COLLEGE OF HEALTH SCIENCE

SCHOOL OF NURSING AND MIDWIFERY

MAGNITUDE AND ASSOCIATED FACTORS OF HOSPITAL ACQUIRED INFECTION IN NEONATES ADMITTED TO NEONATAL INTENSIVE CARE UNIT IN SELECTED PUBLIC HOSPITALS, ADDIS ABABA, ETHIOPIA, 2024

BY: BIRHAN ASAFAW AYELE (BSC)

A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY, COLLAGE OF HEALTH SCIENCES, SCHOOL OF NURSING AND MIDWIFERY, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTERS OF SCIENCE IN NEONATAL NURSING

MAY, 2024

ADDIS ABABA, ETHIOPIA

ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

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Title	Magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospitals in Addis Ababa, Ethiopia, 2024
Duration of study	From February 19/2024 to March /19/2024.
Total budget	**26,754 ETB**.

APPROVAL SHEET

I, the undersigned MSc student, declare that I have submitted my original thesis work entitled magnitude and associated factors of hospital acquired infection in neonatal intensive care unit at selected public hospitals of Addis Ababa, Ethiopia, 2024 for examination.

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DECLARATION

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in this or another university and that all sources of materials used for this thesis have been fully acknowledged.

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STATEMENT OF THE AUTHOR

By my signature below, I declare and confirm that this thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this thesis. Any scholarly matter that is included in the thesis has been given recognition through citation.

This thesis is submitted in partial fulfillment of the requirements for a master's degree in neonatal nursing at the Addis Ababa University. It will be submitted to Addis Ababa University library and is made available to readers under the rules of the library. I declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma of certificate.

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ACKNOWLEDGMENT

First of all, I would like to thank Addis Ababa University School of Nursing and Midwifery department which allowed me to prepare this thesis. 2nd I would like to convey my deep and sincere gratitude towards my advisors Dr. Erdaw Tachbele (PHD), and Sr. Yeshi Berhan (BSC, MSC) for providing invaluable guidance, support, advice, comments, suggestions, and provisions that helped in the completion of this proposal.

I would also like to express my deepest gratitude for all staffs of hospitals these study areas for their willingness & cooperative in providing the necessary ideas &materials. I also thank all data collectors & supervisors for their active role to participate in this study. I like to express my deepest gratitude to my colleagues & my families for their advice & support to do this research paper. My thanks go to all the people who have supported me to complete the thesis directly or indirectly.

Finally, a big thanks to Almighty GOD for giving me the strength, knowledge, ability and opportunity to undertake this proposal.

ABBREVIATIONS AND ACRONYMS

APGAR	Appearance, pulse, grimace, activity, respiration
CPAP	Continuous Positive Airway Pressure
CVC	Central Venous Catheter
ETB	Ethiopian Birr
GMH	Ghandi Memorial Hospital
HAI	Hospital acquired infection
Iv line	Intravenous Line
LP	Lumbar Puncture
MV	Mechanical Ventilation
NICU	Neonatal intensive care unit
NG/ OG tube	Nasogastric/ Oro gastric tube
PROM	Prolonged rupture of membrane
SPHMMC	St. Paul's Hospital Millennium Medical College
SPSS	Statistical Package for Social Science
UC	Umbilical Catheter
WHO	World health organization
Y12HMC	Yekatit 12 hospital medical college
ZMH	Zewuditu memorial hospital

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ABSTRACT

Back ground: Neonates are particularly vulnerable to Hospital Acquired Infections (HAI) due to the severity of the illness, compromised immune systems, and exposure to invasive medical procedures. It is global health concerns, particularly in neonatal intensive care unit (NICU) that causes morbidity, mortality, prolonged hospital stays, and higher treatment costs in both developed and developing nations**.**

Objective: To assess the magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospitals in Addis Ababa, Ethiopia, 2024

Methods: A five-year Institution-based retrospective chart review study design was employed among neonates admitted between January 1/ 2019 and December 31/2023. A total of 401 medical charts of neonates were reviewed from February to Mach 2024 using structured check list. The Collected Data was coded, entered into Epi-Data version 4.6, and analyzed by IBM SPSS version 26 statistical software. Factors associated with HAI were determined using bivariate and multivariate logistic regression models. Statistically significant associations were declared at P- value less < 0.05.

Result: The findings from this study revealed that the magnitude of hospital acquired infection in neonate was 125 (31.2%). In this study variables such as birth weight <2500grams (AOR=7.2, 95%CI: 1.45-35.6), antibiotics at admission (AOR=15.5, 95%CI: 3.3-74.5), mechanical ventilation (AOR=6.5,95%CI:1.19-22.5), transfusion (AOR=9.4, 95%CI: 3.7-25.9), Surgical procedure (AOR=3.7, 95%CI: 1.2-12.4), and antibiotics use >14 days (AOR=29, 95%CI: 4.5-186.0) were factors associated with hospital acquired infection in neonates. The predominant causative organisms were Klebsiella pneumonia (33.6%), Coagulase-negative staphylococci (CoNS) (24.8%), and Acinetobacter (17.6%).

Conclusion and recommendation: Magnitude of hospital acquired infection in neonates in Addis Ababa public hospitals neonatal intensive care unit is high. Therefore, give emphasis for future hospital acquired infection control and prevention activities. A review of treatment modalities and related infection prevention and control in neonatal management are the key to prevention, early detection and management of nosocomial infections

Key words: hospital acquired infection, neonates, NICU, nosocomial infection, sepsis

1. INTRODUCTION

1.1 Background

In a neonatal intensive care unit (NICU), severely sick infants are admitted and treated for a variety of conditions, the most prevalent of which is a hospital acquired infection (1). Hospital acquired infection (HAI) also known as nosocomial infection(NI) by the Centers for Disease Control and Prevention (CDC) defined as an infection acquired during the period of hospitalization that was absent before or at the time of admission and that must occur after 48 hours of hospital admission which are caused by pathogens that are not maternally derived, or within 30 days after receiving health care, or up to 90 days after undergoing certain surgical procedures(2, 3).

Newborn infections are caused by a variety of fetal, maternal, and NICU environmental factors(4). Because of their thinner, more permeable skin, undeveloped mucous membranes, underdeveloped innate and adaptive immune responses, significant exposure to medical devices, antimicrobial drugs, underlying severe disease, and frequent need for invasive operations, infants in the neonatal intensive care unit (NICU) are more susceptible to infections related to medical care(5).

The diagnosis of a nosocomial infection in a neonate is typically made based on clinical symptoms, laboratory tests, and imaging studies. Common signs and symptoms of nosocomial infections in neonates may include fever, poor feeding, lethargy, irritability, respiratory distress, and abnormal vital signs. Laboratory tests such as blood cultures, urine cultures, and cerebrospinal fluid analysis may be performed to identify the causative organism. Additionally, imaging studies such as chest X-rays or ultrasound may be used to assess for signs of infection in specific organs or body systems(1, 6).

HAI encompasses a variety of infections, such as bloodstream infections, pneumonia, meningitis, infections of the throat, eyes, ears, or nose, as well as secondary skin infections. These could be brought on by a combination of bacteria, viruses, and fungus(3). The majority of bacteria that cause HAIs are antibiotic-resistant, and they are important causes of mortality and morbidity in neonatal intensive care units(7). Staphylococcus aureus, coagulase-negative Staphylococci, and enterococci are the primary microbes that cause HAIs. Furthermore, there has been a noticeable rise in health-related infections (HAIs) caused by fungi and Gram-

negative bacteria, particularly Candida species(8). Any organ can be affected by nosocomial infections; however, compared to other organs, blood, the urinary tract, surgical wounds, and the lower respiratory tract are more commonly affected(9). Infectious agents from both endogenous and exogenous sources may be the cause of this infection. Skin, nose, mouth, gastrointestinal tract, or vagina are examples of endogenous sources. Hospital equipment, caregivers, and guests are examples of exogenous sources(10).

Predisposing factors for HAI are prematurity, low weight, extended hospital stays, Apgar scores, respiratory diseases, the use of broad-spectrum antibiotics, and in particular the use of invasive procedures like ventricular shunts, intubations, intravascular catheters, urinary catheters, parenteral nutrition, meconium-stained amniotic fluid (MSAF), instrumental delivery and insufficient hand washing by hospital staff are some of the factors that contribute to HAI(4, 9). Organizational risk factors that contribute to healthcare-associated infections (HAIs) include staffing levels, tainted water systems, and the physical design of the hospital (such as open beds near each other and a high nurse-to-patient ratio)(11, 12).

