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DETERMINANTS OF LENGTH OF STAY AND MORTALITY AMONG NEONATES ADMITTED TO THE NEWBORN UNIT, WAJIR COUNTY REFERRAL HOSPITAL, KENYA

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ABSTRACT

Background: Prolonged hospital length of stay for neonates admitted to the newborn unit is a public health concern. Prolonged stay within the hospital exposes neonates to infection and increased healthcare costs.

Objective: To assess the determinants of length of length of stay and neonatal mortality among neonates admitted to the Newborn Unit of Wajir County Referral Hospital.

Methodology: A facility-based cross-sectional study design were employed to collect quantitative data from 122 mothers and their neonates admitted to newborn unit. The consecutive sampling technique was used to recruit participants who met the inclusion criteria and consented to the study. Data was collected using a structured questionnaire tools and analyzed using Statistical Package for Social Sciences (SPSS) version 26 software. Descriptive and inferential statistical techniques was applied for all variables. Bivariate and multivariable logistic regression analysis with odds ratio and 95% Confidence interval were calculated to assess the determinants of length of stay and neonatal mortality and associated factors.

Results: Majority (77.9%) of the mothers whose neonates were admitted to the NBU came from different parts of the vast Wajir County. Majority (59%) of the respondents reside in urban areas and had no formal education 92 (75.4%) and largely unemployed 107 (87.7%). Half (52.5%) of the respondents were aged between 21 to 26 years (±0.5). The study revealed a neonatal mortality rate of 12.3%. The bivariate analysis of length of stay show that the obstetrics complications, mode of delivery, sex of neonate, prematurity, low birth weight, complication during and post-delivery, hospital quality of service, staff attitude, as the contributory factors associated with prolonged length of stay. While neonatal mortality is associated with lack of ANC attendance, obstetrics complications, sex of neonate, prematurity, low birth weight, and complication during delivery. A multivariable logistic regression showed that the gestation age (AOR = 7.133; 95% CI (0.000, 0.000): P<0.000) birth weight (AOR = 2417; 95% CI (58, 99.95): P<0.000), Complications during delivery (AOR = 11.469 (1.489, 88.33), 95%CI: P<0.019), Lack of ANC attendance (AOR = 0.028; 95% CI (0.003, 0.227): P<0.001) were significantly associated with length of stay and neonatal mortality. The three leading causes of admission and neonatal mortality were found to be Perinatal Asphyxia 40 (32.8%), respiratory distress syndrome (RDS) 18 (14.8%) and Neonatal Sepsis 15 (12.3%).

Conclusions: The study has shown that prematurity and low birth weight as the leading cause of neonatal mortality and that the higher the number of ANC visits the lower the length of hospital stay. The deaths among the preterm and low birth weights occur early in life due to preventable causes, which can be averted through implementation of enhanced intrapartum and immediate postpartum care interventions targeting the leading causes of neonatal mortality of perinatal asphyxia, respiratory distress syndrome and neonatal sepsis.

Keywords: *Neonates, Newborn unit, Length of Stay, neonatal mortality, risk factors*

1. INTRODUCTION

Newborns are admitted to the NBU for a variety of reasons, such as prematurity, fetal distress, respiratory distress syndrome, and other maternal condition or illness that makes newborns unable to cope without intensive care support [(1)]. The reason for admission to the unit, combined with other factors, affects the Length of Stay (LOS), which varies from one newborn to another [(2)]. In many countries, extended hospital length of stay remains one of the most significant problems facing hospitals and has important consequences for quality of treatment, patient safety, and health outcomes. A major risk factor is the Healthcare-associated infections (HCAI) that occur while receiving healthcare, developed in a hospital or other healthcare facility that first appear 48 hours or more after hospital admission, or within 30 days after having received healthcare [(3)]. Second risk involves preventable medical errors which contribute substantially to hospital length of stay as well as healthcare costs, including higher health insurance costs per person expenses [(4)]. Delayed discharge from the hospital can lead to higher costs, an increased risk of complications and reduced patient satisfaction. Prolonged hospitalization is expensive, especially in the pediatric age group, and poses a serious threat. This is the despite the fact that studies have estimated that about 22.1 to 48% of days of hospital stay were unnecessary [(2)].

In 2018, an estimated 2.5 million children died before 28 days of age worldwide [(5)]. Neonatal deaths accounted for 47% of all deaths in children under the age of five, and this number is rising. The majority of neonatal deaths occur in the first week of life and are preventable with equal access to appropriate, evidence-based maternal and newborn healthcare [(1)]. Sub-Saharan Africa (SSA) has the highest burden of adverse neonatal outcomes and is also the area where the least progress has been made in resolving neonatal mortality rates. The Third Sustainable Development

Goal (SDG) stresses the need to put an end to preventable newborn deaths, with the goal of reducing the neonatal mortality rate to 12% for 1000 live births or less by 2030 for all countries [(6)].

Studies have shown that long-term living costs in neonatal units are associated with higher costs and economic burdens on the family, society, and healthcare systems. In the United States, for example, it is estimated that approximately 34% of low-birth-weight newborns remain hospitalized until they reach a weight equal to that expected. This has been found to be the one main reasons for long hospital stay among the newborns in major US hospitals [(7)]. Some research findings show that exacerbations are due to a high proportion of the costs of treating neonatal conditions. In seriously affected patients, this ranges from 40 percent to 57 percent of the overall direct costs and can increase to as high as 63 percent [(8)]. Inpatient enrollment in neonatal intensive care is a big cost driver, accounting for around 54 percent of the direct costs associated with its management in the United Kingdom.

Poor parental socio-economic status has been the primary contributor to the long stay of patients in hospitals, irrespective of age, gender, treatment and management provided in the hospital [(9)]. A research by Wycliffe, Joyce and Mageto [(10)], found that parents of children admitted to the NBUs are reported to experience elevated emotional distress; such distress conditions are also suspected to be connected to financial failure to meet enrollment expenses, that are often over such a lengthy amount of time. Due to the resultant financial strain in terms hospital costs and other incurred logistics, the additional stress is a contributory factor to maternal emotional distress. The study further indicates the lack of communication from healthcare staff was yet still another stressor in the NBU among the postpartum mothers.

