separate sampling periods from September 2009-December 2009. The samples were obtained from the center and the lateral sides of the commonly used bath basin in the Neonatal Intensive Care Unit of Gregorio T. Lluch Memorial Hospital.

This study was limited to identifying the presence and types of microorganisms and the risks associated with these microorganisms.

The tests done on species identification depended on the chemicals, ingredients and materials available. Therefore, species identification was dependent on the tests performed.

Intervening variables such as the physiologic maturity of the newborn and the length of stay of the newborns in the hospital were not included in the scope of the study. Furthermore, bath basins for Hepatitis patients and the type of material from which the basins are made have been excluded in the scope of this study.

Related Studies

Local

A study entitled, "Impact of Enhanced Infection Control at Two Neonatal Intensive Care Units in the Philippines" by CJ Gill, JB Mantaring, M Mendoza, S Mendoza, WC Huskins, DA Goldmann, and DH Hamer from Center for International Health and Development, Department of International Health, Boston University School of Public Health, Boston, Massachusetts 02118, USA in 2009 conducted to study the urgent need of cost-effective infection control measures in resource-limited settings for the increasing problem of neonatal mortality associated with hospital-acquired neonatal sepsis in the developing world. They used a before-and-after comparison design wherein they measured how the rates of staff hand hygiene compliance, the colonization with drug-resistant pathogens (defined as ceftazidime- and/or gentamicin-resistant gram-negative bacilli and drug-resistant gram-positive cocci), bacteremia, and overall mortality changed after the introduction of a simplified package of infection-control measures at 2 neonatal intensive care units (NICUs) in Manila. Their results showed that of all 1,827 neonates that were admitted to the NICU, 561 (30.7%) arrived from delivery already colonized with drug-resistant bacteria. Of the 1,266 neonates who were not already colonized, 578 (45.6%) became newly colonized with drug-resistant bacteria. Of all 1,827 neonates, 358 (19.6%) became bacteremic (78.2% were infected with gram-negative bacilli) and 615 (33.7%) died. Of 2,903 identified drug-resistant colonizing bacteria, 85% were drug-resistant gram-negative bacilli (predominantly Klebsiella species, Pseudomonas species, and Acinetobacter species) and 14% were methicillin-resistant Staphylococcus aureus. Comparing the control period with the intervention period at each NICU revealed that staff hand-hygiene compliance improved (NICU 1: relative risk, 1.3; 95% confidence interval 1.1-1.5; NICU 2: relative risk, 1.6; 95% confidence interval, 1.4-2.0) and that overall mortality decreased (NICU 1: relative risk, 0.5; 95% confidence interval, 0.4-0.6; NICU 2: relative risk, 0.8; 95% confidence interval, 0.7-0.9). Then again, the rates of colonization with drug-resistant pathogens and of sepsis did not change significantly at either NICU. Thus, they were able to discuss that nosocomial infection

transmission of drug-resistant pathogens was severe at these two NICUs in the Philippines and that transmission mostly involved drug-resistant gram-negative bacilli. They concluded that infection control interventions are feasible and are possibly effective in resource-limited hospital settings.

Foreign

A study entitled, "Patient's Bath Basins as Potential Sources of Infection: A Multicenter Sampling Study" by D. Johnson from Westerley Hospital, Westerley, Rhode Island; L. Lineweaver from Presbyterian Hospital, Albuquerque, New Mexico; and L. M. Maze from Wishard Health Services, Indianapolis, Indiana, in 2009 was conducted to identify and measure bacteria present in patients' bath basins and evaluate them as possible reservoirs for bacterial colonization thus becoming a risk factor for subsequent nosocomial infection. They used sterile culture sponges to obtain samples from the 92 bath basins at 3 acute care hospitals, including basins from 3 intensive care units. Results showed that there was some form of bacteria that grew in 98% of the samples. The organisms with the highest positive rates of growth on enrichment were enterococci (54%), gram-negative organisms (32%), Staphylococcus aureus (23%), vancomycin-resistant enterococci (13%), methicillin-resistant S aureus (8%), Pseudomonas aeruginosa (5%), Candida albicans (3%), and Escherichia coli (2%). They concluded that bath basins are reservoirs for bacteria and may be a source of transmission of nosocomial infections. An increased awareness helped high-risk patients whose bath basins become possible sources of transmission of nosocomial infections.