1.2 Statement of the problem

Neonates are particularly vulnerable to Hospital acquired infections (HAI) due to the severity of the illness, compromised immune systems, and exposure to invasive medical procedures and devices such central venous catheters or mechanical ventilators(13). Hospital-acquired infections, are global health concerns, which is a major problem in NICU that causes morbidity and mortality, prolonged hospital stays, and higher treatment costs in both developed and developing nations(1). Hospital acquired infections also increase risk of severe neurodevelopmental problems, particularly in premature infants(14).

In the population, newborns are the most susceptible group to illnesses, in 2010, there were 7.6 million deaths in under five-year-old worldwide; of these, 64% (4.9 million) were related to infectious diseases, and 40% (3.1 million) were neonates (6). In the NICU, the incidence of nosocomial infection is around 30%, and it is responsible for up to 40% of reported neonatal mortality in developing countries(3).The literature reports the rates of hospital acquired infections (HAI) per admission ranging from 6% to 50%. In high-income nations, 4-8% of hospitalized neonates experience hospital associated infection (HAI), which are common and dangerous complications(15). The rates of HAIs in underdeveloped nations are 3 to 20 times greater than those in wealthy countries(16).

Over the past few years, the rate of HAI in NICUs has increased. The majority of reports show that the incidence varies significantly depending on gestational age and baby birth weight, with a range of 6% to 25% (11).

According to studies, HAI may be avoided by implementing strategies that reduce susceptibility to infections by enhancing hand hygiene compliance, halting the spread of microorganisms from healthcare providers, avoiding invasive procedures, shortening the duration of catheter indwelling, and encouraging the prudent use of antibiotics(17). A basic infection control effort could prevent 6% of all nosocomial infections, and a well-organized and highly effective infection control program could prevent 32% of all nosocomial infections(18).

The majority of research on the risk factors for HAIs has been carried out in developed nations in highly developed, well-resourced, and advanced medical facilities. Financial limitations cause a lot of issues when it comes to HAI control in developing nations. Neonates with HAI are at high risk for negative outcomes due to multidrug resistance especially Carbapenem resistance, which can raise the chance of death by 27%(19). Ethiopia is a nation undergoing

socioeconomic change, and its health care system is overwhelmed with numerous issues. It is a hidden but serious burden for health systems and patients. In our setting, which is a busy NICU at a public hospital, a limited recent nosocomial infection study has been conducted. Therefore, good knowledge of prevalence and associated factors can help to make the right decisions to reduce and control HAI, so this study aimed at determining the magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit in Addis Ababa city among public hospitals that have NICU services.

1.3 Significance of the study

This study determined magnitude and factors associated with HAI, and it will help the Addis Ababa health bureau to emphasize on early diagnosis and proper management of the problems after the result is known and help to make the right decisions to reduce and control HAI. It will help health professionals to become aware of the severity of the problem and give attention and care for neonates with HAI thereby avoiding complications, prolonged hospital stays and minimize mortality and morbidity related to the problem. It will help to create awareness to any one of the readers of this research result based on the result finding.

The results of the study will also assist hospital administrators and health policy makers in determining the cause of healthcare-associated infections (HAIs) and implementing efficient control programs to implement various strategies to lower the rate of HAIs, lower the associated financial expenses, and conserve resources. It will also be a baseline for other researchers to do prospective cohort studies about HAI.

2. LITERATURE REVIEW

2.1 Magnitude of hospital acquired infection

HAIs are linked to higher rates of morbidity and mortality, longer hospital stays, and noticeably higher overall expenses, making them a growing concern to worldwide public health(3).

A study conducted in Canada registered that the magnitude of nosocomial infection among neonates in neonatal intensive care units was 11.7%(20). According to research done in NICUs across Europe, nosocomial infections impacted 11.4% of patients(9), which has similar magnitude with the result in prospective observational study conducted in Eastern India showing that the prevalence of hospital acquired infection among neonates was 11.98% and the mortality rates in patients with HAI was 17.2%(21). Another study conducted at New Delhi, India the prevalence of hospital acquired infection among neonates was 13.2%(22).

A prospective cohort study conducted in Ankara University School of Medicine, Turkey revealed that the overall incidence of hospital-acquired infections was 17% from these the total mortality rate attributed to HAI was 10.8% (23). A descriptive, cross-sectional, prospective study conducted in the NICU of Ali Asghar Children Hospital, Iran showed that the prevalence of hospital-acquired infections was 13.5%(14). Similarly, A cross-sectional study conducted in neonatal intensive care unit of Besa hospital, Iran shows that the prevalence hospital acquired infection was 15.96%(10). According to a prospective cohort study conducted in Serbia the prevalence of hospital acquired infection was 18.6%(24).

A cohort study conducted in the neonatal intensive care unit of Abha general hospital, Saudi Arabia revealed that the magnitude of hospital acquired infection was 19.2%(25). Similarly, a cohort study conducted in Al-Azhar university hospital, Cairo, Egypt showed that the prevalence of nosocomial infection was 20% (26). On the contrary a prospective cohort study was conducted in Ain Shams University Hospital, Egypt shows that prevalence of hospital-acquired infections was 28% from these the total mortality rate attributed to HAI was 11.75% (27). A retrospective descriptive study conducted at Mohamed VI Marrakech University Hospital, Morocco revealed that the magnitude of hospital acquired infection was 16%(28).

A cross-sectional survey study conducted at Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria shows that the magnitude of hospital acquired infection was 8.9%(29). On the

other hand, the study conducted in Botswana revealed that the prevalence of hospital acquired infection was 41.9%(30).

2.2 Types of pathogens

A study conducted in India revealed that gram positive cocci (staphylococcus aureus) (67%) and gram-negative bacilli (acinetobacter baumanii, escherichia coli and pseudomonas aeruginosa) (33%) were the most common isolates from neonates who develop HAI (22). Whereas another study conducted in Turkey showed that gram-negative pathogens (60 %) from which enterobacter (33.3%), acinetobacter baumannii (25%), klebsiella pneumonia (13.9%), escherichia coli (11.1%), serratia spp. (11.1%) and pseudomonas aeruginosa (5.5%) were more predominant pathogen's followed by gram-positive pathogen (28.3%) like; Enterococcus species (47.1%), Staphylococcus aureus (23.5%), Cons (23.5%) and Group B Streptococcus (5.9%) were a common isolates(17).

A study done in Iran revealed that Gram-positive bacteria (59.6%)from this; cons (56.1%) and staphylococcus aureus (3.5%) followed by gram-negative pathogens (40.4%) escherichia coli (21%), klebsiella (14.1%) and entrobacter (3.5%) were the most prevalent pathogenic cause of nosocomial infection(31). According to a retrospective study conducted in Morocco indicated that klebsiella pneumoniae (43.6%), staph coagulase negative (25.2%), enterobacter cloacae (6.4%), serratia marcescens (6.4%), escherichia coli, (3.6%), enterobacter faecalis, (3.6%), acinetobacter baumani, (3.6%) and pseudomonas (1.2%) were the prevalent pathogenic cause of hospital acquired infection(32).

A Systemic Review and Meta-analysis of the Leading Pathogens conducted in Ethiopia showed that the leading cause of pathogens for nosocomial infection in developing countries were klebsiella (26.36%), staphylococcus aureus (23.22%), coagulase-negative Staphylococcus (23.22%), and escherichia coli (15.30%) (33). According to a cohort study conducted in Ethiopia showed that Coagulase Negative Staphylococcus (CONS) (25.7%), staphylococcus aureus (22.0%; 24/109), klebsiella species (16.5%), micrococcus spp. (2.8%), group B streptococcus (2.8%) and Listeria monocytogenes (0.9%) were the three predominant bacteria isolated (34). Similarly, a study conducted in Ethiopia revealed that Gram-negative bacterial species were the most commonly isolated organism (58.2%) compared to Gram-positive

organisms (39.1%). The bacteria that were most typically isolated were Klebsiella species (33.9%), Coagulase negative Staphylococcus (CoNS) (18.2%), staphylococcus aureus, (16.9%), escherichia coli (5.2%), Serratia spp (4.3), enterobacter spp (3.9%) and acinetobacter spp (2.6%) (35).

