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Predictors of Prolonged Hospital Stay among Patients Admitted with Pneumothorax: A Retrospective Study

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Abstract

Background: Pneumothorax is a common cause of hospital admission. Prolonged stay increases cost, bed occupancy, and patient morbidity, making early identification of related factors important. ***Objective***: To identify predictors of prolonged hospital stay among patients with pneumothorax at Al-Imamain Al-Kadhimain Medical City, Iraq. ***Methods***: This was a retrospective study conducted at Al-Imamain Al-Kadhimain Medical City, Baghdad, from 2024 to 2026, including 100 admitted patients with confirmed pneumothorax. Clinical and management data were collected from hospital records. Prolonged hospital stay was defined as more than 7 days. ***Results***: Mean age was 38.6±13.3 years; 82% were male. Secondary pneumothorax was most common (46%). Recurrent cases were 19%. Chest tube was used in 73%, persistent air leak in 30%, and surgery at 12% (thoracotomy 1%). Prolonged stay occurred in 43% and was significantly associated with disease severity, recurrence, chest tube use, persistent air leak, surgery, and complications (all $p<0.05$; chi-square/Fisher's exact test and independent-samples t-test as appropriate). The strongest associations were persistent air leak ($p<0.001$), recurrent pneumothorax ($p<0.001$), and secondary/traumatic/iatrogenic pneumothorax ($p<0.001$). ***Conclusions***: Prolonged hospital stay in pneumothorax was mainly associated with more severe disease and a complicated hospital course, especially recurrent or secondary cases, persistent air leak, chest tube requirement, complications, and surgery.

Keywords: Chest tube; Pneumothorax; Prolonged hospital stay; Persistent air leak; Recurrent pneumothorax; Thoracotomy.

مؤشرات البقاء الطويل في المستشفى بين المرضى الراقدين بسبب استرواح الصدر: دراسة بأثر رجعي

الخلاصة

الخلفية: الالتهاب الرئوي هو سبب شائع لدخول المستشفى. الإقامة الطويلة تزيد من التكلفة، ونسبة استخدام الأسرة، ومعدل مراضة المرضى، مما يجعل التعرف المبكر على العوامل ذات الصلة أمرا مهما. **الهدف**: تحديد مؤشرات الإقامة الطويلة في المستشفى بين مرضى استرواح الصدر في مدينة الإمامين الكاظمين الطبية، العراق. **الطرائق**: كانت هذه دراسة استرجاعية أجريت في مدينة الإمامين الكاظمين الطبية في بغداد من 2024 إلى 2026، شملت 100 مريض تم إدخالهم بالتهاب رئوي مؤكد. تم جمع البيانات السريرية والإدارية من سجلات المستشفى. تم تعريف مدة الإقامة الطويلة في المستشفى بأنها تزيد عن 7 أيام. **النتائج**: كان متوسط العمر 38.6±13.3 سنة؛ 82٪ من الذكور. كان الالتهاب الرئوي الثانوي هو الأكثر شيوعا (46٪). كانت الحالات المتكررة 19٪. تم استخدام أنبوب الصدر في 73٪، وتسرب الهواء المستمر في 30٪، والجراحة بنسبة 12٪ (استئصال الصدر 1٪). حدثت فترة البقاء الممتدة في 43٪ وكانت مرتبطة بشكل ملحوظ بشدة المرض، وتكراره، واستخدام أنابيب الصدر، وتسرب الهواء المستمر، والجراحة، والمضاعفات (جميعها $p<0.05$؛ اختبار كاي سكوير/فيشر الدقيق واختبار t العينات المستقلة حسب الحاجة). أقوى الارتباطات كانت تسرب الهواء المستمر ($p<0.001$)، واسترواح الصدر المتكرر ($p<0.001$)، والاسترواح الصدري الثانوي/الرضحي/العلاجي ($p<0.001$). **الاستنتاجات**: كان الإقامة الطويلة في المستشفى في المستشفى مرتبطة بشكل رئيسي بمرض أكثر خطورة ومسار مستشفى معقد، خاصة الحالات المتكررة أو الثانوية، وتسرب الهواء المستمر، والحاجة إلى أنبوب الصدر، والمضاعفات، والجراحة.