According to a study entitled, "*Klebsiella* spp. as Nosocomial Pathogens: Epidemiology, Taxonomy, Typing Methods, and Pathogenicity Factors," by R. Podschun and U. Ullmann from the Department of Medical Microbiology and Virology, University of Kiel, Kiel, Germany, in pediatric wards, nosocomial *Klebsiella* infections are especially troublesome, particularly in premature infants and intensive care units. *Klebsiella* species are often the pathogens involved in neonatal sepsis, in both early-manifestation and late-manifestation infections. Apart from medical equipment (contaminated due to faulty hygienic procedures) and blood products, the principal reservoirs for transmission of *Klebsiella* in the hospital setting are the gastrointestinal tract of

patients and the hands of hospital personnel. The ability of this organism to spread rapidly often leads to nosocomial outbreaks, especially in neonatal units. Of the 145 epidemic nosocomial infections reported in the literature published in English between 1983 and 1991, 13 were caused by *Klebsiella*. According to the statistics of the Centers for Disease Control and Prevention, *Klebsiella* spp. account for 8% of endemic hospital infections and 3% of epidemic outbreaks.

A study entitled, "Effect of Less Frequent Bathing of Preterm Infants on Skin Flora and Pathogen Colonization," by Linda S. Franck from Children's Nursing Research at King's College London School of Nursing and Midwifery and Great Ormond Street Hospital for Children NHS Trust, London, England, Dolores Quinn from the Intensive Care Nursery at the University of California, San Francisco Medical Center, and Lina Zahr from the School of Nursing, University of California, Los Angeles in 2000 was conducted wherein they aimed to determine if less frequent bathing alters colony count or type of organism in skin flora of preterm infants. Results showed that normal skin flora colony-forming unit (CFU) count, predominantly coagulase-negative *Staphylococci*, increased within 48 hours after bathing compared to values 30 minutes after bathing. There were no differences in normal skin flora CFU on Days 2, 3, and 4. Pathogens were identified in 12 infants for at least one time point during the study. Significantly fewer pathogens were found in the cultures over time, despite longer interval since bathing, and no infant developed symptoms of infection during the study period. Hence, findings from this study suggested that the frequency of bathing of preterm infants could be reduced without increasing the risk of infection.

Research Design

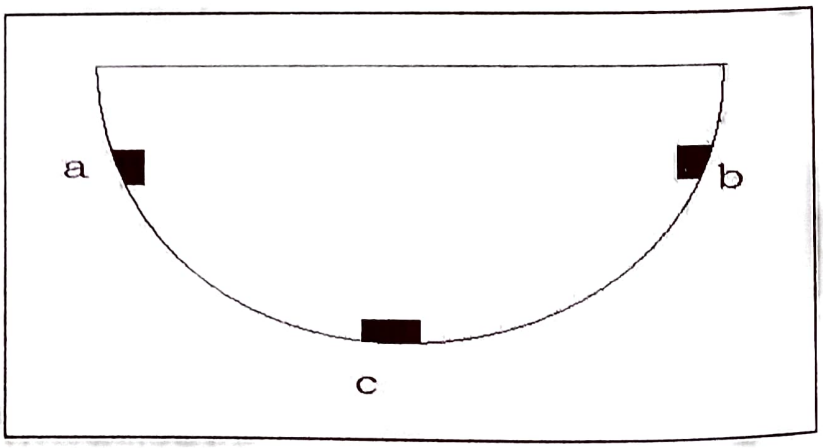
The descriptive-survey method of research was used in this study which assessed a sample at one explicit point in time without trying to make conclusion or causal statements. The reason of conducting this study was to provide informal information about a condition. This focused on detection of specific microorganisms from the bath basins used in the NICU of Gregorio T. Lluch Memorial Hospital.

Sampling Procedure

Swab samples were collected from bath basins of the neonatal intensive care units of GTLHM. Sampling was done twice and was limited to basins used in whole body bathing of newborn babies confined at the neonatal intensive care units.

