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BAHIR DAR UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF EPIDEMIOLOGY AND BIOSTATISTICS

INCIDENCE AND PREDICTORS OF ASPIRATION PNEUMONIA AMONG STROKE PATIENTS ADMITTED AT FELEGE HIWOT COMPRESSIVE SPECIALIZED HOSPITAL, BAHIR DAR, NORTH WEST ETHIOPIA, 2021: A RETROSPECTIVE FOLLOW UP STUDY

BY: TADIOS LIDETU (BSC NURSE)

APRIL, 2022

BAHIR DAR, ETHIOPIA

BAHIR DAR UNIVERSITY
College of Medicine and Health Sciences
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Department of Epidemiology and Biostatistics

Incidence and Predictors of Aspiration Pneumonia among Stroke Patients admitted at Felege Hiwot Compressive Specialized Hospital, Bahir Dar, North West Ethiopia, 2021: A Retrospective Follow up Study

A Research Thesis Submitted to Department of Epidemiology and Biostatistics, School of Public Health, College of Medicine and Health Science, Bahir Dar University for the Partial Fulfillment of Master of Public Health Degree in Epidemiology

By: Tadios Lidetu (BSc Nurse)

Name of Advisors:

1. Dr. Essey Kebede (Associate Professor in Statistics)
2. Mr. Gizachew Tadesse (MPH in Epidemiology)

April, 2022

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DECLARATION SHEET

Through my signature below, I declared and affirmed that this thesis is my work. I have followed all ethical principles of scholarship in the preparation, data collection, data analysis, and completion of this thesis work. All scholarly matter that was included in the thesis has been given recognition through citation. I affirm that I have cited and referenced all sources used in this document. Every effort has been made to avoid plagiarism in the preparation of this thesis work. This thesis is submitted for partial fulfillment of a master of public health degree in Epidemiology from college of medicine and health sciences, Bahirdar University. The thesis would be deposited in the library of Bahir Dar University and will be made accessible for readers under the rules of the library. I solemnly declared that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

Student Name: Tadios Lidetu (BSc Nurse)

Signature: _____

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Date of Submission: _____

ADVISORS APPROVAL SHEET

BAHIRDAR UNIVERSITY, COLLEGE OF MEDICINE AND HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH, DEPARTMENT OF EPIDEMIOLOGY AND BIOSTATISTICS

I hereby certify that I had advised, supervised, and evaluated the research paper that is entitled "incidence and predictors of Aspiration pneumonia among admitted stroke patients at Felege Hiwot compressive and specialized hospital, Bahir Dar, north-west Ethiopia, 2022". A retrospective follow-up study was investigated by Tadios Lidetu with my advice, guidance, and support. Hence, I approve as this thesis can be submitted as the final thesis draft for different purposes.

Advisors, Name	**Date**	**Signature**
1. Dr. Essey Kebede (Associate professor in Statistics)	_____	_____
2. Mr. Gizachew Tadesse (MPH in Epidemiology)	_____	_____

FINAL APPROVAL OF RESEARCH THESIS REPORT SHEET

BAHIRDAR UNIVERSITY, COLLEGE OF MEDICINE AND HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH, DEPARTMENT OF EPIDEMIOLOGY AND BIOSTATISTICS

I hereby certify that I have examined this thesis report entitled "incidence and predictors of Aspiration pneumonia among admitted stroke patients at Felege Hiwot compressive and specialized hospital, Bahir Dar, north-west Ethiopia, 2022". A retrospective follow-up study reported By Tadios Lidetu .We recommend and approved the thesis report for a degree of "Master of Public Health in Epidemiology".

Board of Examiners

External examiner

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Department head

Name _____sig _____date _____

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I would like to dedicate my heart-felt gratitude to my Advisors Dr. Essey Kebede (BSc, MSc, PhD, and Associate Professor in Statistics) and Mr. Gizachew Tadesse (BSc, MPH in Epidemiology) for their unwavering support on this thesis work. I would also want to express my gratitude to everyone in the department of Epidemiology and Biostatistics for their contributions on this thesis work. I want to express my gratitude to Bahir Dar University for providing me the opportunity to learn. I also like to thank the employees of Felege Hiwot Referral Hospital (research coordinator, medical ward coordinator, card room workers, and others) for their help during data collection for this thesis. Furthermore, I would like to express my gratitude to every one of my family and friends who helped me in different ways to complete this thesis work.

ABSTRACT

Background: Aspiration pneumonia is an infection of the lung that induced by the inhalation of gastrointestinal contents. Globally, its incidence is ranging from five to eight three percent with hospital mortality rates of up to 70 percent. To prevent and reduce the risk, there is need of evidence regarding to incidence and factors of post-stroke aspiration pneumonia. However, there is no enough evidence regarding to post stroke aspiration pneumonia. As a result, this study was aimed to bring evidence on the incidence and predictors of post-stroke aspiration pneumonia.

Objective: To assess the incidence and predictors of aspiration pneumonia among stroke patients admitted at Felege Hiwot referral hospital, Bahir Dar, North West Ethiopia, 2021

Methods and Materials: An institution-based retrospective follow-up study was conducted at Felege Hiwot compressive specialized hospital and charts of 568 stroke patients were reviewed through a simple random sampling technique. Both bi-variable and multi-variable log binomial regressions were applied. Predictors that had p-value < 0.25 on bi-variable regression analysis, they were entered to final model. The data were presented in the form of texts and tables.

Result: In this study, 568 charts reviewed, of those a cumulative incidence of aspiration pneumonia was 23.06%. Variables like age, sex, dysphagia, oxygen therapy, etc. were significant predictors of aspiration pneumonia. Males were 1.71 times more risky than females to acquire aspiration pneumonia (ARR = 1.71, (95 percent CI 1.07-2.74). Patients with vomiting and dysphagia were more risky to acquire aspiration pneumonia as compared to patients without vomiting and dysphagia (ARR = 1.81, 95 percent CI 1.04-3.14) and (ARR = 1.95, 95 percent CI 1.10-3.48) respectively. Patients who received antibiotic prophylaxis and Glasgow Comma Scale greater than twelve were less risky to acquire aspiration pneumonia as compare to who not received antibiotic prophylaxis and Glasgow Comma Scale less than eight (ARR = 0.10, 95 percent CI 0.04-0.28), (ARR = 0.45, 95 percent CI 0.22-0.94) respectively.

Conclusion and recommendation: The cumulative incidence of aspiration pneumonia was 23.06%. Vomiting, low level Glasgow Comma Scale, dysphagia, etc. found as the risk factors of aspiration pneumonia. Therefore, health care providers better to give special attention for patients with those risk factors to prevent post-stroke aspiration pneumonia.

Keywords: incidence, predictors, aspiration pneumonia, stroke patients

ACRONEMS AND ABBREVIATIONS

ABC ----------Air, Breathing, Circulation

AP----------Aspiration Pneumonia

ARR ----------Adjusted Risk Ratio

ART ---------- Anti-Retroviral Therapy

BOR ----------Bed Occupancy Rate

CI ---------- Cumulative Incidence

COPD ---------- Chronic Obstructive Pulmonary Disease

CRR ---------- Crude Risk Ratio

DR. - - - - - - - - - - - - - - - - - Doctor

DM---------- Diabetes Mellitus

ETB - - - - - - - - - - - - - - - - Ethiopian Birr

FHRH ----------Felege Hiwot Referral Hospital

GI - - - - - - - - - - - - - - - - - - Gastro-Intestinal

IDR ----------Incidence Density Rate

IV - - - - - - - - - - - - - - - - - - Intra Venous

GCS---------- Glasgow Comma Scale

LOHS---------- Length of Hospital Stay

MRN---------- Medical Registration Number

NGT - - - - - - - - - - - - - - - - - - Nasogastric Tube

PI ---------- Principal Investigator

PSAP ----------Post Stroke Aspiration Pneumonia

OPD ---------- Out Patient Department

RCT---------- Randomized Control Trial

USA ----------United State of America

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1. INTRODUCTION

1.1. Background

There are different conditions that lead the patient to post-stroke aspiration pneumonia. Among that stroke is the main condition, which exposes the patient to post stroke aspiration pneumonia. A stroke is a cerebrovascular medical emergency characterized by the sudden loss of neurological function, due to interruption of the blood supply to the brain(1, 2). Among the complications of stroke, post stroke aspiration and aspiration-pneumonia are the serious and the commonest problems (3). The term aspiration is the inhalation of gastric contents into the lower airways that is the act of taking foreign material into the lungs (2).

Among different aspirations, food aspiration is common in debilitated patients like patient with stroke that lead the patients to a high risk of aspiration pneumonia and interfering with the patient's eating ability(4). It can cause airway obstruction and acute respiratory distress syndrome, all of which enhance the patient's morbidity and mortality(5). In addition to food aspiration, various different body liquids and chemicals are all forms of gastrointestinal contents that can infiltrate the lungs that can cause post-stroke aspiration pneumonia(6).

Aspiration pneumonia is an infection of the lung that induced by the inhalation or entrance of endogenous flora and different body chemicals from the gastrointestinal tract into the respiratory system(7, 8). It is the most incidental (up to 83 percent) and fatal (up to 70 percent) disease among all complications that occur on post stroke patients(8, 9). Post-stroke aspiration pneumonia occur on stroke patient after one up to two days of hospital admission(10, 11).