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INTRODUCTION

Pneumothorax is the presence of air within the pleural space, leading to partial or complete collapse of the lung and variable degrees of respiratory compromise. It is a common clinical problem in emergency, respiratory, and thoracic practice, and its burden remains relevant because it frequently affects young adults, recurs in a considerable proportion of patients, and often requires hospital-based management [1,2]. Clinically, pneumothorax may be classified as primary spontaneous pneumothorax (PSP), secondary spontaneous pneumothorax (SSP), traumatic pneumothorax, or iatrogenic pneumothorax. PSP usually occurs in patients without overt underlying lung disease, whereas SSP develops in patients with pre-existing pulmonary pathology such as chronic obstructive pulmonary disease, tuberculosis, asthma, cystic lung disease, or interstitial lung disease [3,4]. This distinction is important because SSP is generally associated with more severe symptoms, lower pulmonary reserve, and more complicated inpatient care [5]. The management of pneumothorax ranges from observation and supplemental oxygen to needle aspiration, chest tube drainage, ambulatory devices, and definitive surgical treatment. Contemporary British, American, and European guidance emphasizes tailoring intervention to the patient's symptoms, physiological stability, recurrence status, and the type of pneumothorax rather than relying on radiographic size alone. In recurrent or complicated cases, a thoracic surgical referral may be required to reduce further recurrence and control persistent air leaks [6]. Hospital stay is an important outcome in pneumothorax because it reflects overall disease

severity, speed of lung re-expansion, response to treatment, and the occurrence of complications. Longer admission means greater cost, heavier bed occupancy, delayed return to normal activity, and increased exposure to hospital-acquired complications [7-9]. In resource-limited settings, minimizing unnecessary prolonged hospitalization is particularly important. Several factors may contribute to extended hospital stays in patients with pneumothorax. These include secondary etiology, recurrent pneumothorax, low oxygen saturation at presentation, need for chest tube drainage, persistent air leak, infectious complications, and delayed referral for definitive intervention [10]. Persistent air leak is especially important because it prolongs chest drain duration and often becomes the main practical reason for delayed discharge [11]. However, most of this evidence comes from Western or East Asian cohorts, and local data from Iraqi tertiary centers remain scarce. Local data are valuable because patient characteristics, underlying lung disease, timing of presentation, and treatment patterns may differ across institutions. This study aims to identify predictors of prolonged hospital stays among patients admitted with pneumothorax at Al-Imamain Al-Kadhimain Medical City. Particular attention was given to recurrent pneumothorax, persistent air leak, complications, and the need for surgical intervention, including thoracotomy.

METHODS

Study design and setting

This was a retrospective study conducted at Al-Imamain Al-Kadhimain Medical City from 2024 to 2026. The study included patients admitted to the emergency department and medical wards with a confirmed diagnosis of pneumothorax during the study period. The final sample size was 100 cases.

Inclusion criteria

Patients admitted with a confirmed diagnosis of pneumothorax (primary spontaneous, secondary spontaneous, traumatic, or iatrogenic) and patients requiring inpatient management.

Exclusion criteria

Patients managed entirely as outpatients, patients with incomplete clinical records, patients who left against medical advice before completion of management, and patients with missing key outcome variables, particularly total hospital stays.

Data collection

Data were collected retrospectively from patient records using a structured sheet. The following variables were recorded: age, sex, smoking status, type of pneumothorax, underlying lung disease, recurrent pneumothorax, hemodynamic status at admission, side affected, oxygen saturation, duration of symptoms before admission, type of initial management, time to chest tube insertion, chest tube duration, persistent air leak, surgical intervention (including thoracotomy), in-hospital complications, and total duration of hospitalization.

Operational definition

Prolonged hospital stay was defined as admission duration exceeding 7 days. The 7-day threshold was selected a priori based on clinical relevance and consistency with previous studies of pneumothorax outcomes, rather than being data-derived. This cut-off was selected as it reflects clinically significant delay in recovery and distinguishes uncomplicated from complicated cases.

Ethical considerations

Ethical approval was obtained from the IKMC authority. Verbal informed consent was obtained from all participants prior to inclusion. Confidentiality and anonymity of patient data were strictly maintained throughout the study.

Statistical analysis

Data were entered and analyzed using SPSS version 26. Categorical variables were presented as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation (SD), with median and range when appropriate. For comparisons between prolonged and non-prolonged hospital stay groups, the chi-square test or Fisher's exact test was used for categorical variables, and the independent-samples t-test was used for continuous variables. A *p*-value of less than 0.05 was considered statistically significant.