Culturing of the samples included an enrichment step to increase the numbers of organisms to allow qualitative detection of bacterial growth using the Nutrient Broth. Testing was based on the qualitative, rather than quantitative, presence of bacteria, and so any growth during the transport would not affect the result.

Swabbing was performed at the center and lateral area of the basin using a firm, circular motion before and after newborn bathing and after the basin has been air-dried. After swabbing the basin, the procedure was done aseptically. The cotton tip applicator was placed into the sterile screw-capped tube filled with 10 ml of nutrient broth for bacterial growth, and was then thoroughly shaken for proper distribution of unknown numbers of microorganisms. These screw-capped tubes were placed inside a container with ice. The container was then transported immediately to the microbiological testing laboratory for several biochemical tests.



Swabbed Areas of Bath Basin

Pure Culture Preparation

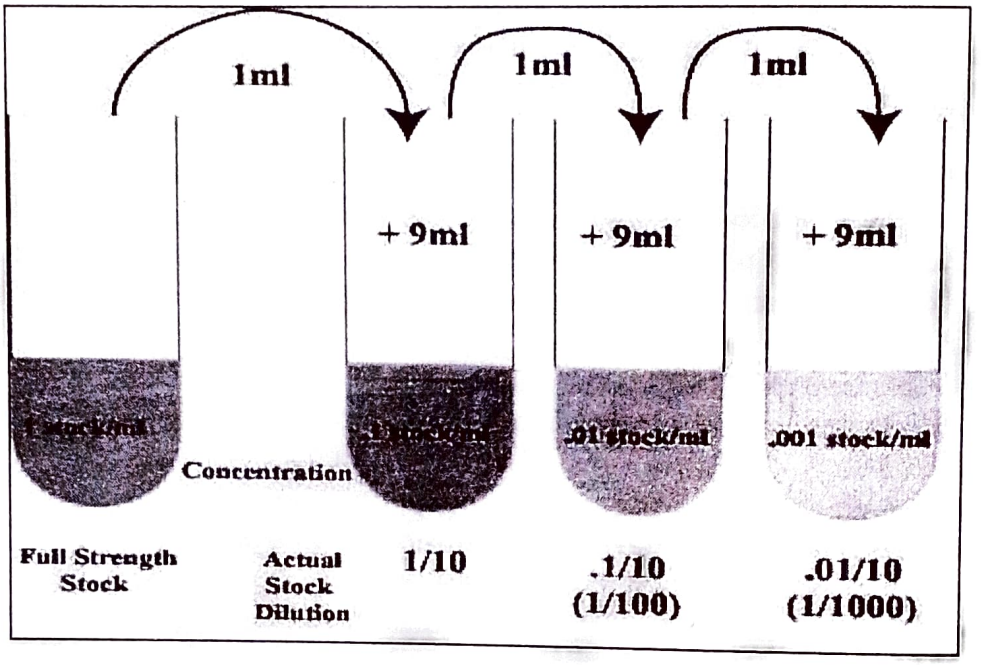
Bacterial cultures were grown and maintained on or in solid and liquid substances called media. Preparation of these media involved weighing ingredients, measuring liquid volumes, calculating proportions, handling basic laboratory glassware, and operating an autoclave under aseptic condition.

Sterilization of plates and media was required to yield a pure culture of bacteria through placing them in an autoclave at a temperature greater than 120 °C and at an exposure period of 15 to 20 minutes, and through methods of preparing plates for plate counts which included spread and pour plate method. Thus, materials that were used in this study underwent the sterilization process.

A. Serial Dilution

Serial dilution was required to sufficiently reduce the cell density to achieve countable plates. A countable plate is one that contains between 30 and 300 individual colonies.

In serial dilution, the original inoculum was diluted in a series of dilution tubes. Each succeeding dilution tube had only one-tenth (1ml) the number of microbial cells as the preceding tube using a micropipettor. The samples of the dilution were used to inoculate Petri plates on which colonies grew and could be counted. This count was then used to estimate the number of bacteria in the original sample.