Globally, the United States of America has attributed escalating healthcare expenditures estimated at between 20% to almost 50% to processes, products, and services that do not improve outcomes [(11)]. This are among the six financial waste categories identified by Berwick and Hackbarth [(12)], which include overtreatment rooted in outmoded habits, supply-driven behaviors, and ignoring science. In a study in the United Kingdom on the length of hospital stay, [(13)], underscored the importance of predicting and commissioning of services to help clinicians in their counselling of parents. The study pointed out the lack of evidence to accurately predicting hospital LOS for patients. The global burden of healthcare-associated infection alone is expected to double mortality and induce increase of healthcare costs. In China, hospitals are estimated to losing between US $7453–15,155 or even double for each patient due to HCAI, among which half of the excess cost was associated with prolonged hospitalization [(14)]. As regards the neonatal mortality, world wide data shows preterm (gestation <37 weeks) and low birthweight (<2.5 kg) infants have an increased risk of mortality in the neonatal and post neonatal periods [(15)]. Over 97% of these infants are born in resource-limited settings like the low and middle income countries [(16)]. Other factors that come into play include the complications of preterm birth which are now the leading cause of under 5 deaths accounting for 18% and intrapartum related events and neonatal sepsis are other major causes of under 5 mortalities. The determinants of the length of stay vary from region to region and country to county due to the health disparities that exist. In Iran, a study by [(8)] found significant association between the length of stay with the type of feeding, umbilical and central venous catheterization, mechanical ventilation, nosocomial infection, acute renal failure, blood transfusion, and antibiotic therapy. In a similar study [(17)], findings indicate significant relationship with the variables of the place of residence, type of admission, and the grade of attending physician and the standard of the healthcare facility.

In another study in upper western region of Ghana [(18)], the pattern of admissions and mortality showed prematurity, low birth weight, including the contribution of malaria associated factors to neonatal mortality in that region. The study concluded that majority of the mortality among the neonates admitted to hospital was due to preventable causes. A comparative study of Nigeria and Kenya by [(19)], recommend interventions to address priority issues during pregnancy and delivery as well as in the newborn as a mitigation against neonatal mortality. In Ethiopia, various studies were undertaken to assess the neonatal mortality and its associated factors. In Southern Ethiopia, affecting factors included quality of services, and poor or no antenatal care [(20)]. Tadesse et. al; findings showed poor antenatal care, cesarean section delivery, length of stay in the hospital, low temperature at admission and birth asphyxia were determinants of neonatal mortality among the pastoral communities [(21)]. In Eastern Ethiopia, Eyeberu et. al; identified multiple pregnancy, low birth weight, perinatal asphyxia, were factors significantly as factors largely associated with neonatal mortality [(22)].

In Kenya, few studies have been conducted in areas related to the current study. Early retrospective research study by [(23)] has shown that data from 14 referral care hospitals which were surveyed with routine statistics showing considerable variation in inpatient pediatric mortality and specific case fatality rates. The studies include the work by [(10)] on emotional distress among postpartum mothers with newborns but did not look at the aspect the length of stay. The study attributed emotional distress to socio-demographic, economic, and hospital factors contributing to maternal emotional distress as contributing factors. A similar study by [(24)] showed a high proportion of neonatal deaths in hospitals to institutional factors despite the availability of high-impact low-cost interventions.

It important to understand and address determinants of hospital length of stay and neonatal mortality in order to improve the health and safety of the children and their mothers admitted to the new-born units. The study on the length of stay and neonatal mortality is of immense benefits to the healthcare facilities and the patients. For one, it is very crucial for every healthcare institution to know the specific pattern and admission outcome of neonates for appropriate treatment and prevention of future problems. The length of stay in a hospital is valuable indication in the following areas: hospital care management, quality control, service availability, hospital policy and planning management, and measuring the efficiency and usage of hospital resources. As a result, examining and assessing length of hospital stay will be beneficial to hospital management, prioritization, service improvement, and resource allocation. The findings may aid in identifying gaps so that efforts can be implemented to shorten hospital stays and admit more needy patients. While several studies have been carried out to enhance admission results for neonatal conditions and improve performance, few have appeared to concentrate on reducing the period of in-patient treatment, but a handful of studies have really concentrated on the factors affecting the length of stay of neonates in the NBU.

1.1 Objective of the Study

The main aim of this study was to assess the determinants of length of stay and neonatal mortality among neonates admitted to the NBU of Wajir County Referral Hospital.

2. RELATED LITERATURE

Demographic characteristics and discharge readiness whether clinical and perceived were correlated with postpartum hospital stay length. According to Enomoto et. al; length of stay is a dynamic interface outcome requiring additional analysis between patient, the healthcare service provider, and payor of services greatly affects the discharge timing. The inclusion of perceived readiness for discharge in the requirements for clinical discharge would add a significant dimension to the evaluation of discharge readiness after birth (25). A Kenyan study conducted to compare the morbidity and outcome of adolescent mothers (< 20 years) with babies with low birth weight and older mothers found that adolescent mothers' low birth weight babies were more likely to have elevated morbidity and adverse outcomes relative to comparable older mothers' babies (26). Another study by (27) found that, while the proportional danger assumption did not hold, males were more likely to be discharged sooner than females. The same research also showed that patient from more deprived areas were more likely to remain in hospital longer, presumably because they had more serious underlying health issues. In contrast, with new mothers with a hospital stay of less than 48 hours to mothers hospitalized for 5 days or more, found that mothers with early discharge were more likely to be from low-income bracket and without any form of health insurance cover. The payor pressure substantially affects the length of stay but other factors that may also affect the length of hospital stay, such as low education levels (primary school or less), age greater than 35 years, insufficient prenatal care, complimentary breastfeeding, and care midwife care (28).

A research by (29) showed that the presence of a full-time doctor who conducts daily rounds has also been associated with a decreased risk of extended duration of stay and decreased complications. Most of the theories of this phenomenon list continuity of treatment and improved familiarity in coping with both health conditions and patient family problems as the key reasons for shortened stays (30). Other institutional factors that affect the LOS are new born intensive care unit activity variation. For example, evidence indicates that treatment is less continuous on weekends where there are numerous caregivers (residents, fellows attending, and many more) compared to NICUs with less direct care workers. Variation from other sources of NICU practice can also prolong the hospital stay (31). While weekly multidisciplinary meetings to coordinate and provide continuity of care for medically complex neonates admitted to NICU was associated with improved patient outcomes (32).

