Volume 3, Issue 5, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

FREQUENCY OF STROKE ASSOCIATED PNEUMONIA (SAP) WITH ISCHEMIC STROKE

Dr Mehak Abbas[*1], Dr Hafiz Muhammad Zainurrehman[2], Dr Bilal Aziz[3], Dr Tazeen Nazar[4], Dr Syed Muhammad Ali Hasnu[5]

*[*1,2]Postgraduate Resident of Medicine, East Medical Ward, Mayo Hospital, Lahore,*
[3]Assistant Professor of Medicine, East Medical Ward, Mayo Hospital, Lahore
[4]Associate Professor of Medicine, East Medical Ward, Mayo Hospital, Lahore
[5]Postgraduate Resident Urology, Ayub Teaching Hospital, Abbottabad

[*1]mehakabbas415@gmail.com

DOI: https://doi.org/10.5281/zenodo.17131110

Keywords
Stroke-associated pneumonia, ischemic stroke, stroke complications, frequency, risk factors

Article History
Received: 12 May 2025
Accepted: 25 June 2025
Published: 03 July 2025

Corresponding Author: *
Dr Mehak Abbas

Abstract

Background: *Stroke-associated pneumonia (SAP) is among the most common complications following ischemic stroke and is strongly linked with increased morbidity, prolonged hospitalization, and mortality.* ***Objective:*** *To determine the frequency of stroke-associated pneumonia (SAP) in patients with acute ischemic stroke and to evaluate its association with demographic and clinical characteristics.* ***Methods:*** *This cross-sectional study was conducted at the Department of General Medicine, KEMU/Mayo Hospital, Lahore, from December 2024 to April 2025 . A total of 140 patients aged 30–80 years with acute ischemic stroke presenting within 24 hours of onset were enrolled using non-probability consecutive sampling. Patients with pre-existing infections were excluded. All patients were followed for 30 days post-stroke for the development of SAP using clinical, radiological, and laboratory criteria.* ***Results:*** *The mean age of the study population was 59.4 ± 10.7 years, and 58.6% were male. The overall frequency of SAP was 20.7% (29/140). Patients aged ≥60 years had a significantly higher frequency of SAP compared to those <60 years (27.5% vs. 13.2%, p = 0.03). Gender, body mass index, and duration of symptoms before presentation were not significantly associated with SAP.* ***Conclusion:*** *SAP is a common complication of ischemic stroke, affecting approximately one in five patients. Advanced age is a significant risk factor, while gender, BMI, and symptom duration showed no significant association. Early recognition of high-risk patients and implementation of preventive measures such as dysphagia screening, aspiration precautions, and infection monitoring are essential to improve outcomes in stroke care.*

INTRODUCTION

A stroke is defined as a cerebrovascular medical emergency characterized by the sudden loss of neurological function attributable to a hemorrhage in the brain tissue or an interruption of the blood supply [1]. Pakistan has 21.8% of cases of stroke and/or transient ischemic attack, according to a recent survey. Stroke-specific fatality ranges 7 to 20% in various studies in our country [2]. Approximately

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

60% of stroke sufferers are at higher risk of complications and a significant proportion, i.e., 89%, are not able to perform routine activities independently. Our population's stroke causes are comparable to those of other Western nations, where diabetes mellitus, heart disease, smoking, hypertension, and dyslipidemia account for the majority of cases [3]. The prognosis, length of stay in the hospital, and cost of healthcare are all significantly impacted by infections, which are a frequent stroke complication [4]. Neurological as well as medical complications, including pneumonia, are major causes of stroke-related mortality. Up to one-third of stroke patients suffer from pneumonia. Various terminologies (e.g., chest infection, stroke-associated pneumonia (SAP), post-stroke pneumonia, aspiration pneumonia) are used for the variable spectrum of lower respiratory tract infections (LRTIs) complicating stroke [5,6].