Serial Dilution Method

B. Spread Plate Method

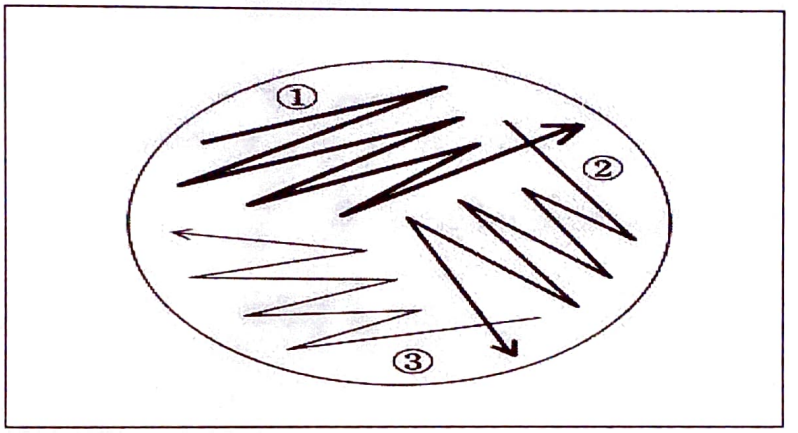
The spread plate technique was a method of isolation in which a diluted microbial sample was deposited on an agar plate and spread uniformly across the surface with a glass rod. With a properly diluted sample, cells were deposited far enough apart on the agar surface to grow into individual colonies.

After incubation, a portion of an isolated colony was transferred to a sterile medium to begin a pure culture.

C. Streak Plate Method of Isolation

This method produced individual colonies on an agar plate. A portion of an isolated colony then was transferred to a sterile medium to start a pure culture. A back and forth motion was used in one quadrant of the agar plate without cutting the agar with the loop. Prior to that,

flamed the loop and then proceeded. The next step followed by rotating the plate nearly by 90°. Before restreaking it directly to the next quadrant, touching the agar in an uninoculated region was recommended to cool the loop and then restreaking followed. The same procedure was done to the third quadrant. Incubation of the plate in an inverted position followed at the assigned time and at the appropriate temperature.



Streaking Method and Direction

Taxonomic Identification of Isolates from NICU Bath Basins

I. Cultural Characterization

Nutrient Broth and Nutrient Agar are common media used for maintaining bacterial cultures. Generally, these are provided in digests of plant material (phytone) or animal material (peptone and others). Because the exact composition and amounts of carbon and nitrogen in these ingredients are unknown, general growth media are considered to be undefined. Microbiological growth media were prepared to cultivate microbes. These general media were used to maintain bacterial stock cultures.

a. Growth on Nutrient Agar Plates

Bacteria grow in and on solid media as colonies. Solidified Nutrient Agar is an essential medium for bacterial growth where bacterial isolates and colonies grow. Characterization of different bacterial isolates was made by describing the colonies including their shape, size, margin/edge, elevation, color, and their consistency.

b. Growth in Nutrient Broth

Nutrient Broth in liquid form was used as a medium during the sampling procedure to ensure growth of bacteria while the samples are transported. Some organisms floated and produced a type of surface membrane while others sank to the bottom. Some bacteria produced uniform fine turbidity, and others appeared to clump in flocculent growth. Bacterial quantities were controlled through serial dilution to produce a pure culture and countable isolates.