RESULTS

Of the 100 patients, the mean age was 38.59 ± 13.28 years; 52 (52.0%) were <40 years, and 48 (48.0%) were ≥40 years. There were 82 (82.0%) males and 18 (18.0%) females. Current smokers were 47 (47.0%), ex-smokers 19 (19.0%), and non-smokers 34 (34.0%) (Table 1).

Table 1: Baseline demographic and smoking characteristics of the study population (n = 100)

Variable	Category	Result
Age (year)	Mean±SD	38.59±13.28
Age group (year)	<40	52(52)
	≥40	48(48)
Sex	Male	82(82)
	Female	18(18)
Smoking status	Current smoker	47(47)
	Ex-smoker	19(19)
	Non-smoker	34(34)

Values are presented as frequency, percentage, and mean±SD.

In terms of clinical features, 42 (42.0%) had primary spontaneous pneumothorax/pneumothoraxes, 46 (46.0%) had secondary spontaneous pneumothorax/pneumothoraxes, 10 (10.0%) had traumatic pneumothorax/pneumothoraxes, and 2 (2.0%) had iatrogenic

pneumothorax/pneumothoraxes. No underlying lung disease was present in 44 (44.0%); COPD in 26 (26.0%), asthma in 8 (8.0%), tuberculosis in 7 (7.0%), interstitial lung disease in 6 (6.0%), malignancy in 5 (5.0%), and other chronic lung disease in 4 (4.0%). 19 (19.0%) had recurrent pneumothorax, while 81 (81.0%) did not (Table 2).

Table 2: Clinical characteristics of patients admitted with pneumothorax (n= 100)

Variable	Category	n(%)
Type of pneumothorax	Primary spontaneous	42(42)
	Secondary spontaneous	46(46)
	Traumatic	10(10)
	Iatrogenic	2(2)
Underlying lung disease	No underlying lung disease	44(44)
	COPD	26(26)
	Asthma	8(8)
	Tuberculosis	7(7)
	Interstitial lung disease	6(6)
	Malignancy	5(5)
	Another chronic lung disease	4(4)
Recurrent pneumothorax	Yes	19(19)
	No	81(81)

Table 3 presents management and outcomes. Twelve (12.0%) received observation/oxygen therapy, 15 (15.0%) had needle aspiration, and 73 (73.0%) had a chest tube inserted. 30 (30.0%) had persistent air leaks. Surgical intervention was performed in 12 (12.0%); VATS in 11 (11.0%); and thoracotomy in 1 (1.0%). No in-hospital complication occurred in 75 (75.0%); pneumonia in 11 (11.0%), empyema in 7 (7.0%), sepsis in 4 (4.0%), and subcutaneous emphysema/other in 3 (3.0%). Hospital stay was ≤7 days in 57 (57.0%) and >7 days in 43 (43.0%) (Table 3).

Table 3: Management profile, complications, and hospital stay outcome (n= 100)

Variable	Category	n(%)
Initial management	Observation / oxygen therapy	12(12)
	Needle aspiration	15(15)
	Chest tube insertion	73(73)
Persistent air leak	Yes	30(30)
	No	70(70)
Surgical intervention	Yes	12(12)
	No	88(88)
Type of surgery	VATS	11(11)
	Thoracotomy	1(1.0)
In-hospital complications	No complication	75(75)
	Pneumonia	11(11)
	Empyema	7(7)
	Sepsis	4(4)
	Subcutaneous emphysema/other	3(3)
Hospital stay	≤7 days	57(57)
	>7 days	43(43)

The continuous clinical variables are summarized in Table 4. The mean duration of symptoms before admission was 2.67 ± 1.66 days (median of 2.0; range 0-8 days). Mean O_2 saturation at admission was 93.95 ± 3.67% (median 94.0; range 86–99). Mean serum albumin was 3.42 ± 0.58 g/dL (median 3.5; range 2.1–4.6). Among patients who underwent chest tube insertion, the mean time to chest tube insertion was 6.18 ± 2.90 hours (median 6, range 1–14), and the mean chest tube duration was 6.62 ± 2.57 days (median 6, range 3–13) for those who had a chest tube inserted. The mean total hospital stay was 8.24 ± 4.39 days (median 7.0; range 2–24).