The inflammation and infiltration of the lung tissues is the pathophysiological process of aspiration pneumonia (12). Inhalation of significant amounts of different GI contents leads to an intense inflammatory response of the Pulmonary parynchemia(3). Because gastrointestinal contents in the lungs suppress the natural defenses of the respiratory system(13).

Clinicians must consider the diagnosis of aspiration pneumonia when a patient presents with risk factors and radiographic evidence of an infiltrate lungs that is the suggestive of aspiration pneumonia(14). The diagnosis of aspiration pneumonia is based on its clinical symptoms, signs and imaging tests then confirmed by physicians(15). Early detection of the clinical presentation of aspiration pneumonia in stroke patients is very important for the prevention and management of post-stroke aspiration pneumonia(16).

1.2. Statements of the problem

Post-stroke aspiration pneumonia is one of the major complication among hospitalized stroke patients in health facilities(17). The entrance of GI content into the lungs can lead to a broad spectrum of pulmonary diseases such as airway obstruction, aspiration pneumonia and acute respiratory distress syndrome which significantly increases the patient's morbidity and mortality(18). Globally, the incidence of post-stroke aspiration pneumonia among post stroke patients is 14 percent. However, the incidence is different in different regions of the world that ranging from 5 in USA up to 83 percent in Iraque (19-21). The incidence of AP in Nigeria, Sierra Leonean and Egypt on post stroke patients is 12.4, 18 and 44 percent respectively (22-24).

Post-stroke aspiration pneumonia occurred in around one-third(1/3) of post stroke patients and it increases the mortality through three- times(25). The hospital mortality rate of stroke patient that is caused by aspiration pneumonia is up to 70 percent. It is dependent on the volume and content of aspirated gastrointestinal contents, which entered into the respiratory system (20, 26). Aspiration of gastrointestinal secretions into the respiratory system is linked to the complication of aspiration pneumonia in stroke patients, which increases mortality, duration of hospital stay, and treatment expenses, as well as the patient's financial crisis(16, 27).

Post-stroke aspiration pneumonia is a consequence of stroke, which exposes the patient to a variety of health problems and financial burdens. In addition to stroke treatment modalities, other treatment approaches are required for the management of PSAP(3). Extra therapeutic interventions include oxygen therapy, mechanical breathing, and broad-spectrum antibiotics, all of which expose the patients at higher risk for physical, physiological, and financial suffering(28). Patients to survive from a stroke with aspiration pneumonia take a longer recovery time. Identifying the clinical risk factors for aspiration pneumonia is critical for prevention, early treatment, and reduced mortality of the patients after post stroke attack(15).

Different risk factors influence the entrance of gastrointestinal contents into the respiratory system which are contributing to the occurrence of PSAP(15). Reduced level of consciousness and improper positioning are the most important risk factors for aspiration pneumonia (29). Increasing age in years, degree of consciousness, feeding modalities, types of stroke, stroke severity and comorbidities such as heart disease, diabetes mellitus, hypertension, and epilepsy are connected with the occurrence of post-stroke aspiration pneumonia(19, 30). If aspiration

pneumonia linked to dysphagia, the patient mortality rate becomes high. In the clinical setting, early diagnosis and management of dysphagia in patients can decrease the incidence and mortality of aspiration pneumonia in post-stroke patients**(**31**)**.

Different preventative and therapeutic approaches are implementing in medical settings regarding to post stroke aspiration pneumonia(32). In clinical settings, antibiotics prophylaxes, gastro esophageal reflux therapy, nasogastric tube feeding, and oral care are all significant medical treatments and therapeutic methods for aspiration pneumonia(33). In addition to these in clinical setting, patient care strategies such as positioning, mobilization, close monitoring of stroke patients and adherence to safe swallowing are clinical techniques that practice in the health facilities to prevent and decrease the risk of PSAP(32).

Despite of different preventive and therapeutic approaches that practice for patient with post stroke aspiration pneumonia at health facilities level, patient morbidity and mortality still at increasing (mortality rate up to70 percent)(26, 34). The medical prognosis of post stroke aspiration pneumonia is influenced by a variety of factors, and it is a crucial problem in clinical settings(35). To prevent and reduce the problem of aspiration pneumonia, there is need of standard guideline for the prevention and management of aspiration pneumonia at health care facilities level. To prevent aspiration pneumonia the health care professionals have to equip through updated evidence on the preventive and risk factors of aspiration pneumonia. However, there is no enough evidence on PSAP and health care professional have not similar practice towards the prevention and management of post-stroke aspiration pneumonia(34, 36).

There is no study on the incidence of the disease and identification of the preventive and the risk factors of post-stroke aspiration pneumonia, which are paramount to design similar management approaches at health care facilities level. Different studies in different countries showed that the incidence of aspiration pneumonia varied across the world. In Ethiopia, the incidence and predictors of aspiration pneumonia among post-stroke patients are still not well addressed. Therefore, this study was aimed to determine the incidence and identify predictors of aspiration pneumonia among post-stroke patients.

1.3. Significance of the study

The findings of this study are useful for health care professionals, hospital managers and higher-ranking authorities in the health-care system and other health-care fund-raising organizations. The findings support the health care professional to decrease the occurrence of post-stroke aspiration pneumonia through preventing of the risk factors and promoting of the protecting factors. Then the findings would enables health-care providers to improving the quality of patient care and treatment strategies based on patient needs. The hospital administrators would utilize the information in their resource allocation. Moreover, policy makers would use the findings (along with similar research findings) for the development of guidelines and management protocols of aspiration pneumonia on post stroke patients. In addition, the findings are very important for other stakeholders and concerned bodies working in the area through providing updated information. Furthermore, the findings would serve as a starting point for future researchers in the field.

2. LITERATURE REVIEW

2.1. Incidence of aspiration pneumonia

Post stroke aspiration pneumonia is the common complication that occurs on post stroke patients. Its incidence varies across geographical regions of the world. Globally the average incidence of post stroke aspiration pneumonia on post stroke patients reaches up to 14 percent(17). Study conducted in the regions of south and north America such as in Brazil and United States of America the incidence of aspiration pneumonia is thirty and five percent respectively(20, 37). In Portugal and United Kingdom, the incidences of aspiration pneumonia were 13.5 and 7.12 percent respectively (38, 39).

Studies conducted in Asian countries China and Indonesian reported that the incidence of post stroke aspiration pneumonia on post stroke patients was 13.2, 20 percent respectively (40, 41). Study conducted in Iraq the incidence of PSAP is 83 percent. Of those, 58 percent of patients have developed aspiration pneumonia which have ischemic stroke type whereas 25 percent patients have hemorrhagic types of stroke(42). A systematic review and meta-analysis study done in India showed that the incidence of aspiration is 32 percent (19). A study conducted in Japan showed that the incidence of PSAP is 76.2 percent(43). In Taiwan, the incidence of aspiration pneumonia is higher patients with stroke and dysphagia are 20.8 percent whereas patients with only stroke are 9.8 percent(31).

From the western parts of Africa, study conducted in Nigeria and Sierra Leoneans showed that the incidence of post stroke aspiration pneumonia on post stroke patients were 12.4 and 18 percent respectively (9, 22, 23). While in Egypt the incidence of aspiration pneumonia on post stroke patients accounted for 44 percent(24).

2.2. Factors of aspiration pneumonia

2.2.1 Sociodemographic factors

There are different sociodemographic factors, which contributes to the incidence of PSAP(37). Males are more exposed to behavioral risk factors such as alcohol and smoking which leads to different chronic diseases that have higher contribution to the occurrence of stroke and aspiration pneumonia as a result, male are more risky than female to develop post stroke aspiration pneumonia (20, 41, 44). Age is one of the factors of post-stroke aspiration pneumonia. Specially,

patient with advanced age has the higher incidence of post stroke aspiration pneumonia since old age influences level of physical exercise and swallowing function due to changes occur in the masticatory apparatus and they attributed to reduced immunity and increased comorbidities(20, 24, 45). It is also associated with more severe neurological outcome and impaired swallowing function and cough reflex(46). Post stroke aspiration pneumonia is more common in rural residences than urban residences(37, 47).

A study done in Egypt showed that the risk of Unemployed person to develop post stroke aspiration pneumonia is higher than employed person since being unemployed leads the person to different health problems like stress, anxiety and depression which are positive risk factors for the occurrences of aspiration pneumonia(24, 41). Smoking history has positive relation with aspiration pneumonia and it accounts 26.1 percent(48).

2.2.2. Clinical factors

Clinical factors are very important for the occurrences of post-stroke aspiration pneumonia on post stroke patients. When the patients level of consciousness deteriorated that is the Glasgow coma score less than twelve, patients are more risky to develop PSAP as compare to patients their level of consciousness maintained or intact(22). As study showed that patients have an increasing the risk of aspirating oropharyngeal secretions and regurgitated gastric contents are at higher risk of aspiration pneumonia(7). Patients with ischemic type of stroke are less risky to develop PSAP as compared to patients with hemorrhagic type of stroke(27).