Studies have shown that early discharge is mainly controlled by maternal indications. To determine the need for re-hospitalization in healthy newborns released within 48 hours of birth, a follow-up visit after 72 hours is necessary. Vertical HIV transmission during labor or after delivery can occur in the uterus. It is estimated that transmission occurred during labor in 65% of HIV-infected infants (33). Studies have shown that prenatal antiretroviral drugs can significantly and substantially reduce the risk of mother-to-child transmission from the already infected women by reducing viral load (34).

A study conducted to measure risk factors for and incidence of early onset group B streptococcal sepsis in neonates in a geographically specified population has shown that group B streptococcal disease is the main causative factor onset neonatal sepsis in developed countries, and has also shown that rupture of the membranes before childbirth is a significant risk (35).Three-quarters of all cases of infection at the expense of giving antibiotics to 16 percent of all women in labor may be avoided or strengthened by existing prophylactic recommendations . Women experiencing

GBS during pregnancy at an increased risk of premature delivery and organism perinatal transmission. Pregnancy-associated GBS disease most commonly occurs during labor or within the first few days of the life of a child, which may affect the health of the neonates. Unmanaged maternal diabetes and planning for extra uterine life have an effect on fetal development. suggest that a small subgroup of fetuses, typically borne by mothers with chronic diabetic vascular disease, are less than the fifth percentile of gestational age at risk for birth weight [36]. Other risk factors identified are the Maternal age ≤ 20 years, twin gestation, maternal urinary tract infections, and pregnancy induced hypertension [37].

Antenatal risks factors which have been shown to associate with an increased prevalence of neonatal sepsis include prolonged membrane rupture and chorioamnionitis, prematurity, birth asphyxia, male gender, and maternal urinary tract infection and maternal colonization with group B streptococcus. Birth asphyxia is characterized as a serious disruption in the supply of oxygen to the fetus. In all, it is estimated that it affects 2.9 to 9 neonates per 1000 births during the first or second stage of labor and causes 1 million deaths annually on a global basis, with an equivalent number of infants left with significant neurological sequelae [38].

Thermal care (including prevention of neonatal hypothermia) has been included by the WHO as a portion of critical care for newborns in a package of basic measures widely recommended for all babies in under-resourced settings in low-and middle-income countries, including Kenya. Results from a South Nepal study found that birth hypothermia is one of the most relevant determinant of morbidity and mortality in newborn babies of all birth weights and gestational ages. Hypothermia prevention and treatment is one of the main strategies to minimize neonatal mortality and morbidity.by 18% – 42% [39]. Neonatal hypoglycemia [40] is a major serious metabolic problem that is prevalent among elevated survivors and can result in morbidity and extreme handicap. Hypoglycemia may occur in infants who are small or large for gestational age, or premature, and in those with low glycogen stores, hyperinsulinemia, stress, or mothers with gestational diabetes.

3. METHODS AND MATERIALS

3.1.Study Design

A facility based cross-sectional study that was conducted to assess the determinants of length of stay and mortality among the neonates admitted to the New Born Unit (NBU) of Wajir Referral Hospital (WCRH), Kenya. The Hospital is a level five (5) Ministry of Health facility located in Wagberi ward of Wajir East constituency in North Eastern Province of Kenya.

3.2.Study Site

The research was carried out in Wajir County situated in the north eastern region of Kenya. The county is inhabited by pastoralist communities. It is the referral facility for Habaswein Sub-County Hospital, Wajir TB Manyatta Sub-District Hospital, Griftu District Hospital, Tarbaj Health Centre, Buna Sub-District Hospital, Eldas Health Centre among other health facilities in the county. WCRH offers both outpatient and inpatient services, which include preventive, curative, and rehabilitative services. It has six inpatient wards and a total bed capacity of 83 with an average annual inpatient turnover of 8,341. The average annual outpatient workload was 6,700 inclusive of both adults and children. The neonatal unit has abed capacity of 28 and average bed occupancy of about 71%. The unit is manned by 15 nurse-midwives, two (2) medical officers. There was no full time Pediatrician working at the facility.

3.3.Study and Target Population

The study population comprised of all the newborn babies and their mothers admitted to New Born Unit of WCRH. The study's target population comprised of all the newborn babies and their mothers admitted to the NBU at Wajir County Referral Hospital.

3.4.Inclusion and exclusion criteria

The study included all neonates admitted to the NBU and their mothers. The medical records of mothers and their neonates were reviewed and relevant admission and diagnosis data collected. The study excluded neonates and mothers with incomplete or illegible medical records.

3.5.Sample Size

The sample size of 122 neonates and their mothers was determined using the Fisher's formula [41] for estimating the minimum sample size with adjustment for populations greater than 10,000 and non-response.

3.6.Sampling Procedure

All mothers who give birth at the WCRH who consented to the study were enrolled together with the neonates. The sampling frame prepared for those target populations using their Medical Registration Number (MRN) obtained from their medical records. Then the study subjects that had been included in the study was identified through consecutive sampling technique.

3.7. Data collection procedure

A pre-test was undertaken in Garissa County Referral Hospital one month prior to the commencement of the study in WCRH. It was used to test reliability, validity and practicability of the research instruments. On the basis of the results of the pre-test, data collection instruments were reviewed appropriately. Data was collected using a structured questionnaire through face-to-face interview with the mothers of the neonates. Medical records of the neonates and their mothers was used to collect data on risk factors. The researcher worked closely with the medical officer in charge and the nurses at the facility. Electronic data collection method was employed using Open Data Kit (ODK). The ODK is a free, open-source software suite of tools that allows data collection using Android operating systems based mobile devices and submission to an online server. The ODK was used to collect and store data and submit to a central server.

The following guideline was applicable to data security, storage and management and backup of data. The server and the stored data were password protected. The collected data was backed-up on a daily basis. To guarantee the confidentiality of the data collected, no data was stored on portable external storage devices and access to data was on prior authorization by project investigators. All the COVID-19 protocols and guidelines from the Ministry of Health was observed during the data collection exercise. This included hand washing/sanitizing, observing social distance and wearing of face masks where applicable.

3.8. Data Analysis

The Excel data was imported into Statistical Package for the Social Sciences (SPSS) version 26 for statistical data analysis. Descriptive statistical analysis was done and the results presented with texts, tables, mean and standard deviation. A bivariate logistic regression analysis was done to identify variables that had a $p < 0.25$ to be considered in the multivariable logistic regression model. Multivariable logistic regression analysis was done to identify factors associated with neonatal mortality. The findings of the final model were reported with odds ratio (OR) and corresponding 95% Confidence Interval. Finally, a statistically significant level was declared at a p <0.05 in the final regression model.