2.3 Associated factors of hospital acquired infection in neonate

Associated factors for hospital acquired infection in neonates includes; characteristics of the mother, neonatal factors and therapeutic interventions.

2.3.1 Characteristics of the mother

According to a study conducted in China revealed that being Twins or triplets and gestational age <32 weeks were independent factors for NI for nosocomial infection(36). An observational, analytical case-control study conducted in the neonatal intensive care unit at Mahatma Gandhi Memorial hospital, India shows that multiple deliveries, prolonged rupture of membranes and gestation age (<37 weeks) are strongly associated with hospital acquired infection, but, there was no significant association between the age of the mother(6). Similarly, a prospective cohort study conducted in a Neonatal Intensive Care Unit at Ujjain, India shows that Gestational age <37weeks and PROM mothers have significant associations with hospital acquired infection(4).

2.3.2 Neonatal factors

A Systematic Review and Meta-Analysis study from China shows that there was a significant association between hospital acquired infection and low birth weight (<2500gm), being preterm and asphyxia(19). Similarly, a study conducted NICU of Guangzhou Women and Children's Medical Center, China showed that Gestational age < 32 week, birth weight <2000 gm were significantly associated with nosocomial infection(36). Another case control study conducted in India, shows that lower gestational age, male gender and Apgar score less than 7 at 5 min are strongly associated with hospital acquired infection(16). Similarly, another observational, analytical case-control study was conducted in the neonatal intensive care unit at Mahatma Gandhi Memorial hospital, India, shows that low birth weight, and prematurity are strongly associated with hospital acquired infection(6).

A study conducted in Turkey shows that, fifth-minute Apgar less than 7, low birth weight, and long length of hospitalization were major factors for hospital acquired infection(12). In addition,

prospective cohort studies conducted in Serbia indicated that independent risk factors for hospital acquired infections were birth weight, length of hospitalization, duration of mechanical ventilation, and Apgar score <7 at 5^{th} minute have significant association(24).

A cross-sectional study conducted in neonatal intensive care unit of Besa hospital, Iran shows that low birth weight and length of hospitalization had statistically significant relationship with hospital acquired infection(10). A prospective cohort was conducted in Egypt showed that the major associated factors for hospital acquired infections were very low and low birth weight, gestational age <38 weeks and increased hospital length of stay(37). Similarly, another study conducted in Egypt, shows that low birth weight and prematurity were the most important neonatal factors in the occurrence of HAI(38).

2.3.3 Therapeutic interventions

According to a study conducted in China revealed that mechanical ventilation, gastric tube feeding, operation, duration of prophylaxis antibiotic use, and duration of parenteral nutrition were the risk factors associated with hospital acquired infections in NICU(36). A prospective observational study conducted in, Eastern India showed that prior antimicrobial therapy, urinary catheterization, endotracheal intubation, re-intubation, tracheostomy, placement of nasogastric tube, mechanical ventilation, antibiotics at admission and length of ICU stay were found to be statistically significant risk factors associated with hospital acquired infection(39). Similarly, a study in Iran showed that invasive procedures (such as umbilical catheters, central venous catheters, surgery, intubation, and TPN) are statistically significant factors for hospital acquired infection(9).

A study done in Bulgaria revealed that intubation, duration of antibiotic therapy (>7 days), and PVC indwelling time (>14 days) were strongly associated with HAI(40). A laboratory-based, active, prospective nosocomial infection surveillance conducted in Turkey indicated that therapeutic interventions which are associated with hospital acquired infection were,, prolonged intubation, prolonged mechanical ventilation and reintubation(41). Similarly, another retrospective study was conducted in the clinic of neonatology in Dicle university Turkey shows that Surgical operation, antibiotics at admission and transfusion with blood product have significant association with hospital acquired infection in neonate (42).

According to a case control study in Mexico indicated that CVC, prolonged Hospital stay, surgeries, and MV (> 7 days) were found to be significant predictors of HAI (43). Whereas a study conducted in Zagazig University Hospital, Egypt, showed that umbilical catheterization, endotracheal tube insertion, IV cannula, gastric tube insertion, and TPN uses are significantly associated therapeutic interventions for hospital acquired infection in NICU(38). Similarly, another A prospective study was conducted in Ain Shams University Hospital of Obstetrics and Gynecology, Egypt shows that there were a strong significant association between gestational <37 weeks (AOR, 1.65), age birth weight <1500gms (AOR, 1.39), mechanical ventilation (AOR, 1.74), and surgical procedures (AOR, 1.65). and hospital acquired infection (27).

2.3 Conceptual framework

A conceptual framework is to determine the magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit was developed based reviewing the literature (6, 9, 12, 21, 24, 27, 38). This conceptual framework shows hypothesized associations between hospital acquired infection and different risk factors such as characteristics of the mother, neonatal factors, therapeutic intervention, and pathogens those have directly association to HAI.

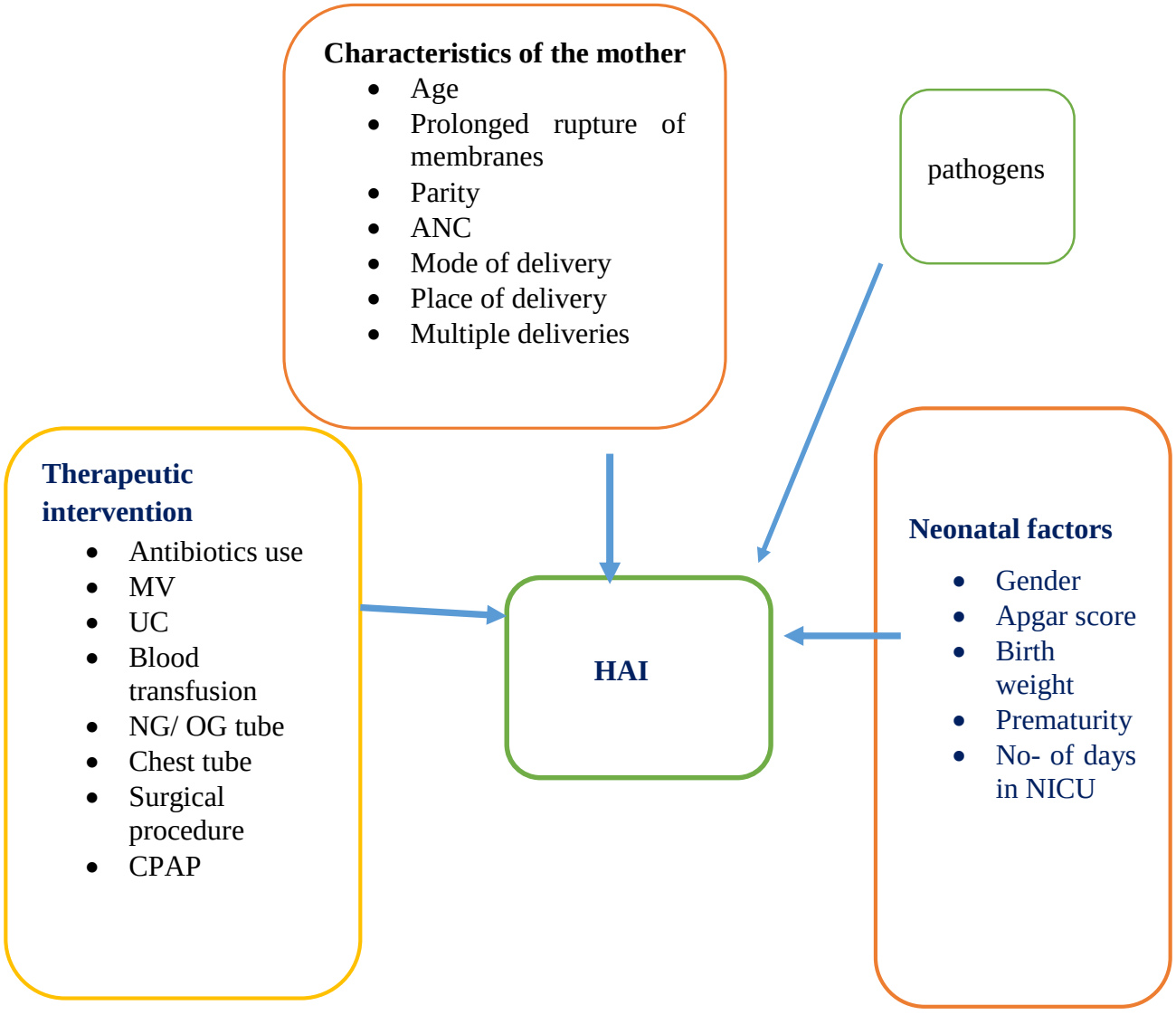

Figure 1. Conceptual framework developed from different literature for the magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care units.