Pneumonia that occurs within the first week following the onset of stroke symptoms is considered SAP. It is now increasingly recognized as a distinct clinical entity, different from community-acquired or hospital-acquired pneumonia, because of its unique pathophysiological basis and temporal relationship with stroke [7]. Globally, the frequency of SAP ranges between 7% and 22%, although some intensive care–based cohorts have reported even higher rates. These variations largely reflect differences in study design, diagnostic criteria, population characteristics, and preventive strategies employed [8]. Nonetheless, SAP consistently emerges as a leading cause of post-stroke morbidity and mortality. The development of SAP in ischemic stroke is multifactorial [9[. Dysphagia is one of the strongest predictors, as impaired swallowing and reduced protective airway reflexes promote aspiration of oropharyngeal contents. Studies estimate that up to 65% of stroke patients experience some degree of dysphagia, highlighting the magnitude of this risk factor. Similarly, a reduced level of consciousness, immobility, and stroke severity, particularly involvement of the brainstem and cortical areas regulating swallowing, are major contributors [10]. Post-stroke immunosuppression also plays a crucial role, in addition to mechanical factors. The stroke-induced immunodepression syndrome (SIDS), characterized by lymphopenia, reduced monocyte function, and impaired cytokine responses, predisposes patients to infections. This interplay of neurological, mechanical, and immunological dysfunction sets the stage for the high frequency of SAP in ischemic stroke populations [11].

The term “Stroke Associated Pneumonia” (SAP) was first used by Hilker R and his colleagues, and they found 21% incidence of SAP in patients with acute stroke. In another study by Hassan et al., 23% prevalence of SAP was reported. Aspiration combined with stroke-induced immune depression is the likely pathology of SAP, which consists of complex neuro-humoral pathways including the hypothalamic-pituitary-adrenal axis and autonomic system [12]. SAP has an increased incidence in elderly patients and those who exhibit abnormal water swallowing tests, dysarthria, cognitive impairment, and severe post-stroke disability [13]. Timely assessment of these factors can help determine stroke patients who are at high risk of developing SAP. The rationale of our study is to find out the magnitude of SAP in stroke patients so as to allow early recognition and timely management of these patients [14].

Objective

To determine the frequency of stroke-associated pneumonia in patients with ischemic stroke.

Methodology

This Cross-sectional study was conducted at the Department of General Medicine, KEMU/Mayo Hospital, Lahore from December 2024 to April 2025. A total of 140 patients were included. The sample size was calculated using a 95% confidence level, a 7% margin of error, and an expected frequency of stroke-associated pneumonia (SAP) of 20%. Patients were enrolled using a non-probability consecutive sampling technique. Patients aged 30–80 years, both genders, with acute ischemic stroke presenting within 24 hours of onset (as per operational definition) were included in the study. Patients who already had a fever or another identifiable source of infection before the development of pneumonia were excluded.

Data collection

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

After approval of the synopsis from the hospital ethical committee, 140 patients fulfilling the inclusion criteria were enrolled in this study, presenting in the Medicine Department, KEMU/Affiliated Hospital, Lahore. Written informed consent was obtained from each participant or their legal guardian before inclusion. All patients diagnosed with acute ischemic stroke were followed for up to 30 days post-stroke for the development of SAP. Diagnosis of SAP was made using standardized criteria for definite and probable cases. Clinical evaluation included detailed history regarding new-onset cough, purulent sputum, dyspnea, and fever, along with thorough respiratory examination findings. Laboratory investigations included serial temperature recordings, complete blood count to assess leukocytosis or leukopenia, and arterial blood gas analysis. Radiological evaluation with chest X-rays was performed to detect new or progressive infiltrates, consolidation, or cavitation suggestive of pneumonia. All data were documented in a predesigned proforma by the principal investigator and trained medical staff.

Data Analysis

Data were entered and analyzed using SPSS version 26. Quantitative variables, such as age, body mass index (BMI), and duration of symptoms, were presented as mean ± standard deviation (SD). Qualitative variables, including gender and occurrence of SAP, were described as frequencies and percentages. Effect modifiers such as age, gender, BMI, and duration of symptoms were controlled through stratification. Post-stratification, the chi-square test was applied, and a p-value of ≤0.05 was considered statistically significant.

Results

Data were collected from 140 patients, mean age of the cohort was 59.4 ± 10.7 years, with patients who developed SAP being older on average (63.2 ± 9.8 years) compared to those without SAP (58.4 ± 10.8 years). Males constituted 58.6% of the study population, and the proportion of males was slightly higher among SAP cases (65.5%) compared to non-SAP cases (56.8%). Females represented 41.4% of the overall population. The mean BMI was similar across groups (SAP: 27.1 ± 3.9 kg/m² vs. No SAP: 26.1 ± 4.2 kg/m²). The mean duration of presenting symptoms was 13.5 ± 5.9 hours in the SAP group compared to 12.6 ± 6.6 hours in the non-SAP group.