The following categorization of gestation age and birth weight was used to assist in the analysis of the collected data. The categorization is based on the recommendations from Centers for Disease Control and prevention (CDC) and the World Health Organization (WHO).

(a) The health risks associated with birth weight depend upon classifications defined by the Centres for Disease Control [42] as extremely low birth weight (ELBW), very low birth weight (VLBW), low birth weight (LBW), and normal birth weight (NBW). Therefore, Infants with birth weight;

- ELBW (less than 1Kg)
- VLBW (1kg to less than 1.5 Kg)
- LBW (1.5kg to less than 2.5Kg)
- NBW (2.5 Kg to 4.5Kg)

(b) Preterm is defined as babies born alive before 37 weeks of pregnancy are completed. We use the WHO [43] sub-categories of preterm birth, based on gestational age:

- extremely preterm (less than 28 weeks)
- very preterm (28 to 32 weeks)
- moderate to late preterm (33 to 37 weeks).
- Normal term (38 to 41 Weeks)
- Post term (>42 weeks)

(c) Birth interval - Short birth interval ≤2 years and long birth interval >2 years [44].

(d) Length of stay – Short (24hours to 72 hours) and long stay 7weeks [45].

3.9. Ethical Consideration

The proposal was submitted to the AMREF Ethics and Scientific Review Committee (ESRC) for review and approval of this research proposal. Permission to collect data at the WRCH was sought from the County Government of Wajir and the Director of Medical Services. The data collected was kept in strict confidence and would only be used for the study's goals. The data was kept under lock and key in a cabinet. All data in a computer storage was secured through passwords and access control measures.

4. RESULTS

The study findings are based on quantitative data obtained from 122 mothers of neonates admitted at the NBU at the Wajir County Referral Hospital. The data was collected for a period of three months between 2 December 2021 and 28 February 2022.

4.1 Socio-Demographic Factors

The social-demographics characteristics of the respondents is as summarized in table 3. The following is a summary of the findings.

(a) Residence

The majority of the mothers reside in urban areas representing 72 (59%) of the respondents.

(b) Maternal Age

The maternal age ranged from 15 to 38. The age group 21 – 26 represented the highest maternal age 64 (52.5 %) followed by 27-32 age bracket 18 (14.8%). All the respondents have reported their marital status as married. Some of the maternal age was below 18, pointing to early marriage among the community.

(c) Education and occupation

Majority of the respondents had no formal education 92 (75.4%) while about 21 (17.2%) had primary level of education. The occupation status is largely unemployed 107 (87.7%) while the remaining are self-employed in business activities.

4.1.1 Institutional Risk Factors

Institutional factors measured the hospital characteristics in terms of access to healthcare facility, availability of healthcare personnel, drugs and specialized equipment. In addition, quality of services and staff attitude. The distance to the hospital varied among the mothers interviewed. The reported distance to the health facility ranges from 4 Km to 7.9 Km representing 66 (54.1%) and about 27 (22.1%) came from more than 8Km. The majority of the mothers arrived at the hospital using taxis 112 (91.8%) as public transport is limited to long distances in the county. Most of the wards in Wajir County are inaccessible due to poor road infrastructure.

We sought to establish the reasons for choice of the health facility. The majority of the respondents selected the availability of healthcare personnel, drugs, specialized equipment, quality of service and staff attitude as the reason for selecting the hospital.

In terms of quality of service and staff attitude, the majority felt that quality was good and that the staff are friendly respectively. The results on quality of service are; Good 60 (49.2%) and neutral 32 (26.2%). Staff attitude was measured as friendly, neutral or very friendly. The majority of the respondents reported staff as friendly 62 (50.8%), while 39 (32.0%) reported as very friendly. Overall, the findings point to overall satisfaction with the quality of service, availability of healthcare personnel, drugs and specialized equipment.

4.1.2 Maternal Risk Factors

Maternal risk factors considered a number of variables including total number of previous deliveries, number alive and dead. In addition, family planning, lifestyle of the mother (smoking, drinking of alcohol and/or chewing of miraa), and the general medical history of previous diseases, before, during or after delivery. The summary of the findings is presented in table 5

(a) Previous Deliveries and Deaths

Overall findings on previous deliveries are that the majority are first time mother 45 (36.9%). The highest number of previous deliveries is eight (8) and about 22 (18%) have indicated to have two previous births. Deaths from previous births are low compared to live births; only 5 (4.1%), 3 (0.8%) and 5 (1.6%) reported loss one, three and five children respectively.

(b) Birth Internal

Birth interval as indicator of family planning practice was measured. The findings show the majority had a birth interval of one year 53 (43.4%) and about 49 (40%) had less than 6 months. More than two years birth interval was as low as 8 (6.6%).

(c) ANC Attendance

The majority of the mothers had attended four (4) antenatal care visits. Women with uncomplicated pregnancies are recommended to make four ANC visits. Therefore, majority of the mothers had the minimum recommended ANC visits. However, women with a history of any complications or illnesses in previous pregnancies are identified to be high risk and recommended to make more than four visits. The findings show only about 5 (4.1%) had five (5) visits. The mothers who did not attend any ANC attributed the non – attendance to the distance to the hospital.

(d) Maternal Medical History

Overall, the majority of the mothers did not have a history of maternal disease 115 (94.3%) or a maternal pregnancy related disease 81 (66.4%), maternal risk factors 108 (89%) and obstetric complications 100 (82%). Therefore, the majority of respondents reported no complications during or after pregnancy 106 (86.9%) and 105 (86.1%) respectively. A few of the mothers indicated a history of Anaemia 5 (4.1%), Hypertension 1 (0.8%) and Kidney 1 (0.8%) disease. Reported maternal risk factors are Antepartum Hemorrhage 1 (0.8%), Diabetes 1 (0.8%), Pregnancy Induced Hypertension 12 (9.8%) and Premature Rupture of Membrane (PROM) 16 (13.1%). Obstetric complications are Cervical Incompetence 2 (1.6%), Diabetes 5 (4.1%), maternal infection 5 (4.1%) and Pregnancy Induced hypertension 10 (8.2%).