3. OBJECTIVES

3.1 General objective

- To assess the magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospitals in Addis Ababa, Ethiopia, 2024

3.2 Specific objectives

- To determine the magnitude of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospitals in Addis Ababa, Ethiopia, 2024
- To identify factors associated with hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospitals in Addis Ababa, Ethiopia, 2024

4. METHODS

4.1 Study Area

This study was conducted in selected public hospitals in Addis Ababa, Ethiopia's capital city. Addis Ababa, also serves as the home of the African Union and the United Nations World Economic Commission for Africa. It has an area of 527 square kilometers and situated between 2320 and 3000 meters above sea level, and has an annual average temperature range of 10 and 32 degrees Celsius with annual rainfall around 1200mm. There are 11 sub cities in the city. The city's expected population in 2023 was 5.46 million, according to population prediction values(44). In Addis Ababa, there are 13 public hospitals, of which, one university hospital, six federal hospitals, and six regional hospitals. Among these eleven of them provide intensive neonatal care. Out of which, four hospitals were randomly selected, namely ST. Paul's Hospital Millennium Medical College, Yekatit 12 Hospital Medical College, Ghandi Memorial Hospital, and Zewuditu Memorial Hospital.

St. Paul Millennium Medical College Hospital (SPMMC) is under the Ministry of Health, The Hospital has 3,000 annual admissions of neonates and it has 250 average monthly admissions of neonates. Zewuditu Memorial Hospital is one of the public hospitals under the Addis Ababa City Administration Health Bureau. The average annual admission rate is 1908 and the average monthly admission is 159 neonates. Gandhi Memorial Hospital (GMH) is one of the public Hospitals under the Addis Ababa City Administration Health Bureau The average annual admission rate is 2,280 and the average monthly admission is 190 neonates. Yekatit 12 Hospital Medical College(Y-12HMC) is also under Addis Ababa Health Bureau and has 200 average monthly admissions of neonates in the neonatal intensive care unit and 2400 annual admissions.

4.2 Study design and period

An institution based retrospective cohort study design was used to review the document of all neonates who were admitted to NICU of selected public hospitals. The study was conducted from February 19/2024 to March /19/2024. Data collection was done using chart review and data abstraction form.

4.3 Target population

All neonates who were admitted and treated in the NICU of Addis Ababa public hospital.

4.4 Source of population

The source of population was all neonates who were admitted and treated in the NICU of in Addis Ababa from January 1/ 2019 to December 31/2023.

4.5 Study population

The study population was all neonates who were admitted and treated in the NICU of selected public hospitals during the study period.

4.5 Inclusion and exclusion criteria

4.5.1 Inclusion criteria

All neonates admitted to the neonatal intensive care unit during the study period who were hospitalized for more than 48 hours and neonates who were ≥ 28 weeks of gestation.

4.5.2 Exclusion criteria

Those patients who stay in the NICU was less than 48 hours and neonates transferred to the NICU with a diagnosis of sepsis.

4.6 Sample size determination

The sample size of study participants is calculated using the single population proportion formula. The calculation considered the magnitude of hospital acquired infection among neonates in neonatal intensive care units as 50% since there is no study done in Ethiopia. By using the following formula, the sample size calculated for P=50% is 384.

$$n=Z(\frac{\alpha}{2})^2 \ \frac{P(1-P)}{d^2}$$

Where, n = required sample size

Z α/2 = critical value for normal distribution at 95% confidence level (1.96)

P= the magnitude of hospital acquired infection among neonates in neonatal intensive care unit

d= 0.05 is margin of error.

Then after adding 38(10%) nonresponse rate, the optimal sample size will be 422.

4.7 Sampling procedure and technique

There are a total of 13 public hospitals in Addis Ababa city among this 11 of them deliver NICU service, and from these 4 hospitals are selected by lottery method and the calculated sample size is distributed to each hospital by proportionally depending on the number of admitted neonates with in the last five years, then from each hospital by using systematic random sampling neonates with hospital acquired infection was selected from the sample size proportionally distributed to each hospital. The total admitted of neonates over the past five years to ZMH, Ghandi Memorial hospital, Yekatit 12 medical hospital college and SPHMMC are 47,940 from these 22,778 patients were stayed more than 48 hours after admission (table 1).

Table 1. Proportional allocation of total sample size from selected hospitals based on the previous 5 years' enrollment data using proportional allocation formula

Name of selected hospitals	Previous 5 years' admission report and Proportional allocation												
	2019		**2020**		**2021**		**2022**		**2023**		**TA**		Total
	NA	AL	NA	AL	NA	AL	NA	AL	NA	AL	TA		
ZMH	864	**16**	860	**16**	902	**17**	868	**16**	908	**17**	**82**	4402	
SPHMMC	1344	**25**	1236	**23**	1512	**28**	1584	**29**	1824	**34**	**139**	7500	
Y12HMC	960	**18**	1032	**19**	1200	**22**	1284	**24**	1380	**26**	**109**	5856	
GMH	936	**17**	864	**16**	1008	**19**	1140	**21**	1032	**19**	**92**	4980	
											422		22,738

NB.

NA – Number of admission who stayed more than 48 hours, **AL** – Allocation, **TA** total allocation