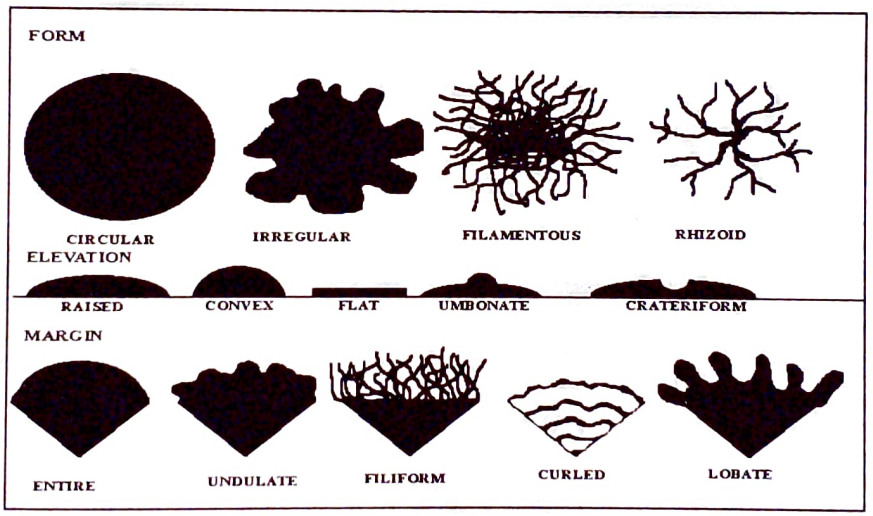
c. Growth on Agar Slants

Agar slants are useful primarily as media for cultivation and maintenance of stock cultures. This medium was prepared, after sterilization by placing the tube at an angle during cooling period until a slanted surface was formed. Streaking and incubation then followed for 24 to 48 hours, and patterns of bacterial growth were observed after the incubation.

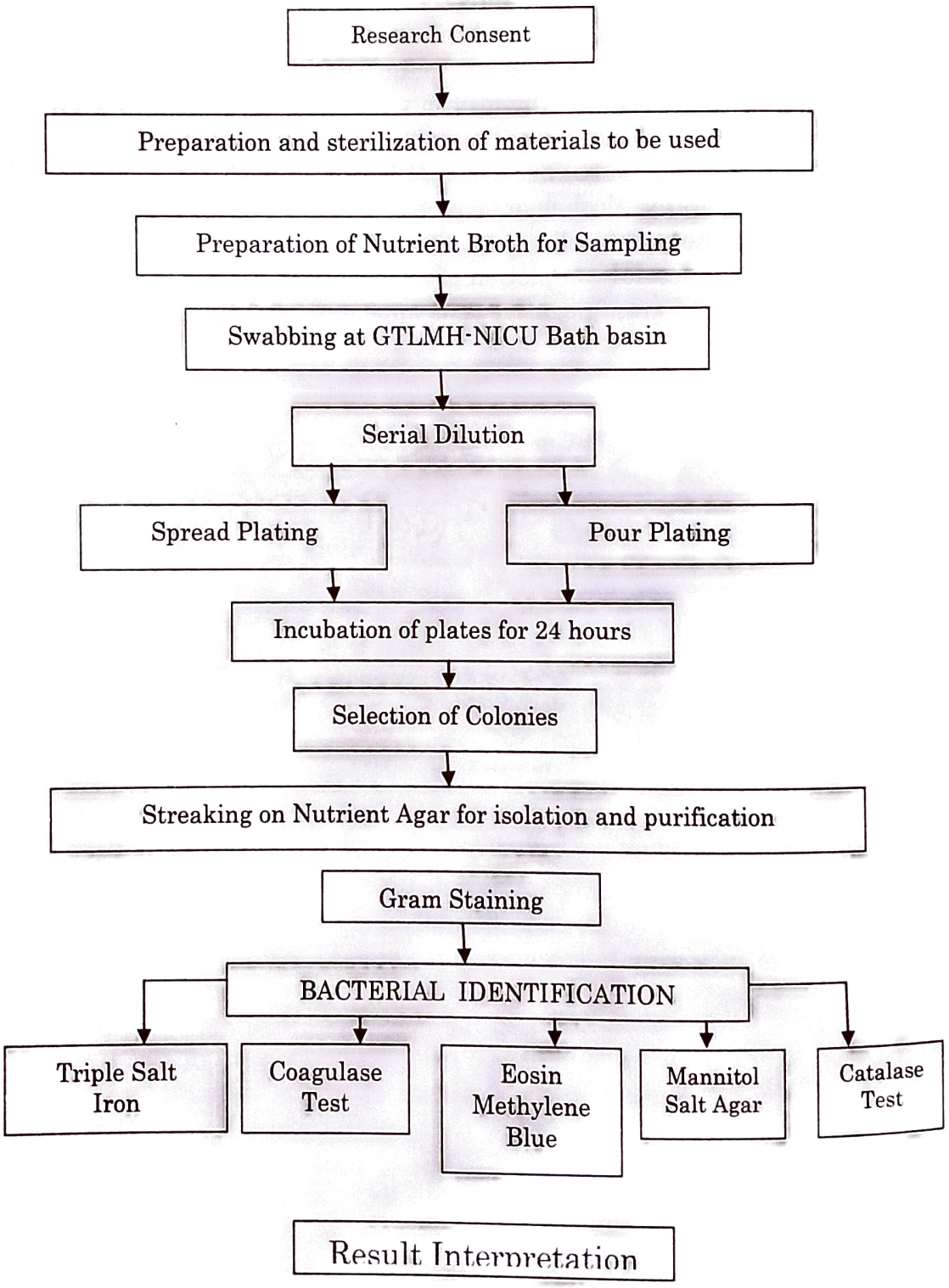
II. Morphological Characterization by Gram Staining