(e) Mode and Place of Delivery

The mode of delivery for the majority of the mothers was mainly through Spontaneous Vaginal Delivery (SVD) representing 97 (79.5%) while rest through Cesarean Section (CS) delivery 25 (20.5%). Majority of the respondents 76 (62.3%) delivered at a health facility.

4.1.3 Neonatal Risk Factors

Neonatal risk factors considered the gender of the neonates, mothers' birth complications, after birth complications, reason for the admission to the new born unit and admission diagnosis. Further, we analyze the gestational age of the neonates, birth weight and the length of stay in the NBU. The following tables provide the summaries of the findings.

(a) Neonatal Characteristics

The gender of the neonates admitted to the NBU was 48 (39.3%) females and 74 (60.7%) males. The majority had birth complications 90 (73.8%) while 58 (47.5%) had complications after birth that necessitated their admission to the NBU.

(b) Reason for Admission

The three leading causes of admission are Perinatal Asphyxia 40 (32.8%), Prematurity/Respiratory Distress Syndrome (RDS) 18 (14.8%) and Neonatal Sepsis 15 (12.3%). Others are Meconium Aspiration, Prematurity/Low Birth Weight, and Prematurity/ Low Birth Weight /RDS, all at 12 (9.8%).

(c) Admission Diagnosis

The admission diagnosis ranged Perinatal asphyxia 41 (33.6%), Prematurity/LBWT/RDS, 30 (24.6%), and neonatal sepsis, 15 (12.3%). This admission diagnosis largely confirmed the reason for admission to the NBU. The findings show that the reason for admission and the admission diagnosis point to prematurity of the newborn. Table 6 summarizes these findings.

(d) Gestational Age and Birth Weight

From table 6, majority of the neonates were premature, gestation age categories ranging from extremely preterm 9 (7.4%), very pre-term 27 (22.1%) and pre-term 47 (38.5%). Of the 122 neonates, only 39 (32.0%) were born at full gestation term. However, majority of the neonates had normal birth weight 89 (73.0%) while 33 (27.0%) had birth weight ranging from extreme low birth weight, very low birth weight and low birth weight.

Table 7 gives summary of the cross tabulation of gestation age with discharge outcome. 4/9 of the neonates with extremely pre-term gestation age died while 6/27 and 5/47 of very pre-term and pre-term neonates respectively died.

Birth weight and discharge outcome show that of the two neonates with extremely very low birth, one survived while one died. Of the very low birth weight 2/7 died and low birth weight which had the highest number of deaths 11/24 died. For the normal birth neonates 1/89 died. Table 8 gives the summary of the findings.

(e) Gender and Discharge Outcome

The cross-tabulation of gender of neonate with discharge outcome shows out of the 44 (36.1%) female neonates, only 4 (9.1%) died while of the 63(51.6%) male neonates 11(17.5%) died. Table 9 provides the summary.

(f) Length of Stay (LOS)

The study found that the overall prevalence of neonatal mortality was 15 (12.3%). The minimum length of stay was 0 days and the maximum 14 days; the mean length of stay newborn in NBU was 4.07 days ±2.484 SD. On length of stay and discharge outcome, 5/6 neonates were discharged within 24 hours of admission. Survival rate of neonates increased beyond day three of admission. Figure 3 gives the summary of the findings.

4.2 Determinants of Length Of Stay And Neonatal Mortality

4.2.1 Determinants of Neonatal Mortality

(a) Bivariate Analysis

Bivariate and multivariate logistic regression analysis was performed to evaluate relationship between the determinants of length of stay and neonatal mortality. The variables that were significant at P value of < 0.05 level in the bivariate analysis were included and retained in the multivariate model. The bivariate analysis was conducted for the two dependent variables of length of stay and neonatal mortality. The independent variables for the bivariate analysis were:

(a) Social demographics – Residence, Education, and Occupation

(b) Institutional – Distance to health facility, mode of transport, choice of health facility, quality of service and staff attitude

(c) Maternal – Maternal age, previous deliveries, place of delivery, birth internal, ANC attendance, multiple gestation, mode of delivery

(d) Neonatal - gender of the neonate, gestational age, birth weight, complication before and after birth, admission diagnosis and discharge outcome.

The odds ratio is a measure of association between exposure and an outcome. An odd ratio >1 indicates an increased occurrence of an event while an OR <1 indicates decreased occurrence of an event. The findings of the bivariate analysis is as shown in table 10. The leading determinants of neonatal mortality are long distance to hospital, quality of service, lack of ANC attendance Obstetrics complications, sex of neonate, preterm birth, low birth weight, and complication during delivery. The mortality of the neonates occurred for mothers who had less than four (4) antenatal care visits representing 58 (47.5%).

4.2.2 Determinants of Length of Stay

A further bivariate analysis of the determinants of length of stay of the neonates admitted to the NBU show that the hospital quality of service, staff attitude, obstetrics complications, mode of delivery, sex of neonate, preterm birth, low birth weight, and complication during and post-delivery as the contributory factors associated with prolonged length of stay. The summary of the findings with the associated odds ratios are provided in table 11.

(b) Multivariable Analysis

(i) Mortality

The variables which had an association with neonatal mortality in the new-born unit ($p < 0.05$) from the bivariate analysis were entered into a multivariate logistic model. The model was estimated against hospital distance, hospital quality, staff attitude, number of ANC visits, obstetric complication, mode of delivery, gestation period, birth weight, complications during and post-delivery.

The inclusion of these variables compared to the base model yielded a chi-square value of 63.66 (df = 2), $p < 0.001$, indicating an improvement from the base model. The model had a high pseudo-R-square of the Cox and Snell R^2 (.407) and the Nagelkerke R^2 (.774). The Hosmer and Lemeshow test showed non-significance, indicating no difference in the distribution of the actual and predicted dependent values, χ (df =4) = 0.792, p >0.939. The classification results show that the model had an overall success rate of 95.9% compared to 87.7% of the intercept only base model.

Two predictors were found to be significant predictors of neonatal mortality, number of ANC visits (β = -3.05), Wald χ (df = 1) = 8.80, p<0.05 and presence of a complication at delivery (β = 2.44, Wald χ (df = 1) = 5.49, p<0.05. The dependent variable was coded as 0 = Alive and 1= died, these coefficients imply that the neonates who died had mothers with a higher tendency for few ANC visits and were more likely to have a complication at delivery, while neonates who were alive at discharge had mothers with more ANC visits and no complication at delivery. Similar to the length of stay outcome, a unit increase in the number of ANC visits made over the course of the pregnancy increase the odds of a neonate being alive after discharge from the new-born unit. Additionally, mothers with no complication delivery had a higher odds ratio of the neonates being alive at discharge from the neonatal unit.