There are different comorbidities that increase the risk of post-stroke aspiration pneumonia. Among comorbidities, hypertension, diabetes mellitus, heart diseases, etc. are the major risk factors for PSAP(49, 50). A study done in Japan showed that hypertension, dementia and cerebral infarctions have strongly associated with PSAP(14). In addition, aspiration pneumonia is the most common post stroke complication in patients who have congestive heart failure, neurological diseases and pulmonary diseases (51). Post stroke patients with such chronic diseases are at higher risk to develop PSAP(52). The neurological problems like seizures expose a patient to acquire post stroke aspiration pneumonia(53, 54). A study found that poor oral health status which mimic vomiting, which is an independent risk factor for the occurrences of aspiration pneumonia. Because of post stroke aspiration pneumonia is an infection of the lungs that caused by inhaling of vomited materials into the respiratory system(48).

Dysphagia is the main clinical risk factor for post-stroke aspiration pneumonia. Patients with dysphagia are more exposed to aspiration pneumonia than patients without dysphagia(41, 55). Patients exposed to impaired corticodiaphragmatic pathways can cause abnormal motion of diaphragm, which leads the patient to develop dysphagia. If severity of dysphagia increases the risk of post-stroke aspiration pneumonia also increases(56).

As study showed that hyperglycemia is a one of the risk factors for post-stroke aspiration pneumonia. Because of high blood sugar level, make it difficult for the patients' white blood cells to fight infections. High blood sugar level can also negatively affect the immune system by impairing circulation and nerves. This puts the patients at a higher risk of infections, including aspiration pneumonia (49). Gag and cough reflex problems are another risk factors for aspiration pneumonia since gag and cough reflex impaired, gastrointestinal content easily enter to respiratory system. Gag reflex problem contributes 32.4% for the occurrence of aspiration pneumonia whereas cough reflex problem contributes 28.6%(27).

2.2.3. Treatment related factors

There are several pharmacological and non-pharmacological treatment approaches that reduce the risk of PSAP(57). Medical interventions for post stroke patients to prevent the complication of post stroke aspiration pneumonia including screening of immune-depression, management of gastro-esophageal reflux, the use of angiotensin-converting enzyme inhibitors and other important drugs (Aspirin, Heparin, warfarin, Anti-Cholesterol, Mannitol, etc.) that improve the prognosis of stroke and reduce the risk of post-stroke aspiration pneumonia (57). Care processes that include positioning of the patient, mobilization, health care provider competences and adherence to safe swallowing techniques are non-pharmacological treatments approaches that decrease the risk of post-stroke aspiration pneumonia(32).

Study showed that giving antibiotic prophylaxis for post stroke patients, greatly reduce the risk of post-stroke aspiration pneumonia(58, 59). Randomized control trial study revealed that giving anti-vomiting medications and putting the patient on nasogastric tube feeding decreases the risk of post-stroke aspiration pneumonia(58). Patients who are on tube feeding are less exposed to aspiration pneumonia than non-tube feeding because of nasogastric tube protect the entrance of gastrointestinal contents into the respiratory system(55). Oxygen saturation below the normal range (less than 95%) accounts for 20.6% of the risk of developing post-stroke aspiration

pneumonia(60). Oxygen administration through face mask is a more suitable option than oxygen administration via nasal cannula to decrease the risk of post-stroke aspiration pneumonia(59). As studies revealed that if brain reperfusion is achieved through thrombolysis and lowering high blood pressure through pharmacological and non-pharmacological treatment approaches can reduce the risk of post-stroke aspiration pneumonia(61, 62).

Post stroke patients develop post-stroke aspiration pneumonia at different point of time. As study showed that among hospital admitted patients, 33% of the patients develop at their admission time and 50% of the patients develop after three days of hospital admission(41). Prolonged hospital stay has positive associations with the risk of post-stroke aspiration pneumonia. Post-stroke aspiration pneumonia affects 44 up to 71.4 percent of patients who stay in the hospital for more than seven days. (24, 40). The length of hospital stay is depending on the severity of the disease and other patients clinical status(63).

3. CONCEPTUAL FRAMEWORK

The conceptual framework describes the socio-demographic factors, the clinical factors, the treatment related factors and the outcome variable. The conceptual framework used only to explain the possible factors that can affect the outcome variable. It was self-constructed through review of different literature and patient charts (31, 39, 43).

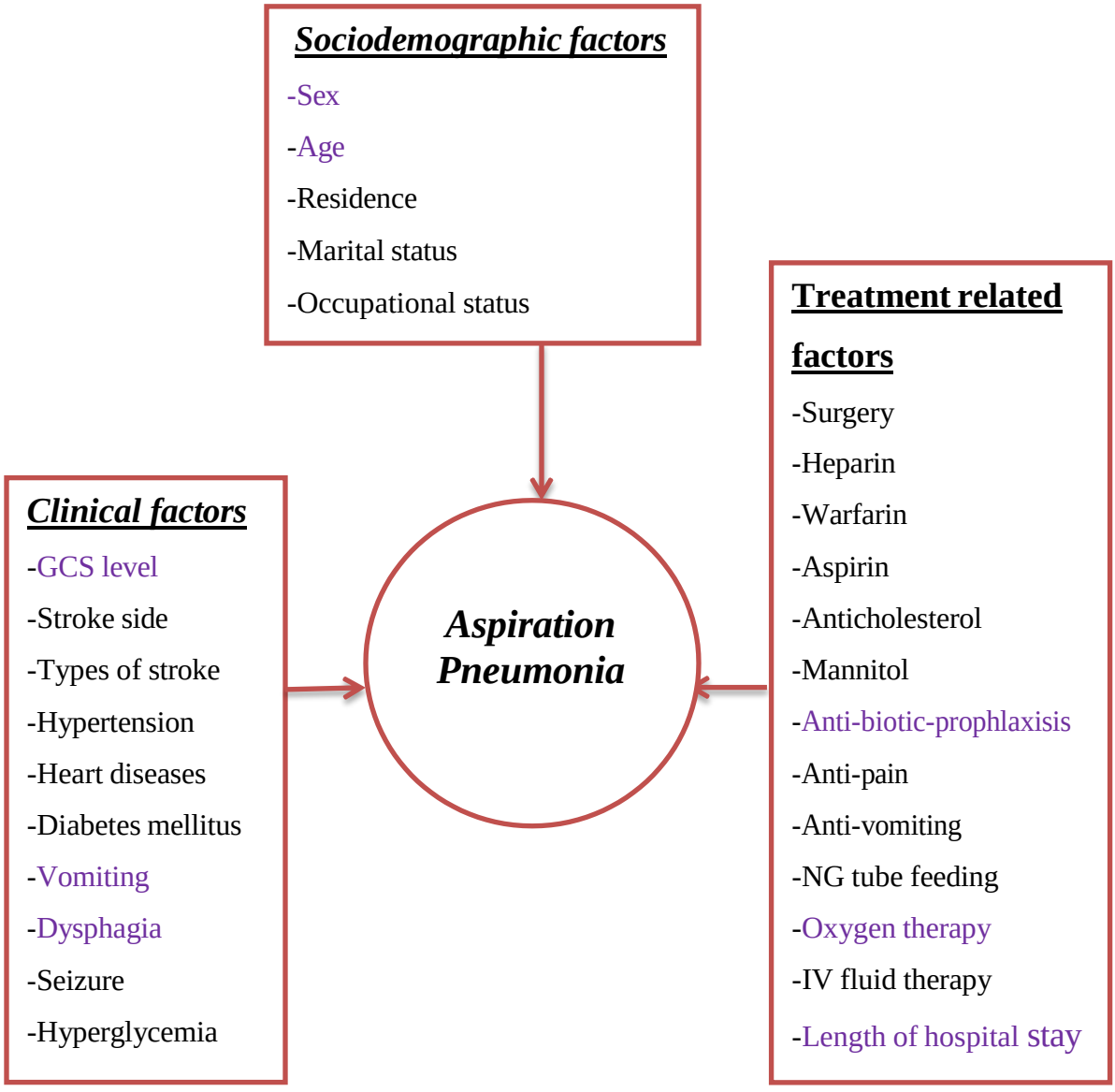

Figure 1 conceptual formwork for the incidence and predictors of aspiration pneumonia among stroke patients at Felege Hiwot compressive specialized hospital, Northwest Ethiopia, 2021

4. OBJECTIVES

4.1. General objective

To assess the incidence and predictors of aspiration pneumonia among stroke patients admitted at Felege Hiwot compressive specialized hospital, Bahir Dar, North West Ethiopia, 2021

4.2. Specific objectives

1. To determine the incidence of aspiration pneumonia among stroke patients admitted at Felege Hiwot compressive specialized hospital, Bahir Dar, North West Ethiopia, 2021
2. To identify predictors of aspiration pneumonia among stroke patients admitted at Felege Hiwot compressive specialized hospital, Bahir Dar, North West Ethiopia, 2021

5. METHODS AND MATERIALS

5.1. Study design

Institution based retrospective follow up study design was conducted to determine the incidence and to identify the predictors of aspiration pneumonia among stroke patients admitted at Felege Hiwot compressive specialized hospital.