Table 4: Continuous clinical variables

Variable	*n	Mean±SD	Median	Range
Symptoms before admission (day)	100	2.67±1.66	2	0–8**
O_2 saturation at admission (%)	100	93.95±3.67	94	86–99
Serum albumin (g/dL)	100	3.42±0.58	3.5	2.1–4.6
Time to chest tube (hours)*	73	6.18±2.90	6	1–14
Chest tube duration (days)*	73	6.62±2.57	6	3–13
Total stay (days)	100	8.24±4.39	7	2–24

*n = number of patients with available data. **Calculated among patients who underwent chest tube insertion only.

The categorical associations are presented in Table 5. Prolonged stay was significantly associated with age ≥40 years (30/43, 69.8% *vs*. 18/57, 31.6%; $p< 0.001$), current or ex-smoking (36/43, 83.7% *vs*. 30/57, 52.6%; $p= 0.001$), secondary/traumatic/iatrogenic pneumothorax (34/43, 79.1% *vs*. 24/57, 42.1%; $p< 0.001$), recurrent pneumothorax (16/43, 37.2% *vs*. 3/57, 5.3%; $p< 0.001$), hemodynamic instability (10/43, 23.3% *vs*. 2/57, 3.5%; $p= 0.004$), chest tube insertion (39/43, 90.7% *vs*. 34/57, 59.6%; $p= 0.001$), persistent air leak (25/43, 58.1% *vs*. 5/57, 8.8%; $p< 0.001$), surgical intervention (10/43, 23.3% *vs*. 2/57, 3.5%; $p= 0.004$), and any in-hospital complication (19/43, 44.2% *vs*. 6/57, 10.5%; $p< 0.001$).

Table 5: Association between categorical variables and prolonged hospital stay (>7 days)

Variable	Prolonged stay (n=43)	Non-prolonged stay (n=57)	*p*-value
Age ≥40 years	30(69.8)	18(31.6)	<0.001*
Current or ex-smoker	36(83.7)	30(52.6)	0.001*
Secondary / traumatic / iatrogenic pneumothorax	34(79.1)	24(42.1)	<0.001*
Recurrent pneumothorax	16(37.2)	3(5.3)	<0.001*
Hemodynamic instability	10(23.3)	2(3.5)	0.004**
Chest tube insertion	39(90.7)	34(59.6)	0.001*
Persistent air leak	25(58.1)	5(8.8)	<0.001*
Surgical intervention	10(23.3)	2(3.5)	0.004**
Any in-hospital complication	19(44.2)	6(10.5)	<0.001*

Values are presented as frequency and percentage. * Chi-square test; ** Fisher's exact test.

The continuous variables (age, symptom duration, O_2 saturation, time to chest tube, chest tube duration) are compared and presented in Table 6. Patients with prolonged stays were older (45.2 ± 12.8 *vs*. 33.6 ± 11.4 years; $p< 0.001$), had longer symptom duration before admission (3.7 ± 1.8 *vs*. 1.9 ± 1.0 days; $p< 0.001$), had lower O_2 saturation (91.9 ± 3.7% *vs*. 95.5 ± 2.8%; $p< 0.001$), had a longer time to chest tube insertion (7.3 ± 3.0 *vs*. 4.9 ± 2.2 hours; $p< 0.001$), and had a longer chest tube duration (8.2 ± 2.3 *vs*. 4.8 ± 1.4 days; $p< 0.001$).

Table 6: Comparison of continuous variables according to hospital stay group

Variable	Prolonged stay (n=43)	Non-prolonged stay (n=57)	*p*-value
Age (year)	45.2±12.8	33.6±11.4	<0.001
Symptom duration before admission (day)	3.7±1.8	1.9±1.0	<0.001
O_2 saturation on admission (%)	91.9±3.7	95.5±2.8	<0.001
Time to chest tube insertion (hour)*	7.3±3.0	4.9±2.2	<0.001
Chest tube duration (day)*	8.2±2.3	4.8±1.4	<0.001

Values are presented as mean±SD. *Calculated among patients treated with a chest tube.

Table 7 shows symptoms before admission: shortness of breath 78 (78.0%), chest pain 72 (72.0%), cough 31 (31.0%), palpitations 14 (14.0%), fever 10 (10.0%), respiratory distress 8 (8.0%), and asymptomatic 4 (4.0%).