(ii) LOS

The variables which had an association with length of stay in the new-born unit ($p < 0.05$) were entered into a multivariate logistic model. The model was estimated against the distance to health facility, quality of service, staff attitude, number of ANC visits, obstetric complication, mode of delivery, sex of neonate, gestation period, birth weight, mode of delivery, complications during delivery and post-delivery.

The inclusion of these variables compared to the base model yielded a chi-square value of 102.20 (df = 2), $p < 0.001$, with a high pseudo-R-square of the Cox and Snell R^2 (.567) and the Nagelkerke R^2 (.89). The Hosmer and Lemeshow test showed non-significance, indicating no difference in the distribution of the actual and predicted dependent values, χ (df =8) = 4.54, p >0.805. The classification results show that the model had an overall success rate of 96.7% compared to 79.5% of the intercept only base model.

Based on the Wald test, two predictors are found to be significant predictors of whether a neonate admitted in the new-born unit will have a short length of stay or a long length of stay.

These variables were birth weight ($\beta = 5.092$), Wald χ (df = 1) = 5.728, p<0.05 and number of ANC visits ($\beta = 2.02$, Wald χ (df = 1) = 4.405, p<0.05.

Given that the dependent variable length of stay is coded as ≤ 3 days as short stay and > 3 days as long stay, these coefficients imply that neonates with short stay have higher tendencies to have mothers who attended more ANC visits and to have higher birth weight, and those who had a long stay have a lower weight at birth and have mothers who had lower tendencies for ANC visits. Therefore, a one unit increase in the number of ANC visits increases the odds of having an admitted neonate have a short length of stay in the new-born unit. Similarly, a one unit increase in birth weight increases the odds of a neonate having a short length of stay in the new-born unit.

5. Conclusion and Recommendation

5.1. Conclusion

This study characterized the factors associated with length of stay and neonatal mortality. Similar to previous studies, the factors associated with and determine longer length of stay and neonatal mortality were preventable and treatable causes. More emphasis should be placed on adequate maternal health, care during pregnancy and management of complications to reduce the length of stay and neonatal mortality. Specifically, the number of ANC visits, birth weight and complications during delivery were determinants of length of stay and neonatal mortality. Therefore, efforts to improve care during pregnancy and management of complications during delivery are required to reduce the length of stay and neonatal mortality rate.

The results of the study will help healthcare policymakers and program designers to support Wajir County in the reduction of neonatal mortality through targeted efforts. Further studies can be undertaken to build efforts toward routine data collection tools with predictive capabilities to identify women at risk of an extended length of stay and neonatal mortality. More data is required to build effective prediction tools aiming to identify risk and provide targeted interventions. Additionally, the findings of the study can also help as secondary data for further study of neonatal units in the Northeastern region of Kenya.

5.2. Recommendation

Previous studies on associated factors present a significant limitation for generalization to nomadic communities who make the majority in Wajir County. The result from this single hospital study highlights the need for early identification and appropriate management of risks to reduce the length of stay and neonatal mortality. From this study, several recommendations can be made to both health care workers and policy makers in the field of health care.

Health care workers should consider induction of mothers with PROM to reduce neonatal sepsis. They should also evaluate their obstetric care so as to identify the cause of perinatal asphyxia. Furthermore, all health care workers should be particularly vigilant during the first 78 hours of life as this will improve the neonatal outcome.

Based on the study findings, there is need to conduct a wide scale study on the determinants of length of stay and neonatal mortality in the larger north eastern and upper eastern regions of Kenya which are mainly inhabited by nomadic communities. The regions have low hospital, staff and equipment coverage especially outside of the urban settlements. This will also help consider more women who rarely attend ANC and give birth at home.

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Abbreviations

NBU	New Born Unit
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
CS	Cesarean Section
RDS	Respiratory Distress Syndrome

Tables

Table 1: Social-demographic characteristics

No	Category	Variable	Frequency (n=122)	Percentage (%)
1	Residence	Urban	72	59.0
		Rural	50	41.0
2	Maternal age	15-20	33	27.0
		21-26	64	52.5
		27-32	18	14.8
		33-38	7	5.7
3	Marital Status	Married	122	100.0
4	Education	No Formal Education	92	75.4
		Primary	21	17.2
		Secondary	9	7.4
5	Occupation	Unemployed	107	87.7
		Self employed	15	12.3

Table 2: Access to healthcare facility and mode of transport

No	Category	Variable	Frequency (n=122)	Percentage (%)
1	Access to health facility	≤ 1.9 KM	10	8.2
		2-3.9 KM	19	15.6
		4-5.9 KM	30	24.6
		6-7.9 KM	36	29.5
		≥ 8 KM	27	22.1
2	Mode of transport	Taxi	112	91.8
		Tuk-tuk	9	7.4
		Walk	1	0.8

Table 3: Neonatal risk factors

No	Category	Description	Frequency (n=122)	Percent (%)
1	Gender	Male	74	60.7
		Female	48	39.3
2	Birth complications	Yes	90	73.8
		No	32	26.2
3	After birth complications	No	64	52.5
		Yes	58	47.5
5	Admission reason	Perinatal Asphyxia	40	32.8
		Prematurity/RDS	18	14.8
		Neonatal Sepsis	15	12.3
		Prematurity/LBWT	12	9.8
		Meconium Aspiration	12	9.8
		Prematurity/LBWT/RDS	12	9.8
		Prematurity	8	6.6
		Neonatal Jaundice	2	1.6
		Low Birth Weight	2	1.6
		Surgical	1	0.8
6	Admission diagnosis	Perinatal asphyxia	41	33.6
		Prematurity/LBWT/RDS	30	24.6
		Neonatal sepsis	15	12.3
		Meconium aspiration	11	9.0
		Prematurity/LBWT	11	9.0
		Prematurity	8	6.6
		Low Birth Weight	3	2.5
		Neonatal Jaundice	2	1.6
		Surgical	1	0.8
7	Gestation Age	Pre-term	47	38.5
		Full Term	39	32.0
		Very Pre-term	27	22.1
		Extremely Pre-term	9	7.4
8	Birth Weight	Normal Birth Weight	89	73.0
		Low Birth Weight	24	19.7
		Very Low Birth Weight	7	5.7
		Extremely Low Birth Weight	2	1.6