5.2. Study area and period

This study was conducted retrospectively at Felege Hiwot compressive specialized hospital at Bahir Dar. Bahir Dar is the capital city of Amhara national regional state. Felege Hiwot compressive specialized Hospital provides services for the people in Amhara and neighboring regions and the hospital serving over 12 million people from the surrounding area. It is a referral hospital having more than 400 hospital beds with 95.5% bed occupancy rate (BOR) and 4.7 days average length of patient stay in hospital. The hospital has 15 adult outpatient departments (OPD) and it serves an average of 935 patients per month within each OPD. It has antiretroviral therapy (ART), psychiatry, internal medicine, surgery, gynecologic and obstetric, pediatric, orthopedic, oncologic, laboratory, pharmacy, etc. services. The study period was from July/2017 to June/2021 while the data extracted period was from September 20/2021 to October 10 / 2021.

5.3. Population

5.3.1. Source population

Stroke patients admitted at Felege Hiwot compressive specialized hospital

5.3.2. Study population

Stroke patients admitted at Felege Hiwot compressive specialized hospital from July/2017 to June/2021 and who fulfilled the inclusion criteria

5.3.3. Study unit

Each selected stroke patient admitted at Felege Hiwot compressive specialized hospital from July/2017 to June/2021

5.4. Eligibility criteria

5.4.1. Inclusion criteria

Adult stroke patients admitted at Felege Hiwot compressive specialized hospital from July/2017 to June/2021 were included in the study.

5.4.2. Exclusion criteria

Stroke patients who had aspiration pneumonia at admission time or diagnosed within 48 hours of hospital stay were excluded. Stroke patients that had length of hospital stay less than two days (48 hours) were excluded.

5.5. Sampling

5.5.1. Sample size determination

The sample size is calculated using Epi-info version-7.2. Double population-proportion formula with the following assumptions was applied. Confidence level = 95%, power =80%, ratio of unexposed to exposed group 1:1. Final sample size was calculated and determined by using pervious related study and based on the above assumptions (49).

Table 1 sample size determination for the incidence and predictors of aspiration pneumonia among stroke patients at Felege Hiwot compressive specialized hospital, Ethiopia

Variables	Confidence level	Power	Exposed to unexposed ratio	percent of outcome in unexposed group	percent of outcome in exposed group	Adjusted Risk ratio	Final Sample Size
Dysphagia(yes /no)	95%	80%	1	16.5%	25.5%	1.61	**568**
Hyperglycemia (yes/no)	95%	80%	1	24.1%	47.5%	1.5	**482**
Heart disease(yes/no)	95%	80%	1	5.1%	25%	2.98	**318**

Based on the above table the final sample size is by considering taking large sample size = **568**

5.5.2. Sampling techniques and procedure

Initially, medical registration numbers of stroke patients who admitted from July/2017 to June/2021 at Felege Hiwot compressive specialized hospital were collected. Then the charts of the patients have been drawn from card room based on the collected Medical Registration Number. To draw actual samples a simple random sampling technique (computer generate random numbering) implemented on recorded medical registration numbers which fulfill the inclusion criteria (from framed recorded medical registration numbers). Finally, appropriate study units were selected.

5.6. Variables

5.6.1. Dependent variable

Aspiration pneumonia (No = 0 and Yes = 1)

5.6.2. Independent variables

Sociodemographic variables

Sociodemographic variables of aspiration pneumonia were sex, age, residence, marital status, and occupational status.

Clinical variables

Clinical variables were Glasgow comma scale, stroke side of the body, types of stroke, hypertension, diabetes mellitus, heart diseases, vomiting, dysphagia, seizure and hyperglycemia.

Treatment related variables

Treatment related variables were surgical treatment, heparin, warfarin, aspirin, anticholestrol, mannitol, antibiotic prophlaxis, antipain, antivomiting, nasogastric tube feeding, oxygen therapy, intravenous fluid therapy and patient length of hospital stay.

5.7. Operational definition

Stroke: It is sudden brain cell death due to lack of oxygen, the cause is vascular origin and clinical presentations persist more than 24 hours and confirmed by physician(10, 64).

Aspiration pneumonia: it is an infection of the lung parenchyma caused by inhaled endogenous flora with gastrointestinal contents, and for this study, physician diagnoses were used as an occurrence of the outcome variable and confirmed by physician (10, 65).

Comorbidity diseases: A patient who had any disease in addition to stroke

5.8. Data collection tool and procedure

Before data collection, well-structured checklist was prepared from different related studies and from patients chart review. Before the data collection period, training was given for three data collectors and one supervisor who were MSc students in adult health nursing. Data collected from existing medical records of the stroke patients from July/2017 to June/2021 and review of the record done from September 20/2021 to October 10/ 2021 through well-structured checklist comprised different parts including socio-demographic variables, clinical variables, treatment related variables and characteristics of aspiration pneumonia at Felege Hiwot compressive specialized hospital.

5.9. Data quality assurance

For the data quality assurance, a proper data extraction checklist was prepared. Before the actual data collection period, the consistency between the data extraction checklist and completeness of the recording system was checked using 5% of the sample size (28 charts); little modification on variables of treatment related was done. A one-day training was given for the data collectors and supervisor on the role of investigator, supervisor, data collectors, the purpose of the study, which data should be extracted, how and from where extracted and how to ensure the confidentiality issues of patient information. Both the supervisor and principal investigator did check the completeness and consistency of collected data on daily basis. Finally, all the collected data were checked by investigator for its completeness and consistency during the data entry, storage, and analysis processes.

5.10. Data management and analysis procedure

The completeness and consistency of the checklist was checked manually. Epi data version 3.1 was used to enter the data, and then it was exported to stata version-14 Statistical software for final analysis. Before analysis, missing values were checked by the principal investigator. Missing values were handled through multiple imputation technique. Multicollinearity was checked between independent variables through variance inflation factor for continuous independent variables and spearman's rank correlation for categorical independent variables. The method of analysis was log binomial regression since the objective of this study was determining incidence and estimate the risk ratio of each predictor. When the outcome of interest is rare (less than 10%), the odds ratio, which is the output of logistic regression indirectly estimate the risk ratio. However, the outcome of interest in this study was not rare (23.06%). Therefore, the odds ratio becomes inflated and it could not estimate the risk ratio. Hence, for this study logistic regression would not be the appropriate statistical model and odds ratio is not good estimator of risk ratio (66-68).

There are different alternative to estimate risk ratio when odds ratio was not good estimator of risk ratio. Generalized linear model (log binomial regression) was one of the alternative methods. The logistic regression model and log binomial model have their own similarities and differences. The similarities were used similar assumptions and general model goodness of fit, both used hosmer and lemeshow model fitness for model goodness of fit. Among the difference

logistic regression used logit-link function (logit $(p/1-p) = \beta 0 + \beta 1X1 + \beta 2X2 + - - - \beta nXn$) but log binomial used log-link function (log $(p/(1-p) + p) = \beta 0 + \beta 1X1 + \beta 2X2 + - - - \beta nXn$) whereas logistic regression give odds ratio but log binomial give risk ratio which was appropriate measure of association in cohort study(66, 67, 69, 70).

In general, a log-binomial model is a similar to the logistic model. Everything is common between the two models except for the link function. Log-binomial models use a log link function, rather than a logit link, to connect the dichotomous outcome to the linear predictor(71). Estimation of risk ratios using a generalized linear model with a log link and binomial distribution was proposed in 1986 by Wacholder(72). It has been called log-binomial model, which is a special case of a generalized linear model, specifically applying a log link function to binomial outcome data. In general, log-binomial model is the form given by equation $\log \pi = \beta 0 + \beta 1X1 + \cdots + \beta pXp$, where π is P(Y = 1) for some binary outcome Y. The standard estimation procedure for all generalized linear models is based on maximum likelihood estimation. Likelihood based estimation is principally ascribed to the work of Sir R.A Fisher, who introduced the expression method of maximum likelihood, that is used by statisticians throughout the world today. A maximization technique depending on the way it has been implemented in the software. For example, in STATA there is a convergence tolerance for the coefficient vector and the log-likelihood. When using the Newton Raphson method if the change in either the parameter vector or the log likelihood is less than their respective tolerances (respectively $1.0 \times 10{-}6$ and $1.0 \times 10{-}7$) by default, but convergence tolerances are user adjustable through select or unselect technique among the alternatives then the iterative process is ceased and convergence problem would solve(68).

The interpretation of the log binomial model output was as the following. The log binomial regression coefficient β associated with a predictor X was the expected change in log risk or incidence (log $(p/1-p+p)$ or log $(a/a+b)$ of had the outcome per unit change in X. So increasing the predictor by 1 unit (or going from 1 level to the next) multiplies the risk (incidence) of having the outcome by$e\beta$, which is the antilog of β. Log binomial model directly print out eβ ' which is risk ratio in the model(71, 72).

Therefore, to assess the association between outcome variable and independent variables log binomial regression model applied at a 95% confidence level. The risk ratio (specially, the crude

risk ratio) that obtained from log binomial regression through stata software was crosschecked with risk ratio obtained from through another method of analysis. The Hosmer and Lemeshow's test used to test the model goodness of fit and its value was 0.14 for this study. To select significant predictors bi-variable log binomial regression carried out and predictors their p-value ≤ 0.25 were entered into multi-variable log binomial regression model. Statistical significance of the association between outcome variable and independent variables declared at P-value less than 5% (0.05). The data were presented in text and table.