The total sample frame of the study is **22,738**

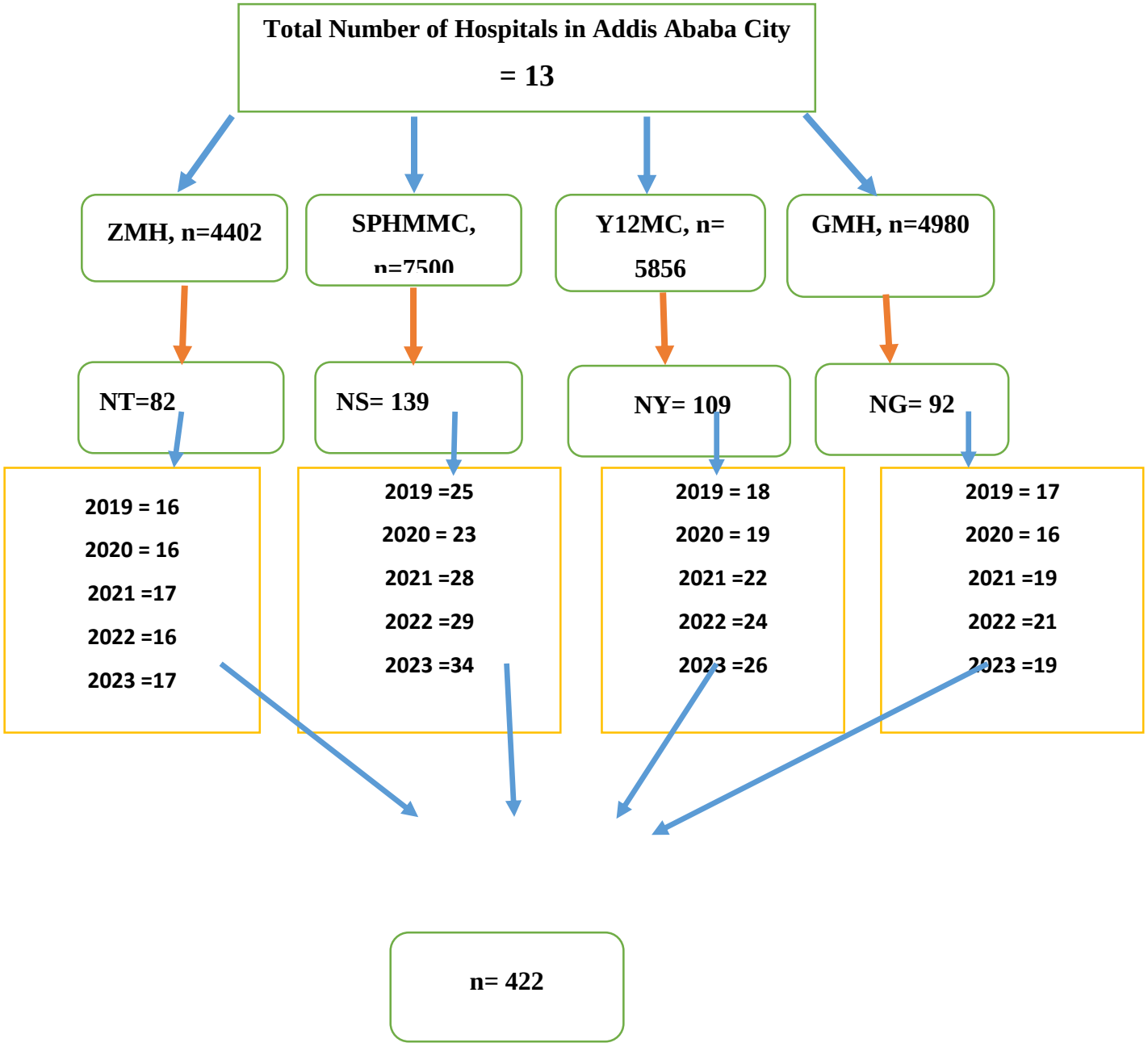

Figure 2: Sampling procedure and technique used to identify magnitude and associated factors of hospital acquired infection among neonates admitted in NICU at selected public hospital of Addis Ababa.

4.8 Study variables

4.8.1 Dependent variable

- Magnitude of hospital acquired infection

4.8.2 Independent variables

- Characteristics of the mother, (Age, Prolonged rupture of membranes, Parity, ANC, Mode of delivery, Place of delivery, Multiple deliveries).
- Neonatal factors (Gender, Apgar score, Birth weight, Prematurity, No- of days in NICU).
- Therapeutic interventions (Antibiotics use, MV, UC, Blood transfusion, NG/ OG tube, Chest tube, Surgical procedure, CPAP).
- Types of pathogen

4.9 Operational definition

Neonate- the neonatal or newborn period is the 1st 4 week or 28 days of extra uterine life(45).

HAI - A hospital acquired infection is an infection that occurs after 48 hours of hospitalization and was not present prior to or at the time of admission which is proven by the attending physicians.

Magnitude of HAI- the number of neonates who develop HAI at the time of NICU during the study period.

4.10 Data collection instrument and procedure

4.10.1 Data collection instrument

The data was collected by record review using pre-tested structured checklists that have been incorporated and modified from various works of literature (1, 3, 6, 21, 31). The checklists are made up of questions on magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care units. The question address three sections: characteristics of the mother, neonatal factor and therapeutic intervention variables.

4.10.2 Data collection procedure

Neonates who meet the inclusion criteria was selected by systematic random sampling from the sample size proportionally distributed to each hospital and the relevant information on the neonate was gathered and reviewed from their medical records. Four nurses with a BSc in nursing and one senior supervisor with a BSc in nursing who work in neonatal care facilities and have experience in collecting data was selected and trained to collect the data. The data collectors and supervisors were trained for one day on the relevance of the study, the confidentiality of client information, eligibility criteria, and how to collect the data.

4.11 Data quality control

The tool to conduct this study was written in English language. The data collectors were received training on data collection methods prior to the actual data collection day. During the training, mechanisms for ensuring the confidentiality of the information of the neonates throughout the whole data collecting and study process was discussed and established. To assure the quality of the data, the supervisors was examined the consistency and completeness of the questionnaires filled out by the data collectors. The supervisor was also pay a visit to the data collectors during the data collection period. Before the actual data collection pre-test was conducted on 5% of the sample size (22 charts) at MIIH two weeks before the actual data collection to evaluate the clarity of questions, reliability and validity of the instrument that was used.

4.12 Data analysis and processing

The Data was cleaned manually, coded, and entered into SPSS and analyzed by IBM SPSS version 26 statistical software. Continuous data was summarized using descriptive statistics of percentile, frequency, mean, and standard deviation. Multicollinearity tests among the independent variables were done by the variance inflation factors (VIF = 1.04-5.90). The Hosmer-lemeshow goodness test was used to test model fitness (0.42) and binary logistic regression was employed to identify the magnitude and associated factors of HAI. After bivariate logistic regression analysis, P-value <0.25 was taken as a cut-off point to select variables eligible for multiple logistic regression analysis at 95% level of confidence interval. Finally, P-value <0.05 was considered as statistically significant. Then the result was interpreted and presented using statements, tables, figures, texts, and pie charts as a whole.

4.13 Ethical approval

Ethical clearance for the start of the study was obtained from the Addis Ababa University, College of Health Sciences, School of Nursing and Midwifery research and ethics review committee with protocol Number **SNM/15/2024**. Following the approval, an official letter of cooperation was written to ZMH, Yekatit 12 Hospital Medical College, Ghandi Memorial Hospital and St. Paul's Hospital Millennium Medical College, and permission was secured at all levels. Information related to those neonates was kept strictly confidential and was not be disclosed to any person.

5. RESULT

5.1 Characteristics of the mothers and neonates

A total of 401 neonatal charts were used for the final analysis. There were 21 incomplete sheets and missed cards that were excluded from the final analysis constituting a response rate of 95.02%.

The study examined various factors related to maternal and neonatal health among a sample of individuals. Maternal age distribution showed a predominance of mothers aged 25-29 years 140 (34.9%), followed by 20-24 years 107 (26.7%). The mean maternal age for the index pregnancy was 27.44 (SD ±5.38). The more than half of participants were male 219 (54.6%) and 182 (45.4%) were female. A significant portion attended antenatal care (ANC) follow-up 355 (88.5%), for the index pregnancy. Three-fourth of mothers 307 (76.6%) delivered their baby's at hospital. Regarding mode of delivery, 223 (55.6%) were spontaneous vaginal delivery (SVD). More than half of the mothers 223 (55.6%) were multiparous. Regarding to birth type of the neonate, 327 (81.5%) were single and 74 (18.5%) were twins. Notably, a minority experienced rupture of membranes for more than 18 hours 52 (13%). (table 2)

Table 2. Characteristics of the mothers and neonates to determine the magnitude and associated factors of hospital acquired infection in neonates at NICU of selected governmental hospitals in Addis Ababa, Ethiopia, 2024(n=401)

S.no	Variable	Category	Frequency	Percent %
1	Maternal age	≤19 years	17	4.25
		20-24 years	107	26.70
		25-29 years	140	34.90
		30-34 years	84	20.90
		≥35 years	53	13.22
2	Sex	Female	182	45.40
		Male	219	54.60
3	Parity	Primipara	178	44.40
		Multipara	223	55.60
4	ANC follow up	Yes	355	88.50
		No	46	11.50
5	Rupture of membranes >18 hour	Yes	52	13.00
		No	349	87.00
6	Mode of delivery	Vaginal Delivery	223	55.60
		Caesarean Section	178	44.40
7	Place of delivery	Hospital	307	76.60
		Born at another facility	94	23.40
8	Birth type of the neonate	Single	327	81.50
		Multiple	74	18.50

5.2 Neonatal factors

The study examined information's related to neonatal health indicators. Among 401 reviewed neonatal records, 167 (41.6%) neonates' birth weight was 1000-2499 grams, while 234 (58.4%) weighed ≥ 2500 grams. The mean birth weight is 2615.8 grams. Among neonates included in this study (401), 197 (49.1%) were <37 weeks and 204 (50.9%) were≥37 weeks'. Length of stay at NICU which is another variable included in neonatal factor showed that 181 (45.1%) neonates stayed in NICU for less than 7 days, 79 (19.7%), neonates stayed in NICU between 8-14, and 141 (35.2%) neonates were stayed in above 14 days. The mean length of stay in NICU is 12.78 days. With regards to APGAR score, APGAR scores at one minute were 279 (69.3%), scoring 7 or above and 122 (30.4%) scoring 6 or lower. Similarly, after 5 minutes, 353 (88%) scored 7 or higher and 48 (12%) scored 6 or lower. Asphyxia was detected in 33 (8.2%) of patients. (table 3).