Table 1. Baseline Characteristics of Patients with Ischemic Stroke (N = 140)

Variable	Total (N=140)	SAP (n=29)	No SAP (n=111)
Age (years), mean ± SD	59.4 ± 10.7	63.2 ± 9.8	58.4 ± 10.8
Gender – Male, n (%)	82 (58.6)	19 (65.5)	63 (56.8)
Gender – Female, n (%)	58 (41.4)	10 (34.5)	48 (43.2)
BMI (kg/m²), mean ± SD	26.3 ± 4.1	27.1 ± 3.9	26.1 ± 4.2
Duration of symptoms (hrs), mean ± SD	12.8 ± 6.4	13.5 ± 5.9	12.6 ± 6.6

The frequency of SAP was higher in patients aged 60 years or above (27.5%) compared to those below 60 years (13.2%), and this difference was statistically significant (p = 0.03). In contrast, SAP was slightly more frequent in males (23.2%) than females (17.2%), but the difference was not statistically significant (p = 0.39).

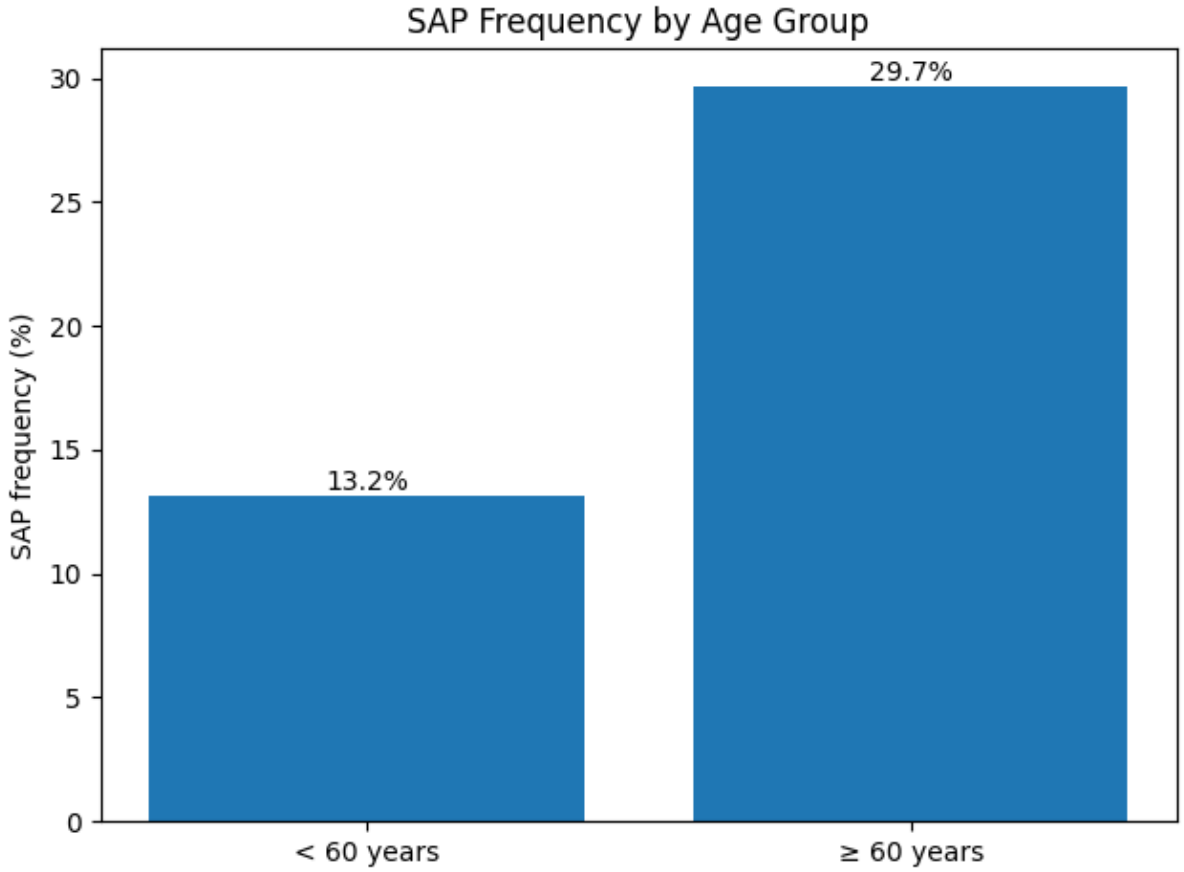
Table 2. Frequency of SAP Stratified by Age and Gender (N = 140)

Variable	SAP Present (n=29)	SAP Absent (n=111)	Frequency (%)	p-value
Age < 60 years	10	66	13.2%	0.03*
Age ≥ 60 years	19	45	27.5%	
Male	19	63	23.2%	0.39