5.11. Ethical consideration

First, ethical clearance was obtained from ethical review board of college of medicine and health science, Bahir Dar University. Then the Official letter was submitted to the Felege Hiwot compressive specialized hospital quality and research coordinator office, inpatient department office, and record keeping unit officer to obtain a list of patients record, permission for access to patient's card and the review of charts respectively. Confidentiality was ensured by not mentioning patients' names in the checklist and unauthorized individuals was not be allowed to access to the data.

6. RESULT

6.1. Socio-demographic characteristics

In this study, 568 charts of adult stroke patients were reviewed. Of those, 342(60.21%) were males and the rest 226 (39.79%) were females. The median age of the patients was 65 years and the range was 23 - 115 years. Majority of patients, 438 (77.10%) were rural residents and above half of the patients 335 (58.99%) were farmers. Regarding to marital status of the patients, two third of the patients were married 430(77.70%) and 28(4.93%) were divorced (Table-2).

Table-2 Socio-demographic characteristics of patients with stroke at Felege Hiwot Compressive specialized hospital, Northwest Ethiopia, July/01/2009 to June/30/2021(N=568)

Variables	Categories	Frequency	Percent
Sex	Female	226	39.79
	Male	342	60.21
Age	23 – 44	76	13.38
	45 – 64	180	31.69
	>65	312	54.93
Residence	Urban	130	22.90
	Rural	438	77.10
Marital status	Married	430	75.70
	Single	13	2.29
	Widowed	97	17.08
	Divorced	28	4.93
Occupational status	Unemployed	108	19.01
	Employed	65	11.44
	Merchant	60	10.56
	Farmer	335	58.99

6.2. Clinical characteristics

Among 568 patients, 253(44.54%) had Glasgow comma scale of greater than twelve and 438 (85.05%) patients had unilateral stroke attack. The predominant stroke-type was ischemic, 392 (69.01%) followed by hemorrhagic, 176 (30.99%). Half of the patients had at least one chronic disease like hypertension 314 (44.72%), heart diseases 94 (16.15%) and diabetes mellitus 61 (10.74%). Clinical manifestations that seen on the patients were vomiting 206 (36.27%),

dysphagia 244 (39.79%), seizure 125 (22.01%) and 79(13.91%) stroke patients were hyperglycemic (Table-3).

Table-3 Clinical characteristics of patients with stroke at Felege Hiwot compressive specialized hospital, Northwest Ethiopia, July/01/2009 to June/30/2021(N = 568)

Variables	Categories	Frequency	Percent
GCS level	≤8	94	16.55
	9 – 12	221	38.90
	>12	253	44.54
Stroked body part	Bilateral	85	14.96
	Unilateral	483	85.04
Type of stroke	Ischemic	392	69.01
	Hemorrhagic	176	30.99
Hypertension	No	254	55.28
	Yes	314	44.72
Heart diseases	No	474	83.45
	Yes	94	16.15
Diabetes mellitus	No	507	89.26
	Yes	61	10.74
Vomiting	No	362	63.73
	Yes	206	36.27
Dysphagia	No	342	60.21
	Yes	244	39.79
Seizure	No	443	77.99
	Yes	125	22.01
Hyperglycemia	No	489	86.09
	Yes	79	13.91

6.3. Treatment related characteristics

The majority of the patients were treated by non-surgical treatments (medication therapy) 543 (95.59%) and only 25 (4.41%) were treated with surgery among 568 total patients. Among medication therapies, Aspirin was the most administered one that accounted 413 (72.71%) while warfarin was only administered for 76 (13.38%) patients during the study period. Most patients did not receive anti-biotic prophylaxis 411 (72.36%). Among 568 patients 180(31.7%) received oxygen therapy during the study period. Regarding hospital stay, length of hospital stay of 397

(69.89%) patients was 3 up to 7 days and 171 (30.11%) patients was eight up to twenty-nine days (Table-4).

Table-4 Treatment related characteristics of patients with stroke at Felege-Hiwot compressive specialized hospital, Northwest Ethiopia, July/01/2009 to June/30/2021(N = 568)

Variables	Categories	Frequency	Percent
Surgery performed	No	543	95.59
	Yes	25	4.41
Heparin given	No	322	56.69
	Yes	246	43.31
Warfarin given	No	492	86.62
	Yes	76	13.38
Aspirin given	No	155	27.29
	Yes	413	72.71
Anti-cholesterol	No	173	30.46
	Yes	395	69.54
Mannitol	No	404	71.13
	Yes	164	28.87
Anti-biotic prophylaxis given	No	411	72.36
	Yes	157	27.64
Anti-pain given	No	260	45.78
	Yes	308	54.22
Anti-vomiting given	No	474	83.45
	Yes	94	16.55
NG tube inserted	No	254	44.72
	Yes	314	55.28
Oxygen administered	No	388	68.30
	Yes	180	31.70
IV fluid given	No	371	65.32
	Yes	197	34.68
Length of hospital stay	3-7	397	69.89
	8-29	171	30.11

6.4. Incidence of aspiration pneumonia

The cumulative incidence (CI) and incidence density rate (IDR) of aspiration pneumonia were 23.06% (95% CI 20% - 27%) and 38/1000 persons per day observation (95% CI 32/1000 – 45/1000) respectively.

6.5. Predictors of aspiration pneumonia

Twenty-eight possible variables believed to be predictors of aspiration pneumonia that entered in bi-variable log binomial regression model. Those were sex, age, residence, marital status, occupational status, GCS level, stroke side, type of stroke, hypertension, heart diseases, diabetes mellitus, vomiting, dysphagia, seizure, hyperglycemia, surgical intervention, , heparin, warfarin anti-cholesterol, mannitol, anti-biotic prophylaxis, anti-pain, anti-vomiting, nasogastric tube, oxygen therapy, intra-venous fluid therapy and length of hospital stay. On bi-variable log binomial regression analysis, twenty-two predictors were significant at level of significance 0.25. All these variables were entered into multi-variable log binomial regression model. On the final log binomial regression model, eight predictors became significant (p-values less than 0.05) which were sex, age, GCS level, vomiting, dysphagia, anti-biotic prophylaxis, oxygen therapy and length of hospital stay.

In this study, 39(17.3%) female and 92(26.9%) male patients acquired aspiration pneumonia during the study period. Males were 1.71 times more risky than females to develop aspiration pneumonia (ARR = 1.71, (95 percent CI 1.07-2.74)). As age increased by one year the risk of acquired aspiration pneumonia increased by 4% (ARR = 1.04, 95 percent 1.01-1.06). Among patients their GCS level greater than twelve, 34(13.4%) patients have acquired aspiration pneumonia while patients their GCS level less than eight, 39(41.5%) have acquired aspiration pneumonia during the study period. The risk of developing post-stroke aspiration pneumonia is 55 times higher in patients with a GCS level of less than eight as compared to patients with a GCS level of greater than twelve (ARR = 0.45, 95 percent CI 0.22-0.94). In this study, 62(30.1%) of patients with vomiting have developed aspiration pneumonia and 69(19.1%) patients without vomiting have developed aspiration pneumonia. Stroke patients who had vomiting were 1.81 times more risky to acquire aspiration pneumonia as compared to stroke patients who had not vomiting (ARR = 1.81, 95 percent CI 1.04-3.14). Among stroke patients who had dysphagia, 85(34.8%) patients have acquired aspiration pneumonia while stroke patients who had not dysphagia, 46(14.2%) patients have acquired aspiration pneumonia. During the study period stroke patients with dysphagia were 1.95 times more risky as compared to stroke patients without dysphagia to acquire aspiration pneumonia (ARR = 1.95, 95 percent CI 1.10-3.48) (Table-5).

Among stroke patients who received antibiotic prophylaxis only 8(5.1%) have developed aspiration pneumonia while patients not received antibiotic prophylaxis, 123(29.9%) patients have developed aspiration pneumonia. The risk of developing post-stroke aspiration pneumonia is 90 times higher in stroke patients not received antibiotic prophylaxis as compared to patients received antibiotic prophylaxis (ARR = 0.10, 95 percent CI 0.04-0.28). Among stroke patients who received oxygen therapy, 81 (45.0%), patients have developed aspiration pneumonia during the study period while patients not received oxygen therapy 50(12.9%) patients have developed aspiration pneumonia. Patients who received oxygen therapy were 3.66 times more risk to acquire aspiration pneumonia as compared to those patients not received oxygen therapy (ARR = 3.66, 95 percent CI 1.93-6.94). As the length of hospital stay of the patient increased by one day duration in the hospital, the risk of acquired aspiration pneumonia increased by 14% (ARR = 1.14, 95 percent CI 1.06-1.21). Those significant predictors contributed a favorable impact on post-stroke patients to acquire aspiration pneumonia in the hospital setting (Table-5).