Table 3: Neonatal characteristics to determine the magnitude and associated factors of hospital acquired infection in neonates at NICU of selected governmental hospitals in Addis Ababa, Ethiopia, 2024

No	Variable	Category	Frequency	Percent
1	Birth weight of the neonate in gram	1000-2499	167	41.60
		≥2500	234	58.40
2	Gestational age of the neonate in weeks	<37	197	49.10
		≥37	204	50.90
3	APGAR Score at 1 minute	≤6	122	30.70
		≥7	279	69.30
5	APGAR Score at 5 minute	≤6	48	12.00
		≥7	353	88.00
6	Asphyxia	Yes	33	8.20
		No	368	91.80
7	Length of stay at NICU	0-7	181	45.10
		8-14	79	19.70
		≥15	141	32.20

5.3 Therapeutic interventions

The result contains the findings of a study that investigated several therapeutic interventions in a sample group. Among neonates included in this study 401 patients, with the majority not receiving antibiotics upon admission 366 (91.3%), whereas 35 (8.7%) did. Among those who received antibiotics, 239 (59.6%) had a treatment duration of 14 days or less, while 162 (40.4%) had a longer course. Mechanical ventilation was administered to 60 (15%) of patients, while 37(9.2%) had an umbilical catheter. Approximately a quarter of the patients 102 (25.4%) received a transfusion. Two-third of the patients had a naso/oro gastric tube 276 (68.8%). Regarding to surgical procedure 68 (17%) patients were undergoing a surgical procedure. Additionally, 61 (15.2%) had a chest tube, and 204 (50.9%) were treated with CPAP, while 197 (49.1%) were not. Majority of the neonates 276 (68.8%) had naso/oro gastric tube. 68 (17%) had surgery (table 4).

Table 4**:** Therapeutic interventions to determine the magnitude and associated factors of hospital acquired infection in neonates at NICU of selected governmental hospitals in Addis Ababa, Ethiopia, 2024

S.no	Variable	Category	Frequency	Percent
1	Antibiotics at admission	Yes	35	8.70
		No	366	91.30
2	Length of antibiotics in days	≤14	239	59.60
		≥15	162	40.40
3	Patient on mechanical Ventilation	Yes	60	15.00
		No	341	85.00
4	Umbilical catheter	Yes	37	9.20
		No	364	90.80
5	Patient transfused	Yes	102	25.40
		No	299	74.60
6	Patient have naso/oro gastric tube	Yes	276	68.80
		No	125	31.20
7	Surgical procedure done	Yes	68	17.00
		No	333	83.00
8	Patient have chest tube	Yes	61	15.20
		No	340	84.80
9	CPAP	Yes	204	50.90
		No	197	49.10

5.4 Magnitude of HAI

Out of 401 neonates who were admitted to NICU of Addis Ababa public hospitals between January 1/ 2019 to December 31/2023, 125 (31.2%) neonates developed Hospital acquired infection, from this 91 (72.8%) neonates were cured, 32 (25.6%) neonates died and the rest 2 (1.6%) neonates were transferred out. In regarding to the length of stay after developing hospital acquired infection 69 (55.2%) neonates stayed more than 14 days. Table 5

Table 5: Magnitude of HAI in neonates at NICU of selected governmental hospitals in Addis Ababa, Ethiopia, 2024

Variable	Category	Frequency	Percentage
Magnitude of HAI	Yes	125	31.20
	No	276	68.80
Outcome after HAI	Cured	91	72.80
	Died	32	25.60
	Transferred out	2	1.60
Length of stay after HAI in days	7 and bellow	22	17.60
	8-14	34	27.20
	Above 14	69	55.20

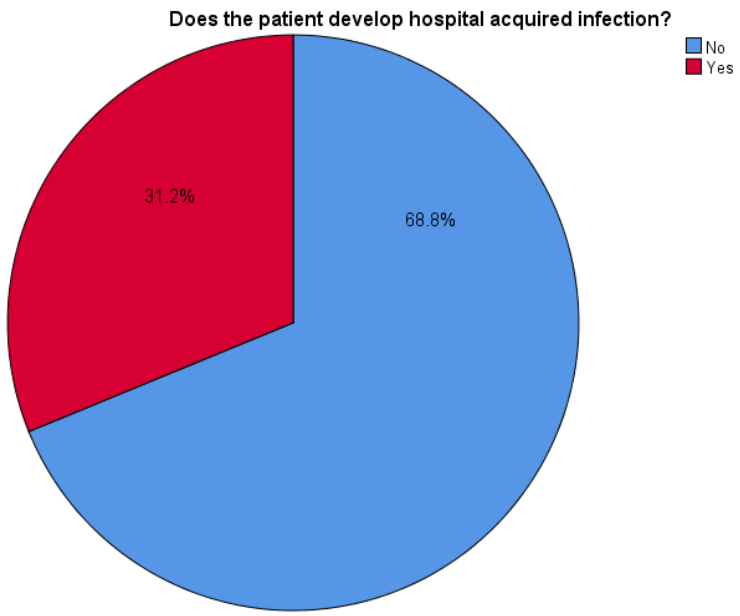

Figure 3: The prevalence of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospital in Addis Ababa, Ethiopia, 2024

5.5 Isolated pathogen

Out of 125 neonates who develop hospital acquired infection the majority of pathogen responsible for HAI were Klebsiella pneumoniae 42 (33.6%) followed by Coagulase-negative staphylococci (CoNS) 31 (24.8%), Acinetobacter 22 (17.6%), Staphylococcus aureus 10 (8%), Pseudomonas aeruginosa 9 (7.2%).

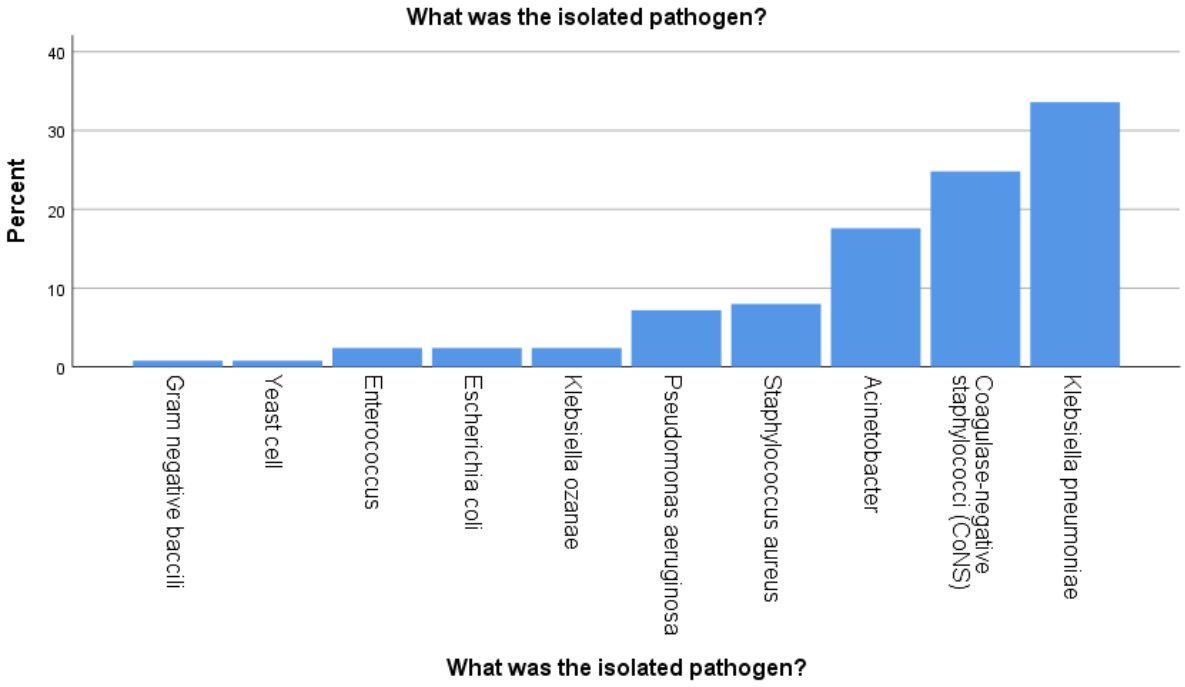

Figure 4: Isolated pathogens which cause for HAI in neonates admitted to NICU of selected hospital

5.6 Association between Nosocomial infection and predictors

To identify factors associated with hospital acquired infection logistic regression model was used. Variables that were used in bi-variable regression with the crude odds ratios (COR) and P value <0.25 associated with hospital acquired infection includes mode of delivery, birth type, gestational age, birth weight, APGAR score at 1 minute, antibiotic at admission, length of antibiotics, length of stay, MV, umbilical catheterization, patient transfuse, naso/oro gastric tube, surgical procedure, chest tube, and patients on CPAP were associate. Then multivariable logistic regression analysis was used to adjust possible confounders. In multivariable logistic regression analysis factors that were significantly associated which showed p-value of below 0.05 with the outcome variable.