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Female	10	48	17.2%	



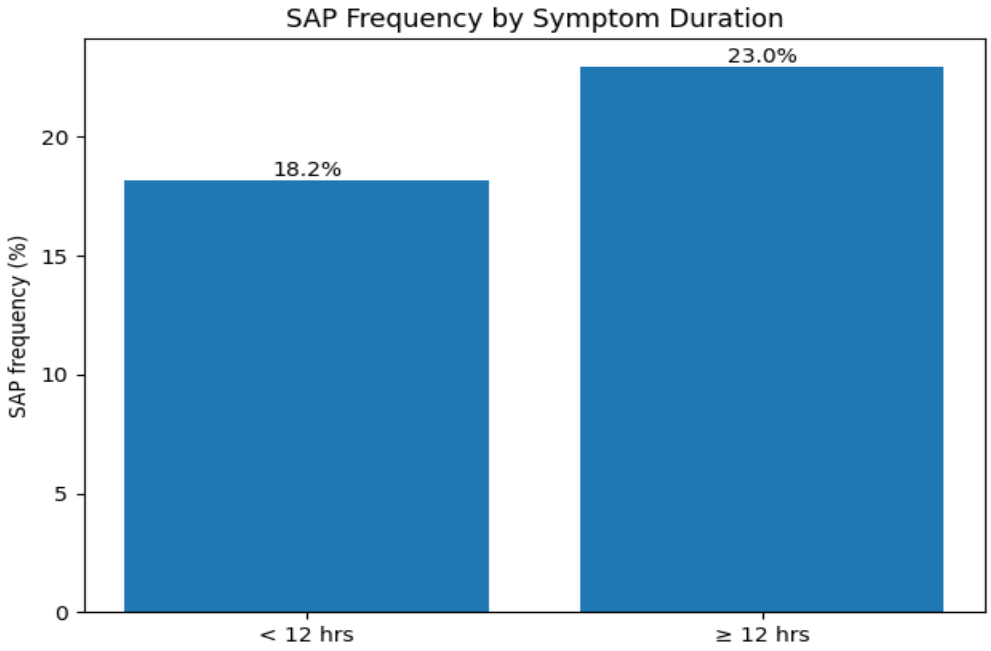
Patients with BMI ≥25 kg/m² had a higher frequency of SAP (23.1%) than those with BMI <25 kg/m² (17.7%), but this difference did not reach statistical significance (p = 0.42). Similarly, patients presenting after 12 hours of symptom onset showed a slightly higher frequency of SAP (23.0%) compared to those presenting within 12 hours (18.2%), but the association was not statistically significant (p = 0.55).

Table 3. Frequency of SAP Stratified by BMI and Duration of Symptoms (N = 140)

Variable	SAP Present (n=29)	SAP Absent (n=111)	Frequency (%)	p-value
BMI < 25 kg/m²	11	51	17.7%	0.42
BMI ≥ 25 kg/m²	18	60	23.1%	
Symptoms < 12 hrs	12	54	18.2%	0.55
Symptoms ≥ 12 hrs	17	57	23.0%	

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593



A significant association was observed only between age group and SAP (χ^2 = 4.58, p = 0.03). Gender (χ^2 = 0.75, p = 0.39), BMI (χ^2 = 0.64, p = 0.42), and symptom duration (χ^2 = 0.36, p = 0.55) showed no statistically significant relationship with SAP occurrence.

Table 4. Association of Age, Gender, and BMI with SAP in Ischemic Stroke (Chi-square Test Results)

Variable	χ^2 value	df	p-value
Age group	4.58	1	0.03*
Gender	0.75	1	0.39
BMI group	0.64	1	0.42
Duration	0.36	1	0.55

Discussion

In this cross-sectional study conducted at a tertiary care hospital in Lahore, the frequency of stroke-associated pneumonia (SAP) among patients with ischemic stroke was found to be 20.7%. This finding aligns with reported global incidence rates of SAP, which range between 7% and 22%, underscoring the clinical importance of this complication in acute stroke care. Our study reinforces the evidence that