The gram stain used to distinguish between Gram-positive and Gram-negative cells is the most important and widely used microbiological differential stain. This stain allows determination of cell

morphology, size, and arrangement. It is typically the first differential test run on a specimen brought into the laboratory for identification. A decolorization step occured between the applications of two basic stains. The primary stain was crystal violet. Iodine was added as a mordant to enhance crystal violet staining by forming a crystal violet-iodine complex. Decolorization followed and was the most critical step in the procedure. Gram negative cells were decolorized by the solution (of variable composition- generally alcohol or acetone) whereas gram positive cells were not. Gram negative cells were thus colorized by the counterstain safranin. Upon successful completion of a Gram Stain, gram positive cells appeared purple and gram negative cells appeared reddish-pink.



Different Colonial Morphologies (e.g. shape, elevation and form) (Hurlbert, 1999).


Research Consent
Preparation and sterilization of materials to be used
Preparation of Nutrient Broth for Sampling
Swabbing at GTLMH-NICU Bath basin
Serial Dilution
Spread Plating
Pour Plating
Incubation of plates for 24 hours
Selection of Colonies
Streaking on Nutrient Agar for isolation and purification
Gram Staining
BACTERIAL IDENTIFICATION
Triple Salt Iron
Coagulase Test
Eosin Methylene Blue
Mannitol Salt Agar
Catalase Test
Result Interpretation

III. Physiological Characterization through Biochemical Tests

Biochemical tests were performed to clearly determine and differentiate the specific bacteria examined based on their specific biochemical characteristics.

a. Catalase Test

This test was used to identify organisms that produce the enzyme catalase. It was used most commonly to differentiate members of the catalase-positive Micrococcaceae from the catalase-negative Streptococcaceae.

Bacteria that produced catalase could be easily detected using typical store-grade hydrogen peroxide. When hydrogen peroxide was added to a catalse-positive culture, oxygen gas bubbles form immediately. If no bubbles occured, the organism was catalase-negative. This test could be performed on a microscope slide or by adding hydrogen peroxide directly to the bacterial growth.

b. Mannitol Salt Agar

Mannitol Salt Agar was used for isolation and differentiation of pathogenic *Staphylococcus* species, principally *S. aureus*. It contains carbohydrate mannitol, 7.5 % sodium chloride, and the pH indicator phenol red. Phenol red is yellow below pH 6.8, red at pH 7.4 to 8.4, and pink at pH 8.4 and above. The sodium chloride makes the medium selective for staphylococci because most other bacteria cannot survive in this level of salinity. The pathogenic species of *Staphylococcus* fermented mannitol and produced acid, which turned the pH indicator yellow. Nonpathogenic staphylococcal species grew but produced no color change. The development of yellow halos around the bacterial growth provided strong evidence that the organism was a pathogenic *Stapylococcus* (usually *S. aureus*). Good growth that produced no color change was evidence for nonpathogenic *Staphylococcus.*

c. Eosin Methylene Blue Agar

Eosin Methylene Blue (EMB) Agar was used for isolation of fecal coliforms. It could be streaked for isolation or used in the Membrane Filter Technique. EMB Agar contains peptone, lactose, sucrose, and the dyes eosin Y and methylene blue. The sugars provided fermentable substrates to encourage growth of fecal coliforms. The dyes inhibited the growth of Gram-positive organisms and, under acidic conditions, also produced a dark purple complex usually accompanied by a green metallic sheen. This sheen served as an indicator of the vigorous lactose or sucrose fermentation typical of fecal coliforms. Smaller amounts of acid production (typical of *Enterobacter aerogenes* and slow lactose fermenters) resulted in a pink coloration of the growth. Nonfermenters retained their normal color or took on the coloration of the medium.