Table-5 Bi-variable and Multi-variable log binomial regression analysis to the predictors of aspiration pneumonia among hospital admitted adult stroke patients at Felege Hiwot compressive specialized hospital, Northwest Ethiopia, from July/2017 to Jun/2021

Variables	Category	AP		CRR	ARR(95% CI)	P-value
		Yes	No			
Sex	Female	39	187	1	1	
	Male	92	250	1.56	1.71 (95% CI 1.07-2.74)	0.024
Age		131	437	1.03	1.04 (95% CI 1.01-1.06)	0.003
Residence	Urban	32	98	1		
	Rural	99	339	0.92		
Marital status	Married	96	334	1	1	
	Single	1	12	0.34	3.83 (95% CI 0.78-18.71)	0.097
	Widowed	23	74	1.06	0.34 (95% CI 0.14-0.82)	0.017
	Divorced	11	17	1.76	1.46 (95% CI 0.68-3.12)	0.325
Occupational status	Unemployed	28	80	1	1	
	Employed	9	56	0.53	1.40 (95% CI 0.58-3.37)	0.450
	Merchant	19	41	1.22	1.63 (95% CI 0.53-4.91)	0.389
	Farmer	75	260	0.86	1.34 (95% CI 0.81-2.22)	0.239
GCS level	≤8	39	55	1	1	
	9-12	58	163	0.63	0.87 (95% CI 0.47-1.62)	0.660
	>12	34	219	0.32	0.45 (95% CI 0.22-0.94)	0.033
Stroked body part	Bilateral	21	64	1		
	Unilateral	110	373	0.92		
Type of stroke	Ischemic	85	307	1	1	
	Hemorrhagic	46	130	1.21	0.53 (95% CI 0.19-1.48)	0.225
Hypertension	No	46	208	1	1	
	Yes	85	229	1.49	1.10 (95% CI 0.63-1.92)	0.728
Heart diseases	No	97	377	1	1	
	Yes	34	60	1.77	1.39 (95% CI 0.76-2.51)	0.291
Diabetes mellitus	No	109	398	1	1	
	Yes	22	39	1.68	1.67 (95% CI 0.58-4.87)	0.345
Vomiting	No	69	293	1	1	
	Yes	62	144	1.58	1.81 (95% CI 1.04-3.14)	0.036
Dysphagia	No	46	278	1	1	
	Yes	85	159	2.45	1.95 (95% CI 1.10-3.48)	0.023
Seizure	No	90	353	1	1	
	Yes	41	84	1.61	0.55 (95% CI 0.24-1.26)	0.156
Hyperglycemia	No	100	389	1	1	
	Yes	31	48	1.92	0.58 (95% CI 0.21-1.58)	0.288

Surgical intervention	No	127	416	1		
	Yes	4	21	0.68		
Heparin	No	75	247	1		
	Yes	56	190	0.98		
Warfarin	No	115	377	1		
	Yes	16	60	0.90		
Aspirin	No	48	107	1	1	
	Yes	83	330	0.650	0.76 (95% CI 0.39-1.47)	0.415
Anti-cholesterol	No	49	124	1	1	
	Yes	82	313	0.73	0.95 (95% CI 0.56-1.64)	0.864
Mannitol	No	90	314	1		
	Yes	41	123	1.12		
Antibiotic prophylaxis	No	123	288	1	1	
	Yes	8	149	0.17	0.10 (95% CI 0.04-0.28)	< 0.001
Anti –pain	No	39	221	1	1	
	Yes	92	216	1.99	1.22 (95% CI 0.73-2.03)	0.449
Anti –vomiting	No	103	371	1	1	
	Yes	28	66	1.37	0.52 (95% CI 0.23-1.18)	0.119
Naso-gastric tube	No	38	216	1	1	
	Yes	93	221	1.98	0.96 (95% CI 0.52-1.75)	0.882
Oxygen-therapy	No	50	338	1	1	
	Yes	81	99	3.49	3.66 (95% CI 1.93-6.94)	< 0.001
Intravenous-fluid	No	75	296	1	1	
	Yes	56	141	1.41	1.24 (95% CI 0.74-2.07)	0.409
Length of hospital stay		131	437	1.05	1.14 (95% CI 1.06-1.21)	< 0.001

Note: AP = Aspiration Pneumonia, ARR= Adjusted Risk Ratio, CI = Confidence Interval, CRR = Crude Risk Ratio, GCS = Glasgow comma scale

7. DISCUSSION

The study showed that the cumulative incidence and the incidence density rate of aspiration pneumonia was 131/568 (23.06 percent) and 38/1000 persons day-observation respectively. This cumulative incidence finding was higher than studies conducted in Nigeria (12.40 percent), China (13.20 percent), United Kingdom (7.12 percent) and USA (5 percent)(9, 20, 39, 55). The discrepancy was due to difference post-stroke patient care and different diagnosis approaches of post-stroke aspiration pneumonia.

But the incidence of this study was less than studies conducted in Egypt (40 percent) and India (32 percent)(19, 24). The source of discrepancy might be due to the difference of sample size and study design. In Egypt and India, prospective follow up study design was applied but in this study retrospective follow-up study was applied that excluded some patients with aspiration pneumonia through the exclusion criteria.

In this study aspiration pneumonia significantly occurred among males as compared to females. This finding was similar with other studies conducted in United Kingdom and China(39, 73). Age is the most important factor referred to by most studies. It associated with more severe neurological outcome and impaired swallowing function as well as cough reflex. These conditions increase the susceptibilities of the patient for post-stroke aspiration pneumonia. As this study revealed that the risk of acquired aspiration pneumonia increases when the age of the patient increases. Age influences the level of physical exercise and swallowing function and they attributed to reduced immunity and increased comorbidities. This finding was similar with study conducted in other countries(24, 74).

Glasgow comma scale greater than twelve were negatively associated with aspiration pneumonia, which means that it is protective for aspiration pneumonia on post stroke adult patients. Patients with Glasgow comma scale greater than twelve were less risky to acquire aspiration pneumonia as compare to Glasgow comma scale less than eight. This finding was similar with a study conducted in Nigeria(20). Low Glasgow comma scale level was shown to be significantly associated with aspiration pneumonia, which was due to a lack of patient oral care and positioning, because stroke patient with low GCS level was more susceptible to aspiration that increased the risk of aspiration pneumonia after a stroke episode. Low GCS level or unconsciousness brings loss of airway reflexes, which is protective mechanism of aspiration. As

a result, patients faced to loss of airway reflexes, they easily exposed to aspiration then they develop aspiration pneumonia.

Stroke patients with vomiting were more risky to acquire aspiration pneumonia as compared to patients without vomiting. This finding was similar with studies conducted in other countries (48, 75). Aspiration pneumonia occurs when food, saliva, liquids, or vomits are breathed into the lungs, instead of being swallowed into the esophagus and stomach. Therefore, any gastrointestinal system contents enter into the lung, the patients are at higher risk of developing post stroke aspiration pneumonia.

When compared to stroke patients with dysphagia and patients without dysphagia, patient with dysphagia was more risky to acquire aspiration pneumonia. This finding was similar to other studies conducted in China and Iraque (40, 55). Dysphagia is one of the most common clinical factors for aspiration pneumonia because individuals with defective corticodiaphragmatic pathways experience abnormal diaphragmatic motion, which leads to dysphagia. As the severity of dysphagia increase, the risk of post-stroke aspiration pneumonia increase.

In this study, Antibiotic prophylaxis showed a negative relationship with post-stroke aspiration pneumonia. Patients who received antibiotic prophylaxis were less risky to acquire aspiration pneumonia as compared to patients who not received antibiotic prophylaxis, implying that antibiotic prophylaxis was protective for aspiration pneumonia. This finding was similar with studies conducted in other countries(58, 76).

In this study, oxygen therapy was linked to a high risk of aspiration pneumonia. The risk of acquired post-stroke aspiration pneumonia was higher in patients who got oxygen therapy as compared to patients who not got oxygen therapy. This finding contradict with study conducted in other countries(58, 59). The reason of the difference was due to patient clinical status difference, the type of stroke, the ways of oxygen administration to the patients and the clinical setting of health facilities like treatment modalities.

According to this study, as the length of a patient's stay in the hospital increases the risk of acquired aspiration pneumonia also increases. This finding was similar with study undertaken in Egypt and Indonesia(24, 40). From the total of 131 patients who acquired aspiration pneumonia, 54.19 percent had a hospital stay of more than seven days, while 45.81 percent had a hospital stay of less than or equal to seven days.

8. LIMITATION OF THE STUDY

Limitation

This study had the following weakness:

Since the data was gathered from a secondary source, certain important variables such as patient position status and behavioral variables, which could be predictors of post-stroke aspiration pneumonia, were missed.

9. CONCLUSION

The aim of this study was to determine the incidence and identify predictors of post-stroke aspiration pneumonia. As a result, this study showed that the cumulative incidence was 23.06 percent, with an incidence density rate of 38/1000 persons day-observation. Being male, advanced age, vomiting, a lower GCS level, dysphagia, long period of hospital stay and oxygen therapy were found as risk factors that increase the risk of post-stroke aspiration pneumonia. On the other way, antibiotic prophylaxis has been discovered as preventive factor that reduce the risk of post-stroke aspiration pneumonia. The findings of this study would help the health-care professionals through providing information regarding to predictors of post-stroke aspiration pneumonia for the prevention and the treatment approaches.

10. RECOMMENDATION

For health care providers/professionals

The health care professionals better to give special attention and clinical care as accordingly for patients with risk factors of post-stroke aspiration pneumonia such as advanced age, vomiting, low GCS level, dysphagia and patients spending longer times in the hospital.

Antibiotic prophylaxis greatly decrease the risk of aspiration pneumonia, therefore, the health care professionals better to encourage the practice of give antibiotic prophylaxis for patient with risk of post stroke aspiration pneumonia.

As this study revealed that oxygen therapy increase the risk of post-stroke aspiration pneumonia, therefore health care professionals closely monitor patients with oxygen therapy.