SAP is a frequent and serious post-stroke event in hospitalized patients, particularly in those with advanced age. Age was observed to be a significant factor associated with SAP, as patients aged ≥60 years demonstrated a higher frequency of pneumonia compared to younger individuals. This is consistent with prior studies, which have highlighted advanced age as a strong independent predictor of post-stroke infections [14]. Elderly patients often exhibit multiple risk-enhancing factors, including diminished cough reflex, impaired swallowing mechanisms, greater comorbidity burden, and immune senescence, all of which collectively increase susceptibility to respiratory infections. In contrast, gender and body mass index (BMI) were not found to be significantly associated with SAP in our cohort. While some research has suggested potential gender-related differences in pneumonia risk, our findings indicate that the effect of gender may be less prominent when other stronger risk factors such as

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

age and dysphagia are accounted for. Similarly, BMI did not appear to influence pneumonia risk in this study [15]. This is in line with most literature, which rarely identifies obesity or underweight status as direct predictors of SAP, though extreme malnutrition may indirectly predispose to infections through impaired immunity [16].

Duration of symptoms before presentation also showed no statistically significant relationship with SAP in this study. However, it is worth noting that delayed presentation after stroke onset is often associated with worse overall prognosis, and may indirectly influence infection risk by limiting timely interventions such as dysphagia screening and mobilization. Larger studies may be needed to clarify this association [17]. The pathophysiology underlying SAP is multifactorial. Dysphagia and impaired airway reflexes are widely recognized as the most important contributors, with aspiration being the primary mechanism. Additionally, the concept of stroke-induced immunodepression syndrome (SIDS) has gained increasing attention, whereby stroke triggers systemic immunosuppression through neuroendocrine and autonomic pathways, predisposing patients to pneumonia. These mechanisms explain why SAP is particularly prevalent in ischemic stroke patients, independent of conventional pneumonia risk factors [18].

The clinical consequences of SAP are profound. Patients who develop pneumonia after stroke experience longer hospital stays, higher rates of admission to intensive care, delayed initiation of rehabilitation, and higher mortality rates compared to those without pneumonia. In our study, while mortality data were not captured, the frequency of SAP highlights its potential contribution to worse outcomes. Early recognition of at-risk patients is therefore critical. Preventive strategies such as early dysphagia screening, aspiration precautions, strict oral care, head elevation during feeding, and timely mobilization have been shown to reduce SAP incidence [19]. Prophylactic antibiotics, however, remain controversial and are not routinely recommended. Our study adds valuable data to the limited literature on SAP in low- and middle-income countries (LMICs) such as Pakistan, where structured stroke units and standardized infection control protocols are not widely implemented. Local data are essential to guide policy makers and clinicians in designing effective stroke care pathways. Given the rising incidence of stroke in South Asia, greater focus on secondary complications such as SAP is necessary to improve patient outcomes [20,21].

Limitations of this study include its single-center design, which may limit generalizability, and the relatively small sample size of 140 patients, which reduces the statistical power to detect associations with less common risk factors. Furthermore, while SAP diagnosis was based on clinical, radiological, and laboratory criteria, the possibility of diagnostic overlap with other pulmonary conditions cannot be entirely excluded. Despite these limitations, the study provides a reliable estimate of SAP frequency in a representative ischemic stroke cohort from Pakistan.

Conclusion

It is concluded that stroke-associated pneumonia (SAP) is a frequent complication in patients with ischemic stroke, with a frequency of approximately one-fifth of cases in our study population. Advanced age was found to be a significant risk factor, whereas gender, body mass index, and symptom duration did not show statistically significant associations. These findings highlight the importance of early recognition and preventive measures, particularly in elderly stroke patients, to reduce the burden of pneumonia-related morbidity and mortality. Strengthening post-stroke care through routine dysphagia screening, aspiration precautions, and infection monitoring can play a critical role in improving outcomes.

REFERENCES

Abbott AL, Silvestrini M, Topakian R, et al. Optimizing the definitions of stroke, transient ischemic attack, and infarction for research and application in clinical practice. *Front Neurol.* 2017;8:537.

Kamal AK, Itrat A, Murtaza M, Khan M, Rasheed A, Ali A. The burden of stroke and transient ischemic attack in Pakistan: a community-based prevalence study. *BMC Neurol.* 2009;9:58.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Farooq MU, Majid A, Reeves MJ, Birbeck GL. The epidemiology of stroke in Pakistan: past, present, and future. *Int J Stroke*. 2009;4:381–9.

Taj F, Zahid R, Syeda UE, Murtaza M, Ahmed S, Kamal AK. Risk factors of stroke in Pakistan: a dedicated stroke clinic experience. *Can J Neurol Sci*. 2020;37:252–7.

Armstrong JR, Mosher BD. Aspiration pneumonia after stroke: intervention and prevention. *Neurohospitalist*. 2021;1(2):85–93.