Table 7: Symptoms before admission

Symptom	n(%)
Shortness of breath	78(78)
Chest pain	72(72)
Cough	31(31)
Palpitations	14(14)
Fever	10(10)
Respiratory distress	8(8)
Asymptomatic	4(4)

The distribution of pneumothorax types is shown in Figure 1; primary (42.0%), secondary (46.0%), traumatic (10.0%), and iatrogenic (2.0%). Figure 2 shows hospital stay duration, where ≤7 days in 57.0% and >7 days in 43.0%.

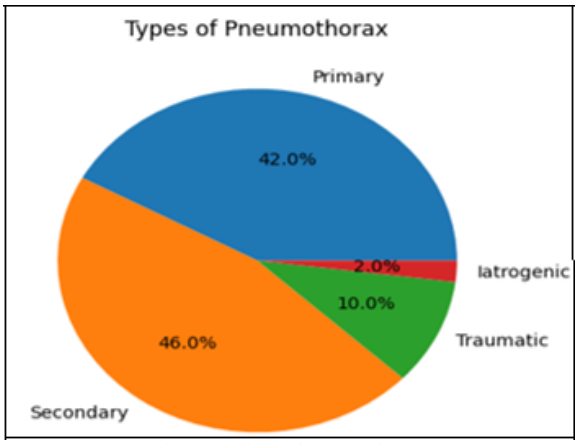


Figure 1: Types of pneumothorax/pneumothoraxes.

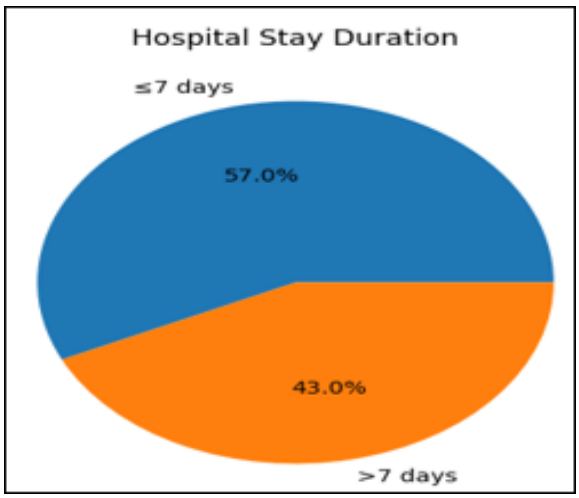


Figure 2: Hospital stay duration.

DISCUSSION

The present study aimed to identify predictors of prolonged hospital stays among patients admitted with pneumothorax in a tertiary care setting. The findings demonstrate that prolonged hospitalization is a frequent outcome, affecting 43% of patients, and is closely related to a combination of clinical severity, disease characteristics, and treatment-related factors. This highlights that the length of hospital stay in pneumothorax is not a simple endpoint but rather a composite reflection of disease complexity and response to management. One of the most prominent findings in this study is the significant association between prolonged hospital stays and the type of pneumothorax. Patients with secondary, traumatic, or iatrogenic pneumothorax were significantly more likely to experience extended hospitalization compared to those with primary spontaneous pneumothorax. This observation is consistent with previous studies, which have demonstrated that secondary pneumothorax is associated with worse clinical outcomes due to underlying lung pathology and reduced physiological reserve [12,13]. In such patients, impaired lung compliance and comorbid respiratory disease contribute to delayed re-expansion and increased need for intervention. Recurrent pneumothorax also emerged as a strong predictor of prolonged admission in the present study. Patients with recurrent episodes showed a markedly higher likelihood of extended hospital stay, reflecting the presence of persistent pleural defects or incomplete healing. This finding is in agreement with previous reports, which emphasize that recurrence often necessitates more aggressive management strategies, including prolonged chest drainage or surgical intervention [14]. Current international recommendations also suggest early consideration of definitive management in recurrent cases to reduce morbidity and prevent repeated admissions [15]. A persistent air leak was identified as one of the most powerful determinants of prolonged hospitalization. This is clinically expected, as continuous air leakage prevents full lung re-expansion and necessitates prolonged chest tube placement. Similar findings have been consistently reported in the literature, where persistent air leak is recognized as a major factor prolonging hospital stay and increasing healthcare utilization [16,17]. The significant difference in chest tube duration between prolonged and non-prolonged groups in this study further supports this relationship. In-hospital complications were also significantly associated with prolonged stay. Patients who developed complications such as pneumonia, empyema, or sepsis had a substantially