From all the factors that are listed under baseline Characteristics of the mothers none of the factors had a significant association. In another group of factors which are neonatal factors birth

weight of the neonate at birth was the only factor that had association with nosocomial infection with in the bi and multivariate analysis. Being in the weight range of 1000-2499g increases the odd of having nosocomial infection by 7 times higher than the age range of ≥2500gm (AOR=7.1981, 95% CI; 1.45, 35.64)

Therapeutic interventions were found to be the most predictors of hospital acquired infection. On multivariate analysis antibiotics at admission, length of antibiotics in days, patient on mechanical ventilation, patient transfused, and surgical procedure remained significantly associated with hospital acquired infection. Neonates that were on antibiotic admission were more than fifteen times more affected than neonates that were not on antibiotic admission (AOR=15.56, 95% CI; 3.25, 74.5). Neonates that were on antibiotics more than 14 days were more than twenty-nine times to be affected than neonates who were on antibiotics for more than 15 days (AOR= 29.0 ,95% CI; 4.52,186.6).

The other factor that remained significant were patients on mechanical ventilation with (AOR= 6.58, 95% CI; 1.19, 22.58) and neonates that have been transfused were more than nine times affected than neonates who were not transfused (AOR=9.49, 95% CI; 3.7, 25.95) also neonates who had surgical procedure were more than three times to be affected than neonates who had no surgical procedure (AOR=3.78, 95% CI; 1.15, 12.4) (Table 6).

Table 6**:** Bivariable and multivariable logistic regression showing the association between hospital acquired infection and the different variables in neonates admitted in NICU at selected Public Hospitals in Addis Ababa, Ethiopia: 2024

Variable	**Category**	hospital acquired infection		COR (95%CI)	AOR (95%CI)	P. value
		Yes, n(%)	**No, n (%)**			
Mode of delivery	Caesarean Section	65, (36.5%)	113,(63.5%)	1	1	0.11
	Vaginal Delivery	60,(26.9%)	163,(73.1%)	1.56(1.0,2.4)	0.48(0.2,1.2)	
	Multiple	32,(43.2%)	42, (56.8%)	1	1	
	Single	93,(28.4%)	234,(71.6%)	1.91(1.1,3.2)	0.9(0.3,2.9)	
Birth weight of the	1000-2499	98,(58.7%)	69,(41.3%)	10.8(6.6,18.0)	7.2(1.5,35.6)	**0.016***

neonate in gram	≥2500	27,(11.5%)	207,(88.5%)	1	1	
Gestational age of the neonate	<37 week	96,(59.6%)	65,(40.4%)	10.7(6.5,17.7)	0.54(0.1,2.5)	0.435
	≥37 week	29, (12.1%)	211,87.9(%)	1	1	
APGAR Score at 1 minute	≥7	76, (27.2%)	203,(72.8%)	1	1	0.986
	≤6	49, (40.2%)	73, (59.8%)	0.6(0.4,0.9)	1.0(0.9,2.6)	
Length of stay at NICU in days	≤7	8, (4.4%)	173,(95.6%)	1	1	
	≥15	101,(71.6%)	40, (28.4%)	54.6(24.5,1)	0.57(0.0,5.1)	0.910
	8-4	16,(20.3%)	63,(79.7%)	9.9(5.1,19.2)	1.1(0.2,7.9)	
Antibiotics at admission	Yes	19,(54.3%)	16,(45.7%)	2.9(1.4,5.8)	15.5(3.3,74.5)	**0.001***
	No	106, (29%)	260, (71%)	1	1	
Length of antibiotics in days	≤14	12,(5%)	227, (95%)	1	1	**0.00***
	≥15	113,(69.8%)	49, 30.2%)	0.02(0.01,0.04)	29.0(4.5,186.6)	
Patient on mechanical Ventilation	Yes	46, (76.7%)	14, (23.3%)	10.9(5.7,20.8)	6.6(1.2,22.6)	**0.003***
	No	79, (23.2%)	262,(76.8%)	1	1	
Umbilical catheter	No	100,(27.5%)	263,(72.5%)	1	1	0.301
	Yes	25,(67.6%)	12,(32.4%)	0.2(0.1,0.4)	2.9,(0.5,10.9)	
Patient transfused	Yes	82, (80.4%)	20,(19.6%)	24(13.4,43.9)	9.49(3.7,25.9	**0.00***
	No	43, (14.4%)	256,(85.6%)	1	1	
	No	13,(10.4%)	112,(89.6%)	1	1	0.475

Patient have naso/oro gastric tube	Yes	112,(40.6%)	164,(59.4%)	0.2(0.1,0.3)	1.6(0.5,5.2)	
Surgical procedure done	Yes	44, (64.7%)	24,(35.3%)	5.7(3.3,9.9)	3.9(1.1,12.4)	**0.028***
	No	81, (24.3%)	252,(75.7%)	1	1	
Patient have chest tube	Yes	39,(63.9%)	22,(36.1%)	5.2(2.9,9.3)	1.8(0.6,6.1)	0.300
	No	86, (25.3%)	254,(74.7%)	1	1	
CPAP	Yes	101,(49.5%)	103,(50.5%)	7.1(4.3,11.7)	0.7(0.2,2.0)	0.682
	No	24, (12.2%)	173,(87.8%)	1		

Key

1= Reference 2. *=Statistically significant by AOR at p-value<0.05, Hosmer and Lemeshow test, p-value = 0.42

6. DISCUSSION

This study was conducted to determine the magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospital, Addis Ababa, Ethiopia. This study revealed that the magnitude of hospital acquired infection among 401 neonates was 125 (31.2%). The prevalence of hospital acquired infection in this study is very much higher (31.2%) compared to studies done in NICUs across Europe 11.4%(9), Canada,11.7%(2), Turkey 17% (23), Iran 13.5%(14), and India 11.9% (21). The finding was higher than studies conducted in high-income countries. These discrepancies could be attributed to differences in healthcare practices, infrastructure, hygiene protocols, and socio-economic factors across regions (46).

This finding is higher than in studies Nigeria 8.9% (29), but it was lower than the study conducted in Botswana 41.9%(30). This inconsistency may be due to differences in the study area, sample size, and methodology. This study also shows a little bit higher than the study was conducted in Egypt 28% (27). The discrepancy of this finding might be due to the study area and the study design.

In this study being low birth weight (1000-2499grams) is positively related with hospital acquired infection than those neonates who are normal birth weight which is seven times more likely to develop hospital acquired infection when compared to birth weight >2500gm. The result found agrees with some of the result found in China study revealed that low birth weight has a significant association with the dependent variable these could be due to newborns with low weight have poor physical development, underdeveloped body organ function, and poor immune system (19, 36). In different studies executed in Turkey (12), Serbia(24),and Egypt (27) also showed that there is significance between low birth weight of the neonate and HAI, this study also assists this association. These could be due to low birth weight infants are immune compromised and increased susceptibility to infection due to an immature immune system (21).

This study indicates that neonates that are on mechanical ventilation were more than six times to be affected than neonates who were not. Similarly, studies done in Iran (9) and Eastern India (39) show those neonates that were on mechanical ventilation will have an increased chance in having HAI, and also agrees with a Mexican (43), Bulgaria (40) and Egyptian (38) studies that

showed having MV will increase the incidence of having HAI. These could be due to its invasive nature, breech in asepsis during and after the procedure, and during indo tracheal suctioning (41, 43).

In the present study there was statistical significance association found between neonates that have had antibiotics more than 14 days and HAI. Neonates who is on antibiotics >14 days were twenty-nine times more affected by HAI as compared to those of neonates don't not. In Chania and Bulgarian study it was a factor for the incidence of HAI which this study agrees with this study (36, 40). In this study antibiotics at admission was shown to be a risk factor for hospital acquired infections, neonates who had antibiotics at admission fifteen times more affected than neonates who had not antibiotics at admission. This result is related with study conducted at NICU of Eastern India (36) and Turkey (42) . This could be related to the entry of drug-resistant bacteria's. Patients who were provided broad-spectrum antimicrobials were more likely to develop hospital-acquired drug-resistant illnesses (47).