Wilson RD. Mortality and cost of pneumonia after stroke for different risk groups. *J Stroke Cerebrovasc Dis*. 2022;21(3):61–67.

Kishore AK, Vail A, Chamorro A, Garau J, Hopkins SJ, Di Napoli M, et al. How is pneumonia diagnosed in clinical stroke research? A systematic review and meta-analysis. *Stroke*. 2015;46(6):1202–1209.

Ning X, Iftikhar S, Ghias M, Pervaiz A, Shabbir B, Akhtar MN. Stroke associated pneumonia in patients of acute ischemic stroke. *Annals of King Edward Medical University*. 2021 Jul 7;27(2).

Hassan A, Khealani BA, Shafqat S, Aslam M, Salahuddin N, Syed NA, et al. Stroke-associated pneumonia: microbiological data and outcome. *Singapore Med J*. 2006;47(4):204–207.

Elhefnawy M, Nazifah Sidek N, Maisharah Sheikh Ghadzi S, Ibrahim B, Looi I, Abdul Aziz Z, Noor Harun S. Prevalence of Stroke-Associated Pneumonia and Its Predictors Among Hyperglycaemia Patients During Acute Ischemic Stroke. Cureus. 2024 Jan 19;16(1):e52574. doi: 10.7759/cureus.52574. PMID: 38371076; PMCID: PMC10874618.

Cugy E, Sibon I. Stroke-Associated Pneumonia Risk Score: Validity in a French Stroke Unit. J Stroke Cerebrovasc Dis. 2017 Jan;26(1):225-229. doi: 10.1016/j.jstrokecerebrovasdis.2016.09.015. Epub 2016 Nov 7. PMID: 27839768.

Teh WH, Smith CJ, Barlas RS, Wood AD, Bettencourt-Silva JH, Clark AB, Metcalf AK, Bowles KM, Potter JF, Myint PK. Impact of stroke-associated pneumonia on mortality, length of hospitalization, and functional outcome. Acta Neurol Scand. 2018 Oct;138(4):293-300. doi: 10.1111/ane.12956. Epub 2018 May 10. PMID: 29749062.

Kishore AK, Vail A, Bray BD, Chamorro A, Napoli MD, Kalra L, Langhorne P, Montaner J, Roffe C, Rudd AG, Tyrrell PJ, van de Beek D, Woodhead M, Meisel A, Smith CJ. Clinical risk scores for predicting stroke-associated pneumonia: A systematic review. Eur Stroke J. 2016 Jun;1(2):76-84. doi: 10.1177/2396987316651759. Epub 2016 Jun 1. PMID: 31008268; PMCID: PMC6301233.

Jitpratoom P, Boonyasiri A. Factors associated with an increased risk of developing pneumonia during acute ischemic stroke hospitalization. PLoS One. 2024 Jan 10;19(1):e0296938. doi: 10.1371/journal.pone.0296938. PMID: 38198494; PMCID: PMC10781189.

Song X, He Y, Bai J, Zhang J. A nomogram based on nutritional status and A^2DS^2 score for predicting stroke-associated pneumonia in acute ischemic stroke patients with type 2 diabetes mellitus: A retrospective study. Front Nutr. 2022 Oct 13;9:1009041. doi: 10.3389/fnut.2022.1009041. PMID: 36313103; PMCID: PMC9608514.

Adrees, M., ., S., Rasool, S., & Ahmad, N. (2017). Frequency of Stroke Associated Pneumonia in Stroke Patients. *Annals of Punjab Medical College*, *11*(2), 154-157. https://doi.org/10.29054/apmc/2017.227

Ingeman A, Andersen G, Hundborg HH. In-hospital medical complications, length of stay, and mortality among stroke unit patients. Stroke. 2011;42:3214-8.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Chamorro A, Urra X, Planas AM. Infection after acute ischemic stroke: a manifestation of brain-induced immunodepression. Stroke. 2007;38:1097-103.

Finlayson O, Kapral M, Hall R, Asllani E, Selchen D, Saposnik G. Risk factors, inpatient care, and outcomes of pneumonia after ischemic stroke. Neurology. 2011;77(14):1338-45.

Hannawi Y, Hannawi B, Rao CP, Suarez JI, Bershad EM. Stroke-associated pneumonia: major advances and obstacles. Cerebrovasc Dis. 2013;35(5):430-43

Hilker R, Poetter C, Findeisen N. Nosocomial pneumonia after acute stroke: implications for neurological intensive care medicine. Stroke. 2003;34:975-81.