Table 4: Maternal risk factors

No	Category	Description	Response	Frequency (n=122)	Percent (%)
1	Previous deliveries	Number	0	45	36.9
			1	19	15.6
			2	22	18.0
			3	15	12.3
			4	11	9.0
			6	5	4.1
			7	3	2.5
			8	2	1.6
		Dead	0	114	93.4
			1	5	4.1
			3	1	0.8
			5	2	1.6
2	Place of Delivery	Health facility	Yes	76	62.3
			No	46	37.7
		Home	0	104	85.2
			1	6	4.9
			2	7	5.7
			3	4	3.3
			5	1	0.8
3	Family Planning	Birth interval	One year	53	43.4
			Less than 6 months	49	40.2
			9 Months	12	9.8
			Two - three years	6	5.0
			More than 4 years	2	1.6
4	Lifestyle	Smoking, drinking alcohol or chewing miraa	None	122	100.0
5	Diagnosis	Before pregnancy	None	115	94.3
			Anaemia	5	4.1
			Hypertension	1	0.8
			Kidney	1	0.8
6	Diagnosis	During pregnancy	None	99	81.1
			Pregnancy Induced Hypertension	13	10.7

			Diabetes	2	1.6
			Kidney	1	0.8
			Maternal infection	2	1.6
			Anaemia	5	4.1
7	ANC Attendance	Attended	1	18	14.8
			2	17	13.9
			3	23	18.9
			4	54	44.3
			5	5	4.1
		Not attended	Hospital is far	5	4.1
8	Gestation	Multiple	No	120	98.4
			Yes	2	1.6
9	Maternal risks		None	81	66.4
			Pregnancy Induced Hypertension	12	9.8
			Diabetes	6	4.9
			Maternal infection	6	4.9
			Antepartum Hemorrhage	1	0.8
			Premature Rupture of Membrane (PROM)	16	13.1
10	Obstetric complications		None	100	82.0
			Pregnancy Induced hypertension	10	8.2
			Diabetes	5	4.1
			Maternal Infection	5	4.1
			Cervical Incompetence	2	1.6
12	Complications	During pregnancy	No	106	86.9
			Yes	16	13.1
		After delivery	Yes	17	13.9
			No	105	86.1
11	Mode of delivery	Mode	SVD	97	79.5
			CS	25	20.5

Table 5: Gestation age with cross-tabulation with discharge outcome

Category	Description	Discharge Outcome		Total
		Alive	Died	
Gestation Age	Extremely Pre-term	5	4	9
	Very Pre-term	21	6	27
	Pre-term	42	5	47
	Full Term	39	0	39
	Total	107	15	122

Table 6: Birth weight with cross-tabulation with discharge outcome

Category	Description	Discharge outcome		Total
		Alive	Died	
Birth Weight	Extremely Low Birth Weight	1	1	2
	Very Low Birth Weight	5	2	7
	Low Birth Weight	13	11	24
	Normal Birth Weight	88	1	89
	Total	107	15	122

Table 7: Cross-tabulation of gender and discharge outcome

Category	Description	Discharge outcome		Total
		Alive	Died	
Gender of neonate	Female	44	4	48
	Male	63	11	74
Total		107	15	122

Table 8: Determinants of neonatal mortality

No.	List of Variables	Category of Variables	Neonatal Mortality(n=122)		OR, 95% CI, (L, U)	P-value
			Died	Alive		
		Taxi	14	99		
1	Distance to Hospital	< 1 KM	5	5	10.2 (2.517, 41.339)	
		>= 1 KM	10	102		
		Drugs, staff & equipment	14	106		0.000
2	Quality of service	Neutral	0	32	1.2 (1.094, 1.316)	
		Good	15	75		
		Friendly	15	86		
		>=24 years	9	86		0.014
3	ANC Attendance	<4 visits	15	58	0.762 (0.664, 0.875)	
		>=4 visits	0	49		
		Multiple	0	64		0.000
4	Obstetrics complications	No	0	105	3.143 (1.705, 5.794)	
		Yes	15	2		
		SVD	9	7		0.000
5	Sex of neonate	Male	5	101	1.921(0.574, 6.424)	
		Female	10	6		0.000
6	Gestation age	Preterm	15	68	0.819 (0.741, 0.906)	
		Term	0	39		0.005
7	Birth Weight	Low Birth Weight	14	17	74.118 (9.132, 601.588)	
		Normal Birth Weight	1	90		0.000
8	Complication during delivery	No	5	101	0.768 (0.260, 2.267)	
		Yes	10	6		0.000

Table 9: Determinants of length of stay

No.	List of Variables	Category of Variables	Frequency (n=122)	Neonatal Mortality		OR, 95% CI, (L, U)	P-Value
				Died	Alive		
1	Quality of service	Neutral	32	22	10	4.4 (1.85, 10.466)	
		Good	90	30	60		0.001
2	Staff Attitude	Unfriendly	21	21	0	3.258 (2.43, 4.368)	
		Friendly	101	31	70		0.000
3	Obstetrics complications	No	100	33	67	0.078 (0.021, 0.282)	
		Yes	22	19	3		0.000
4	Mode of delivery	CS	25	8	17	0.567 (0.224, 1.437)	
		SVD	97	44	53		0.001
5	Sex of neonate	Male	74	26	48	0.458 (0.218, 0.962)	
		Female	48	26	22		0.023
6	Gestation age	Preterm	83	34	49	0.81 (0.376, 1.743)	
		Term	39	18	21		0.005
7	Birth Weight	Low Birth Weight	31	19	12	2.783 (1.202, 6.444)	
		Normal Birth Weight	91	33	58		0.015
8	Complication during delivery	No	106	41	65	0.287 (0.093, 0.885)	
		Yes	16	11	5		0.000
9	Complications after delivery	No	99	40	59	0.621 (0.25, 1.546)	
		Yes	23	12	11		0.005