For health organizations and concerned bodies

Higher health-care organizations better to give a greater emphasis on the preparation of updated guideline regarding for the prevention of post-stroke aspiration pneumonia through avoiding of the risk factors such as vomiting and dysphagia and assign health care professionals and providing necessary resources for all health-care facilities, as they need.

For researchers

The future researchers undertake prospective studies that able to including different variables (patient positioning and different behavioral variables) that missed in this study.

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12. ANNEXS

Annex- I: Information sheet form

Introduction: Information sheet provided for Felege Hiwot referral hospital so that a clear view about the purpose of research, confidentiality, and data collection procedures will be created on concerned bodies.

Title of the Research: incidence and predictors of aspiration pneumonia among stroke patients admitted in medical ward at Felege Hiwot referral hospital, northwest Ethiopia

Name of Investigator: Tadios Lidetu (BSN)

Name of the Organization: Bahir Dar University, College of Medicine and Health Sciences, School of public health, Department of Epidemiology and Biostatistics

Purpose of the Research: To assess incidence and predictors of aspiration pneumonia among stroke patients in medical ward at Felege Hiwot comprehensive hospital, northwest Ethiopia

Procedure: After checking for the inclusion of the chart, it will be reviewed based on the written questionnaires. The total number of questions to be reviewed and it takes around 30 minutes to fill it for one chart.

Risk and /or Discomfort: Since data for this research is obtaining from medical chart review, it will not inflict any harm to the patients. Any other identifying information will not be recorded on the checklist and all information taken from the chart will be kept strictly confidential and in a safe place. The information retrieved will only be used for the study purpose.

Benefits: The research has no direct benefit but the indirect benefit of the research for the participant and other clients in the program is clear. Generally, the research work has a paramount direct benefit for health care planners and managers to design appropriate policies.

Confidentiality: to assure confidentiality the data on the chart will be collected by those individuals who are working in the facility and information will be collected without the name and MRN of the clients. The information collected from this research project will be kept confidential and will be stored in a locked cabinet. Besides, it will not be revealed to anyone except the investigator and will be kept with a password only on the investigator's computer.

Person to contact: If there are any questions or inquiries at any time about the study or the procedures, you can contact any of the following individuals (Investigator and Advisors) at any point in time.

Principal investigator

1. Tadios Lidetu: Department of Epidemiology and Biostatistics, School of public health, College of Medicine and Health Science, Bahir Dar University

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Advisors

1. Dr. Essey Kebede (MSc, PhD), Academic Vice President of Bahir Dar University, Vice President of the Ethiopian Statistician Association, Associate Professor, Department of Epidemiology and Biostatistics School of Public Health College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia.

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Annex -II: Data extraction checklist

The data collection tool will be prepared for the collecting socio-demographic, clinical, and treatment-related information on the patients' inpatient logbook and patients' chart to assess incidence and Predictors of aspiration pneumonia among stroke patients at Felege Hiwot referral hospital from July/2020 to June/2021

Data collection date ----------Name of the Health institutions ----------

Name of data collector - - - - - - - - - - - - - - - - - signature- -

Name of supervisor- signature- -

Unique MRN Number---------- Code No._____

Part-I: Variables that are related to sociodemographic of the patients

Table 9 Sociodemographic variables for the incidence and predictors of aspiration pneumonia among stroke patients at Felege Hiwot referral hospital, Northwest Ethiopia

SNO	Variable	Answers	Codes	Skipping	Remarks
101	What was the Sex of the patient?	Male	0		
		Female	1		
102	How old the Age of the patients in year?	_____			Put in years
103	Where did the Residence of the	Urban	0		
		Rural	1		
104	What was Marital status of the patient?	Single	0		
		Married	1		
		Divorced	2		
		Widowed	3		
105	What was Occupation of the patient?	Unemployed	0		
		employed	1		
		Merchant	2		
		Farmer	3		
		Other (specify)			

Part II: Variables that are related to patients clinical conditions

Table 10 Clinical variables for the incidence and predictors of aspiration pneumonia among stroke patients at Felege Hiwot referral hospital, Northwest Ethiopia

SNO	Variable	Answers	Codes	Skipping	Remarks
106	What was the GCS level of the patient?	<8	0		
		9 -12	1		
		>12	2		
107	Which part of the patient body attacked by stroke?	Bilateral	0		
		Unilateral	1		
108	What Type of stroke occurred on the patient?	Ischemic	0		
		Hemorrhagic	1		
109	Did patient has comorbidity	No	0	If no go to Q111	
		Yes	1		
110	If yes, what type of comorbidity was occurred?	Diabetes mellitus	0		
		Hypertensive	1		
		Heart diseases	2		
		Others(specify)			
111	Did Vomiting occur?	No	0		
		Yes	1		
112	Did Dysphagia occur?	No	0		
		Yes	1		
113	Did seizure occur?	No	0		
		Yes	1		
114	Did the patient has Hyperglycemia?	No	0		
		Yes	1		

Part-III: Variables that related to patients treatment/management

Table 11 Treatment related variables for the incidence and predictors of aspiration pneumonia among stroke patients at Felege Hiwot referral hospital, Northwest Ethiopia

SNO	Variables	Answers	Codes	Skipping	Remarks
115	Did the Patient receive Surgical intervention?	No	0		
		Yes	1		
116	Did Patient receive heparin?	No	0		
		Yes	1		
117	Did Patient receive warfarin?	No	0		
		Yes	1		
118	Did Patient receive Aspirin?	No	0		
		Yes	1		
119	Did Patient receive Anti-cholesterol medication?	No	0		
		Yes	1		
120	Did Patient receive mannitole?	No	0		
		Yes	1		
121	Did Patient receive Antibiotic?	No	0		
		Yes	1		
122	Did Patient receive Anti-pain medication?	No	0		
		Yes	1		
123	Did Patient receive Anti-vomiting medication?	No	0		
		Yes	1		
124	Was the Patient on NG tube?	No	0		
		Yes	1		
125	Did the Patient receive Oxygen therapy?	No	0		
		Yes	1		
126	Did Patient receive IV fluid?	No	0		
		Yes	1		
127	How many days did the patient stay in hospital?	_____			Put in days

Part-IV: Outcome Variable Information

Table 12 Outcome variable for the incidence and predictors of aspiration pneumonia among stroke patients at Felege Hiwot compressive and specialized hospital, Northwest Ethiopia

SNO	Variable	Answers	Codes	Skipping	Remarks
129	When was the Admission date of the patient?	_____			Write in day
136	Did the patient develop Aspiration pneumonia?	No	0	If No go to Q138	
		Yes	1		
137	If yes for Q-136, when did pt. develop AP	_____			Write in day
138	When was Last visit date of the patient?	_____			Write in day

Annex-III log binomial regression outputs

The Output of bi-variable log binomial regression analysis

Variables	Crude risk ratio	Robust Std. Err.	z	P>z	[95% Confidence Interval]	
Sex(female)	**1**					
Male	**1.558854**	**.2664377**	**2.60**	**0.009**	**1.115114**	**2.179174**
_cons	**.1725664**	**.0251578**	**-12.05**	**0.000**	**.1296769**	**.2296412**
Age	**1.028893**	**.0054377**	**5.39**	**0.000**	**1.01829**	**1.039606**
_cons	**.0354747**	**.0134429**	**-8.81**	**0.000**	**.0168796**	**.0745548**
Residence (urbane)	**1**					
Rural	**.9182363**	**.162792**	**-0.48**	**0.630**	**.6487045**	**1.299757**
_cons	**.2461538**	**.0378143**	**-9.13**	**0.000**	**.1821565**	**.3326355**
Marriage (married)	**1**					
Single	**.3445513**	**.3327749**	**-1.10**	**0.270**	**.0518974**	**2.287506**
Widowed	**1.06207**	**.215924**	**0.30**	**0.767**	**.7130171**	**1.582001**
Divorced	**1.759673**	**.4430655**	**2.24**	**0.025**	**1.074259**	**2.882403**
_cons	**.2232558**	**.0200997**	**-16.65**	**0.000**	**.1871412**	**.2663399**
Occupation (unemployed)	**1**					
Employed	**.5340659**	**.1868445**	**-1.79**	**0.073**	**.2690293**	**1.060206**
Merchant	**1.221429**	**.3054305**	**0.80**	**0.424**	**.7481981**	**1.993974**
Farmer	**.8635395**	**.165809**	**-0.76**	**0.445**	**.5927099**	**1.25812**
_cons	**.2592593**	**.0422057**	**-8.29**	**0.000**	**.1884362**	**.3567009**
GCS level(<8)	**1**					
9-12	**.632556**	**.1054076**	**-2.75**	**0.006**	**.4563066**	**.8768821**
>12	**.323908**	**.065212**	**-5.60**	**0.000**	**.2182983**	**.4806102**
_cons	**.4148936**	**.0508633**	**-7.18**	**0.000**	**.3262758**	**.5275803**
Stroke side(bilateral)	**1**					
Unilateral	**.921818**	**.1910421**	**-0.39**	**0.694**	**.6140984**	**1.383733**
_cons	**.2470588**	**.0468224**	**-7.38**	**0.000**	**.1704046**	**.358195**
Type of stroke(ischemic)	**1**					
Hemorrhagic	**1.205348**	**.1917812**	**1.17**	**0.240**	**.882427**	**1.64644**
_cons	**.2168367**	**.0208321**	**-15.91**	**0.000**	**.1796204**	**.261764**
Hypertension (no)	**1**					
Yes	**1.494738**	**.2429979**	**2.47**	**0.013**	**1.086892**	**2.055626**
_cons	**.1811024**	**.0241848**	**-12.80**	**0.000**	**.1393968**	**.2352857**
Heart diseases(no)	**1**					
Yes	**1.767493**	**.2905395**	**3.46**	**0.001**	**1.280672**	**2.439371**
_cons	**.2046414**	**.0185469**	**-17.50**	**0.000**	**.1713357**	**.2444212**
Diabetes mellitus(no)	**1**					
Yes	**1.677546**	**.3197341**	**2.71**	**0.007**	**1.154619**	**2.437307**
_cons	**.2149901**	**.018261**	**-18.10**	**0.000**	**.1820197**	**.2539328**
Vomiting (no)	**1**					
Yes	**1.579007**	**.2397053**	**3.01**	**0.003**	**1.172641**	**2.126194**
_cons	**.1906077**	**.0206623**	**-15.29**	**0.000**	**.1541234**	**.2357287**
Dysphagia (no)	**1**					
Yes	**2.453671**	**.3984135**	**5.53**	**0.000**	**1.784855**	**3.373104**
_cons	**.1419753**	**.0194074**	**-14.28**	**0.000**	**.1086069**	**.1855958**