d. Triple Sugar Iron Agar

Triple Sugar Iron (TSI) was primarily used to differentiate members of *Enterobacteriaceae* and to distinguish them from other Gram-negative bacilli such as *Pseudomonas* or *Alcaligenes*. It is a rich medium designed to differentiate bacteria on the basis of glucose fermentation, lactose fermentation, sucrose fermentation, and sulfur reduction. In addition to the three carbohydrates, it includes beef extract, yeast extract, and peptone as a source of reducible sulfur. Phenol red is the pH indicator, and ferrous sulfate is the hydrogen sulfide indicator.

The medium was prepared as an agar slant with a deep butt, thereby providing both aerobic and anaerobic growth environment. It was inoculated by a stab in the agar butt followed by a fishtail streak of the slant. The incubation period was 18 to 24 hours of carbohydrate fermentation and up to 48 hours for hydrogen sulfide reactions. When TSI was inoculated with a glucose-only fermenter, acid products lowered the pH an turned the entire medium yellow within a few hours. Because glucose is in short supply (0.1%), it wss exhausted within about 12 hours. The organism then began to break down amino acids in the medium, producing NH3 and raising the pH. This process was called reversion. After 18 to 24 hours the alkaline products was sufficient to turn the slant red but did not overcome the acid conditions in the butt which remained

yellow. Thus, a TSI with a red slant and yellow butt indicated that glucose was the only carbohydrate fermented.

Organisms that were able to ferment lactose and/or sucrose turned the medium yellow throughout. However, because the concentrations of lactose and sucrose in the medium were much higher (1.0%) than that of glucose, resulting in greater acid production, both slant and butt remained yellow after a 24-hour incubation period. Therefore, a tube after 24 hours that had a yellow slant and butt indicated that glucose and either or both of the other two carbohydrates were fermented. Gas produced by fermentation of any of the three carbohydrates appeared as fissures in the medium or lifted the agar off the bottom of the tube.

Hydrogen sulfide (H2S) was produced by the reduction of thiosulfate in the medium or by the breakdown of cysteine in the peptone. Ferrous sulfate reacted with the H2S to form a black precipitate, usually seen in the butt. Acid conditions existed for thiosulfate reduction; therefore, black precipitate in the medium was an indication of sulfur reduction and fermentation. If the black precipitate obscured the color of the butt, the color of the slant determined which carbohydrates have been fermented (i.e., red slant- glucose fermentation, yellow slant- glucose and lactose and /or sucrose fermentation).

An organism that did not ferment any of these three carbohydrates but utilized peptone and amino acids alkalinized the medium and turned it red. If the organism could use the peptone aerobically and anaerobically, both the slant and butt will appear red. An obligate aerobe will turn only the slant red.

e. **Blood Agar**

Blood Agar was used for isolation and cultivation of many types of fastidious bacteria. It was also used to differentiate bacteria based on their hemolytic characteristics, especially within the genera *Streptococcus, Enterococcus,* and *Aerococcus.*

Research consent was given by the Hospital Medical Director before starting and performing the procedure. Upon approval, media and materials to be used during swabbing were prepared for sterilization process. For the bacteria to grow, a liquid medium known as Nutrient Broth was prepared and sterilized. With complete materials as well as the

medium to be used, sampling proper via swabbing on the NICU newborn bath basins was performed and these swab samples were transported immediately at the Laboratory for bacterial identification.