Table 10: Bivariate analysis of mortality

List of Variables	Category of Variables	β	S.E.	Wald	p-value	OR, 95% CI (L, U)
Gestation age	Preterm	0.297	0.183	5.728	0.010	1.235 (0.574, 2.659)
	Term					
Birth Weight	Low Birth Weight	5.092	1.897	1.687	0.000	2.417 (5.872, 9.99)
	Normal Birth Weight					
ANC Attendance	<4 visits	2.02	0.963	4.405	0.036	7.541 (1.141, 4.975)
	>=4 visits					

Table 11: Bivariate analysis of length of stay

No.	List of Variables	Category of Variables	β	S.E.	Wald	p-value	OR, 95% CI (L, U)
1	Gestation age	Preterm	0.297	0.183	2.636	0.010	1.235 (0.574, 2.659)
		Term					
2	Birth Weight	Low Birth Weight	7.791	1.897	16.87	0.000	2417 (58, 99.95)
		Normal Birth Weight					
3	ANC Attendance	<4 visits	2.02	0.963	4.405	0.036	7.541 (1.14, 49.75)
		>=4 visits					

Figures

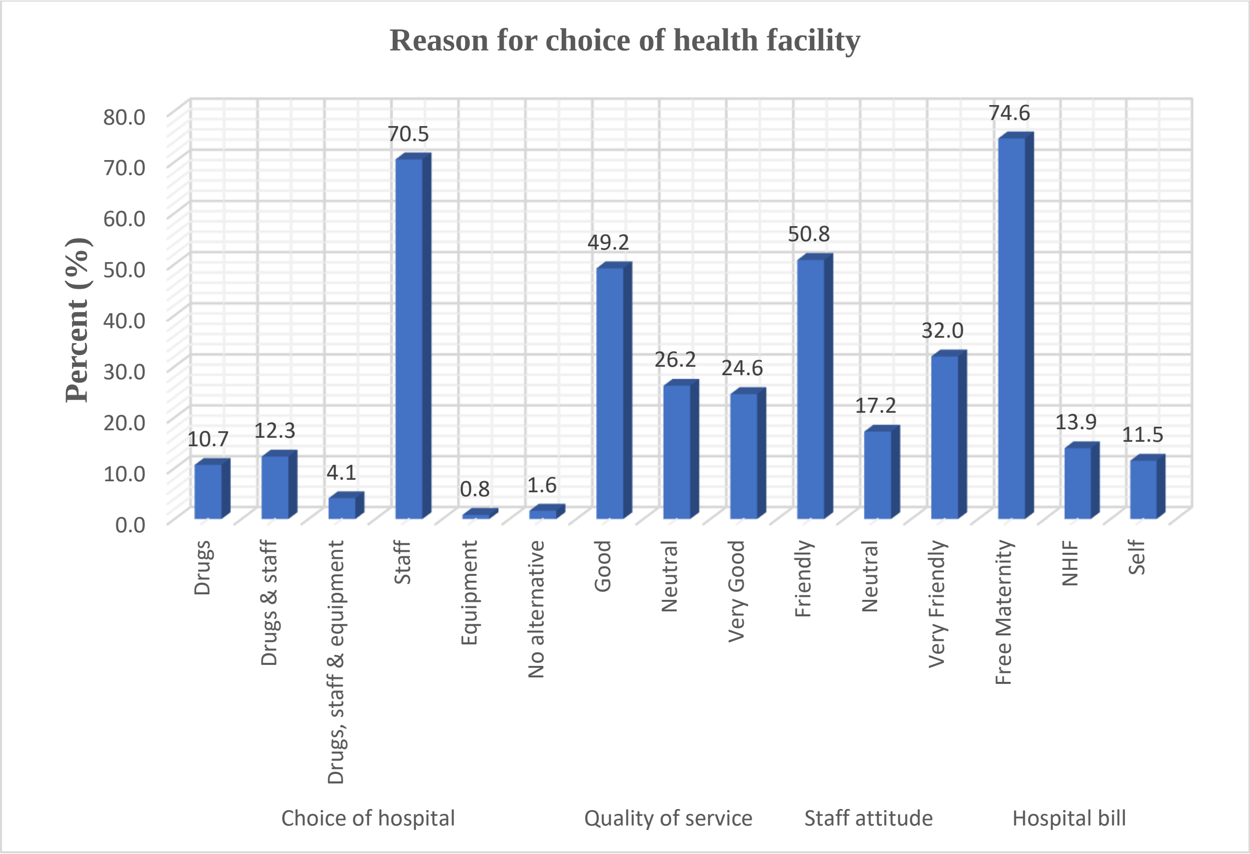

Figure 1: Reasons for choice of health facility

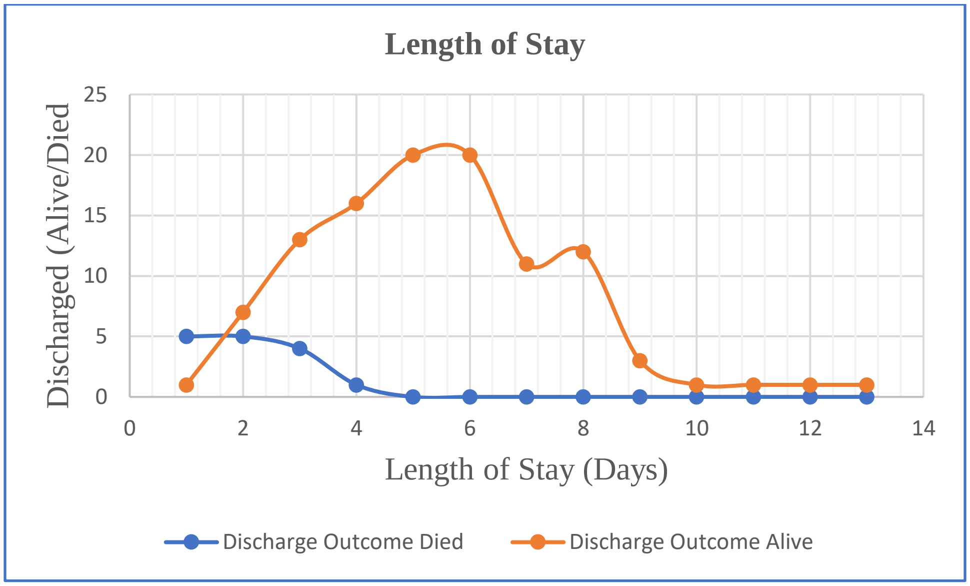

Figure 2: LOS and discharge outcome