Seizure(no)	**1**					
Yes	**1.614489**	**.256742**	**3.01**	**0.003**	**1.182153**	**2.204937**
_cons	**.2031603**	**.0191331**	**-16.92**	**0.000**	**.1689176**	**.2443446**
Hyperglycemia (no)	**1**					
Yes	**1.918861**	**.318805**	**3.92**	**0.000**	**1.385551**	**2.657446**
_cons	**.204499**	**.0182555**	**-17.78**	**0.000**	**.1716741**	**.2436001**
Surgical intervention(no)	**1**					
Yes	**.6840944**	**.3182424**	**-0.82**	**0.414**	**.2748748**	**1.702539**
_cons	**.2338859**	**.0181816**	**-18.69**	**0.000**	**.2008326**	**.2723791**
Heparin(no)	**1**					
Yes	**.9773439**	**.1516055**	**-0.15**	**0.883**	**.7211226**	**1.324603**
_cons	**.2329193**	**.0235764**	**-14.39**	**0.000**	**.1910054**	**.2840307**
Warfarin (no)	**1**					
Yes	**.9006869**	**.2133391**	**-0.44**	**0.659**	**.5661819**	**1.43282**
_cons	**.2337399**	**.0190965**	**-17.79**	**0.000**	**.1991543**	**.2743317**
Aspirin (no)	**1**					
Yes	**.6489609**	**.1006432**	**-2.79**	**0.005**	**.4788627**	**.87948**
_cons	**.3096774**	**.0371704**	**-9.77**	**0.000**	**.2447599**	**.391813**
Anti-cholesterol(no)	**1**					
Yes	**.7329372**	**.1143338**	**-1.99**	**0.046**	**.5398641**	**.9950597**
_cons	**.283237**	**.0342864**	**-10.42**	**0.000**	**.2234139**	**.3590788**
Mannitol(no)	**1**					
Yes	**1.122222**	**.1843181**	**0.70**	**0.483**	**.813344**	**1.548401**
_cons	**.2227723**	**.0207203**	**-16.14**	**0.000**	**.1856478**	**.2673206**
Antibiotic prophylaxis (no)	**1**					
Yes	**.1702657**	**.0600888**	**-5.02**	**0.000**	**.0852566**	**.3400371**
_cons	**.2992701**	**.0226083**	**-15.97**	**0.000**	**.258083**	**.3470302**
Anti-pain(no)	**1**					
Yes	**1.991342**	**.3418478**	**4.01**	**0.000**	**1.422403**	**2.787848**
_cons	**.15**	**.0221641**	**-12.84**	**0.000**	**.1122837**	**.2003852**
Anti-vomiting(no)	**1**					
Yes	**1.370791**	**.2480058**	**1.74**	**0.081**	**.9615471**	**1.954214**
_cons	**.2172996**	**.0189592**	**-17.50**	**0.000**	**.1831438**	**.2578253**
Naso-gastric tube(no)	**1**					
Yes	**1.979718**	**.3428948**	**3.94**	**0.000**	**1.409847**	**2.779936**
_cons	**.1496063**	**.0224001**	**-12.69**	**0.000**	**.1115583**	**.200631**
Oxygen therapy(no)	**1**					
Yes	**3.492**	**.5438504**	**8.03**	**0.000**	**2.573396**	**4.738511**
_cons	**.128866**	**.0170247**	**-15.51**	**0.000**	**.0994683**	**.166952**
Intra –venous fluid(no)	**1**					
Yes	**1.406159**	**.2153776**	**2.23**	**0.026**	**1.041497**	**1.8985**
_cons	**.2021563**	**.0208688**	**-15.49**	**0.000**	**.1651265**	**.2474901**
Length of hospital stay(no)	**1.053891**	**.0075625**	**7.31**	**0.000**	**1.039173**	**1.068818**
_cons	**.1506235**	**.016519**	**-17.26**	**0.000**	**.1214901**	**.1867431**

Outputs of Multi-variable log binomial regression analysis

Variable list	*Risk Ratio*	*Robust SE*	*z-value*	*P>z*	*[95% Conf.*	*Interval]*
Female	*1*					
Male	*1.713538*	*.4096788*	*2.25*	*0.024*	*1.072471*	*2.737802*
Age	*1.037616*	*.0128217*	*2.99*	*0.003*	*1.012788*	*1.063053*
Married (reference)	*1*					
single	*3.832451*	*1.101158*	*1.66*	*0.097*	*.7846899*	*18.71782*
widowed	*.3421829*	*.1536623*	*-2.39*	*0.017*	*.1419102*	*.8250933*
divorced	*1.463536*	*.5661688*	*0.98*	*0.325*	*.685672*	*3.123854*
Unemployed	*1*					
employed	*1.401921*	*.6274595*	*0.75*	*0.450*	*.58311*	*3.37052*
merchant	*1.62516*	*.9164579*	*0.86*	*0.389*	*.538131*	*4.907999*
farmer	*1.343035*	*.3455668*	*1.15*	*0.252*	*.8110931*	*2.223842*
Gcs level < 8	*1*					
9-12	*.8691568*	*.2767107*	*-0.44*	*0.660*	*.4656974*	*1.622155*
>12	*.4539283*	*.1684425*	*-2.13*	*0.033*	*.2193439*	*.9393965*
Ischemic	*1*					
Hemorrhagic	*.5293402*	*.2773518*	*-1.21*	*0.225*	*.1895576*	*1.478184*
Hypertension (no)	*1*					
Yes	*1.103808*	*.3132131*	*0.35*	*0.728*	*.6329349*	*1.924987*
Heart diseases(no)	*1*					
Yes	*1.379978*	*.4209664*	*1.06*	*0.291*	*.7589459*	*2.509191*
DM(no)	*1*					
Yes	*1.673042*	*.9112647*	*0.94*	*0.345*	*.575279*	*4.865588*
Vomiting (no)	*1*					
Yes	*1.805687*	*.5087833*	*2.10*	*0.036*	*1.039446*	*3.136773*
Dysphagia(no)	*1*					
Yes	*1.954878*	*.5757378*	*2.28*	*0.023*	*1.097563*	*3.481849*
Seizure(no)	*1*					
Yes	*.5477327*	*.2326386*	*-1.42*	*0.156*	*.2382526*	*1.259214*
Hyperglycemia(no)	*1*					
Yes	*.5800939*	*.2971092*	*-1.06*	*0.288*	*.212586*	*1.582931*
Aspirin(no)	*1*					
Yes	*.7605047*	*.255633*	*-0.81*	*0.415*	*.3935341*	*1.469675*
Anti-cholesterol(no)	*1*					
Yes	*.9538445*	*.2632776*	*-0.17*	*0.864*	*.5553045*	*1.638415*
Antibiotic(no)	*1*					
Yes	*.104912*	*.0529221*	*-4.47*	*0.000*	*.039034*	*.281973*
Anti-pain(no)	*1*					
Yes	*1.219573*	*.3195058*	*0.76*	*0.449*	*.7298082*	*2.038014*
Anti-vomiting(no)	*1*					
Yes	*.5164517*	*.2188287*	*-1.56*	*0.119*	*.2250932*	*1.184942*
NG tube(no)	*1*					
Yes	*.955446*	*.2942345*	*-0.15*	*0.882*	*.5224855*	*1.747182*
Oxygen therapy(no)	*1*					
Yes	*3.659443*	*1.194599*	*3.97*	*0.000*	*1.929952*	*6.938788*
IV fluid(no)	*1*					
Yes	*1.241459*	*.3250888*	*0.83*	*0.409*	*.7430819*	*2.074093*
LOS	*1.13578*	*.038152*	*3.79*	*0.000*	*1.063412*	*1.213073*
_cons	*.0052037*	*.0064012*	*-4.27*	*0.000*	*.0004669*	*.0579962*