This study also shows that neonates who had surgery was another factor which associated with HAI. Neonates who had surgery were 4 times more affected by HAI as compared to those of neonates who had no surgery. This is consistent with other finding like; a study conducted in in China (36), Iran (9) Mexico (43), Turkey (42), and Egypt (27). This may be due to bacterial dissemination along with the surgical procedure into the patient's body. In this study those neonates who transfused with blood product were nine times more likely to develop hospital acquired infection when compared to neonates who did not transfuse with blood product. This finding is supported by observational, analytical case-control study in India (6) and Turkey (42) which has significant association in this study. This may be due to Thus; the first-line defenses of the skin break down which is vehicle for nosocomial infection particularly when the intravenous cannula is left in situ for a long time (42).

The present study showed that the most frequently isolated pathogens responsible for hospital acquired infection were kilbesllla pneumonia (33.6%) followed by Coagulase-negative staphylococci (CoNS) (24.8%), Acinetobacter (17.6%), Staphylococcus aureus (8%), Pseudomonas aeruginosa (7.2%) (35). Similarly, another study conducted in Ethiopia showed that the leading pathogens to cause for nosocomial infection were klebsiella (26.36%),

staphylococcus aureus (23.22%), coagulase-negative Staphylococcus (23.22%), and escherichia coli (15.30%) which agrees with this study(33). The finding of the pathogens that are responsible for this study differs from studies done in Turkey and India the majority of pathogens found in these study are gram positive cocci (Staphylococcus aureus) and gram-negative pathogens (60 %)(17, 22), but in the contrary it has similarities with studies done in Morocco that klebsiella pneumoniae (43.6%), staph coagulase negative (25.2%)(32).

7. STRENGTHS AND LIMITATIONS OF THE STUDY

7.1 Strengths of the study

To the best of my knowledge, there is no study conducted in Ethiopia that determine the magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospital, Addis Ababa.

7.2 Limitations of the study

There were some limitations in the study, lack of adequate literature on the same topic in, East Africa and Ethiopia. Being a retrospective study there may be additional unmeasured variables associated with HAI such as the nurse–patient ratio and environmental factor which was not available in this study.

8. CONCLUSION

In this study, the overall magnitude of hospital acquired infection among neonates admitted in neonatal intensive care unit of Addis Ababa public hospitals during the period was high. Several significant risk factors were identified, including, antibiotics at admission, mechanical Ventilation, low birth weight, blood transfusion, use of antibiotic>14 days, and surgical procedures. Klebsiella pneumoniae followed by Coagulase-negative staphylococci, were the most frequently isolated pathogens are responsible for HAI. Importantly, the acquisition of HAIs in the NICU led to a considerable increase in the length of stay and mortality rate of is high. These findings highlight the critical need for comprehensive infection prevention and control methods designed specifically for NICU settings in Addis Ababa public hospitals. Implementing strict protocols for antibiotic stewardship, and aseptic techniques during procedures could reduce the risk of HAIs, ultimately improving neonatal outcomes and reducing the burden on healthcare resources.

9. RECOMMENDATION

Based on the findings of this study the following recommendations were forwarded:

Ministry of health

- ✓ Ministry of health should incorporate hospital acquired infection about its magnitude, cause and management in the guideline of national neonatal training manual book and training should be prepared for health professionals who are working on neonatal intensive care unit to highlight about HAI. Prepare training to create awareness on the magnitude of HAI and what factors are associated with it.

Hospital administrators and policy makers

- ✓ Rigorous infection prevention control measures during neonatal management are the key to the prevention, early detection, and management of hospital acquired infection.
- ✓ The multidisciplinary team must be able to implement an excellent surveillance system that improves allowing identification of risk factors and contributes towards implementing strategies to reduce the hospital acquired infection.

For the researchers

- ✓ Finally, researchers should conduct prospective study designs to get better information including variables not included in this study.

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ANNEX

Annex I: Information Sheet

Good morning/ afternoon. My name is _____ Currently I am a graduate student at Addis Ababa University, College of Health Sciences, School of Nursing and Midwifery. Now I am conducting a study to identify the magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospital Addis Ababa in Ethiopia, 2024.

Title of the research: Magnitude and associated factors of hospital acquired infection in neonates admitted to neonatal intensive care unit in selected public hospital Addis Ababa, Ethiopia, 2024.

Name of the organization: Addis Ababa university college of health science school of nursing and midwifery department of nursing

Name of sponsor: SPHMMC

Introduction: this information sheet will be used for administrators and NICU coordinators of selected governmental hospital in Addis Ababa. The aim of the form is to make the above concerned offices clear about the purpose of research, data collection procedures and to get permission to conduct the research.

Objective: this study will be aimed at identifying the magnitude and associated factors of hospital acquired infection in neonates.

Procedure: in order to achieve the objective, information which is necessary for the study will be taken form neonatal medical records of patients admitted to NICU from 2019-2023G.C.

Risks: since the study will be conducted by taking information from medical chart, it does not inflect any harm on the patient.

Benefits: the research have no direct benefit for the one whose document is recorded in this research. But it will have indirect benefit for others in the program. Most importantly, the result of the study will be beneficial to design effective preventive and control measures for hospital acquired infection. All the information that I will extract from the chart give will be kept confidential and private. Only the principal investigator and interviewer will have access to the information.

Principal investigator, Birhan Asafaw. Email, birhanasafaw@gmail.com

Annex II: Extraction checklist

This is a data collection format Questioner to identify magnitude and associated factors of hospital acquired infection in neonatal intensive care unit of Zewuditu memorial Hospital, St, Paul's Hospital Millennium Medical College, Yekatit 12 Hospital Medical College and Ghandi Memorial Hospital from February 19/2024 to March /19/2024.

Name of Datacollector_____Date_____Qualification_____

Data Collector agreement: "I certify that I have filled the questionnaire in accordance with the training that is given to me and instructions stated in it.

Signature _____Date_____

Checked by supervisor for completeness: - Supervisors Name_____ signature _____

001. Neonates code number----------

S.no	**Part I: Characteristics of the mother**	**Possible choice**
101.	Maternal age in years?	----------
102.	Parity	---------
103.	Did the mother have ANC follow up?	1. Yes 2. No
104.	Was rupture of membranes >18 hrs.?	**1.** Yes **2**. No
105.	What was the mode of delivery?	**1.**Vaginal Delivery **2.** Caesarean Section
106.	Where did delivery of the baby?	1. Hospital 2. Born at another facility
107.	What is the birth type of the neonate?	1.Single 2. Multiple

S.no	Part II: Neonatal factors	Possible answer
201.	What is the sex of the neonate?	1. Male 2. Female
202.	What is the birth weight of the neonate in gram?	----------
203.	What is the Gestational age of the neonate?	----------
204.	Was the patient preterm?	1. Yes 2. No
205.	What was the APGAR Score?	**1. at 1 minute** ------ **2. at 5 minute** ------
206.	Was the patient have asphyxia?	1. Yes 2. No
207**.**	For how many days the patient stayed at NICU?	---------

S.no	Part III: Therapeutic interventions	Possible answer
301.	Did the patient have antibiotic at admission?	1. Yes 2. No
302.	For how many days the patient on antibiotics after admission?	----------
303.	Did the neonate have umbilical catheter?	1. Yes 2. No
304.	Did the patient transfuse?	1.Yes 2. No
305.	Did the patient have naso/oro gastric tube?	1. Yes 2. No
306.	Was surgical procedure done?	1. Yes 2. No

307.	Did the patient have chest tube?	1. Yes 2. No
308.	Was the patient on continuous positive airway pressure?	1.Yes 2. No
309.	Was the patient on mechanical Ventilation?	1. Yes 2. No
310.	What was the isolated pathogen?	…….
	Part IV: Final outcome result	
401.	Does the patient develop hospital acquired infection?	**1.Yes** **2. No**
402.	Outcome of neonates after HAI?	1. Cured 2. Died 3.Transferred out 4. Left to follow up

Thank you!!