To provide a countable and acceptable number of colonies, a standard serial dilution was done. In this study, the spread plate method was applied to yield a pure culture of specific microorganisms. After properly spread, incubation of plates for 24 to 48 hours followed. After incubating these plates, a pure colony was selected and was streaked on a solid Nutrient agar for bacterial growth and would serve as the mother culture. Another period of incubation for 24 hours followed after streaking. An initial test run known as the Gram Stain Method was used to identify gram-positive and gram-negative microorganisms and consequently, biochemical tests such as the Catalase test, Eosin Methylene Blue, Triple Salt Iron Agar, Coagulase, and Mannitol Salt Agar tests were then performed. After performing all biochemical tests, results were interpreted for bacterial identification.

Conclusion

Results can be associated through possible bacterial transmission during newborn delivery and newborn bathing whereby such bacteria are capable of residing in areas of the bath basin. The presence of pathogenic bacteria on the bath basin of the NICU of GTLMH in Iligan City should be monitored by the staff of the NICU and the hospital administration as they carry risks which may cause harm to the newborns such as ophthalmic infections arising from *Neisseria spp.*; respiratory and skin infections from *Staphylococcus aureus*; bloodstream, skin, urinary and respiratory tract infections from *Enterobacter spp.*; neonatal sepsis, pneumonia, and other streptococcal infections from *Streptococcus spp.*; common bacterial infections such as diarrhea and pneumonia from *E. coli*; diarrhea from *Bacillus spp.*; and skin and respiratory infections from *Klebsiella spp.* Therefore, it evidently shows that there is a significant relationship between the bath basin and the microorganisms found in the basin.

Hence, as much as possible, disinfection and cleaning of the bath basin every after use should be done to avoid contamination of the basin. Thus, newborn complications will be prevented from occurring.

More importantly, hospital administrators especially the chief nurse should take into consideration the number of staff nurses working in the NICU. There should be enough number of nurses working in the NICU to provide the best care possible to the newborns.

Recommendations

1. The Hospital and Nursing Administrators – The number of staff nurses working in the NICU should be taken into consideration. Enough number of nurses should be delegated to ensure sterility of equipments and to provide optimal care to newborns. Also, if possible, autoclave bath basins aside from disinfecting and cleaning them regularly to promote sterility of the equipment.

2. The Delivery Room Staff – It is recommended to perform thorough perineal care before delivery of the baby to minimize, if not eliminate, transmission of microorganisms from the mother's passageway to the baby.

3. The NICU Staff – It is recommended that bath basins be thoroughly cleaned and disinfected using disinfecting agents every after use. Thorough hand washing is also recommended before and after handling the newborns. Aside from that, extra sterile basins should be reserved in cases of multiple deliveries.

4. The Nurse Educators – Clinical instructors as well as nursing students should be aware of the possible microbial flora which could be transmitted from bath basins. In this way, there would be emphasis on the provision of care to newborns and strict aseptic technique will be maintained, if possible to preserve the health of every infant. Awareness to the cause, signs and symptoms and managements of infection cases which may arise from contaminated materials should be emphasized to the parents of the newborns as well as information regarding complete immunization.

5. The Parents and the Neonates– Optimal health of the parents of the newborns should be maintained to avoid cross contamination

or infection to the newborns. Parents and neonates as well are suggested to have monthly physical examinations or check – ups to ensure their health.

6. Infection Control Staff – thorough cleaning and disinfecting regularly of the bath basins should be done in order to avoid infection to the newborn. Autoclaving of the bath basins, if possible, is highly recommended as well. Aside from that, thorough cleaning and disinfecting of the surroundings of the basin such as the sink, is suggested to ensure cleanliness and sanitation of the area.

7. Laboratory technicians and Microbiologists– a detailed identification of the microorganisms is recommended along with identifying other microorganisms not identified using more biochemical test to specify these bacteria that carry infection. Aside from that, DNA –based characterization of the bacterial isolates can be used for accuracy and precision.

8. Future researchers – it is suggested that in future researches involving the bath basins in the neonatal intensive care units of all the hospitals in Iligan City, identify possible microbial flora on basins of other specialized areas or units in hospitals, specify the bath basin to be swabbed (whether for Hepa or Non- Hepa patients), as well as include the intervening variables such as the length of stay of the newborns, the physiologic maturity, and the sources of water supply and the sterility or cleanliness of the storage material for water. Antibiotic resistance should also be done to determine whether the isolated microorganisms are resistant to common antibiotics.

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