longer duration of hospitalization. These findings are consistent with earlier studies demonstrating that infectious and pleural complications delay recovery and increase the need for prolonged antibiotic therapy and invasive procedures [18]. This emphasizes the necessity of early identification and prevention of complications as part of standard pneumothorax management. Another important observation in this study is the role of initial physiological status. Patients presenting with lower oxygen saturation and hemodynamic instability were more likely to have prolonged hospital stays. This reflects the impact of disease severity at presentation on the subsequent clinical course. Similar associations have been described in previous studies, where hypoxemia and clinical instability were linked to increased morbidity and longer hospitalization [19]. A notable and relatively underexplored finding in the present study is the association between serum albumin level and prolonged hospital stay. Patients with lower serum albumin levels were more likely to experience extended hospitalization, suggesting that nutritional status plays an important role in recovery. Hypoalbuminemia is known to be associated with impaired immune function, delayed tissue healing, and increased susceptibility to complications. This finding is supported by broader clinical research, where low serum albumin has been identified as an independent predictor of poor outcomes and prolonged hospital stay across various medical conditions [20]. The inclusion of serum albumin in this study adds a valuable biological dimension to the analysis of pneumothorax outcomes. In addition, the duration of symptoms before admission was significantly longer among patients with prolonged hospital stays. This suggests that delayed presentation may contribute to disease progression and increased severity at the time of admission. Patients presenting late may have more extensive lung collapse or complications, which require more intensive management and longer recovery time. This observation aligns with previous studies emphasizing the importance of early diagnosis and timely intervention in improving clinical outcomes [12]. Importantly, the findings of this study indicate that prolonged hospital stay is not driven by a single isolated factor but rather by the interaction of multiple variables, including disease type, recurrence, physiological status, treatment modality, complications, and nutritional condition. This multifactorial pattern emphasizes the necessity of a comprehensive and individualized approach to patient management. From a clinical perspective, these results have important implications. Early identification of high-risk patients, particularly those with secondary pneumothorax, recurrence, persistent air leak, or hypoalbuminemia, may allow clinicians to implement targeted strategies, such as early surgical referral, optimized chest tube management, and nutritional support. Such interventions may help reduce hospital stays and improve overall patient outcomes. Finally, this study provides valuable local data from a tertiary care center, contributing to the limited regional literature on pneumothorax outcomes. While the findings are broadly consistent with international studies, the inclusion of nutritional factors such as serum albumin offers additional insight that may be particularly relevant in resource-limited settings.

Study Limitations

This study was conducted in a single center, which may limit generalizability to other hospitals. The convenience sampling technique may have introduced selection bias. Because the study was retrospective and record-based, causal relationships cannot be confirmed. Furthermore, only univariate comparisons were performed; no multivariable regression model was used to adjust for confounding, and the factors identified should therefore be regarded as associated factors rather than independent predictors. Some clinically relevant variables, such as radiological size grading and standardized symptom scoring, were not consistently available in all records. The chosen cut-off of 7 days coincided with the median length of stay in this cohort; although this threshold is clinically meaningful, a data-derived cut-off (e.g., upper quartile) might have classified patients differently, and this discrepancy should be considered when comparing our findings with other series.

Conclusion

Prolonged hospital stay was experienced by almost half of the patients admitted with pneumothorax and had several causes. Secondary or non-primary pneumothorax, recurrent events, persistent air leak, invasive intervention (chest tube and surgery), and in-hospital complications were the most closely related, as well as markers of severity at presentation (hypoxemia, hemodynamic instability, delayed presentation, and hypoalbuminemia). These results suggest that pneumothorax duration is linked to disease complexity and treatment adequacy, not a single variable. Identification of these high-risk features early may help direct more focused management and reduce hospital stays.

Recommendations

Patients requiring more than a single day of hospitalization or who have hypoalbuminemia on admission should be identified early as those at higher risk of prolonged stay and should be seen early by a senior respiratory or thoracic physician. An explicit airway leak pathway (written with timescales for escalation to surgical review and criteria for referral to VATS) should be established to reduce unnecessary delay, and a standardized care package for chest tube management with clearly defined criteria for chest tube removal should be introduced to reduce the duration of chest tube use, if clinically appropriate. Implementation of measures for the prevention of in-hospital complications like pneumonia and empyema should be improved and monitored as a quality indicator. Finally, there is a

need for multicenter research with multivariable modelling and a data-based length-of-stay cut-off to validate independent predictors and provide better risk stratification.

Conflict of interests

The authors declared no conflict of interest.

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The authors did not receive any source of funds.

Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

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