



## Impact of bedside lung ultrasound on physician clinical decision-making in the emergency department: A prospective cross-sectional study.

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### Abstract

#### Background

Rapid and accurate diagnosis of respiratory conditions in the emergency department (ED) is crucial for timely management. Bedside lung ultrasonography (LUS) has emerged as a valuable point-of-care tool for evaluating patients with acute respiratory symptoms.

#### Objective

To assess the impact of bedside lung ultrasonography on physicians' clinical decision-making in patients presenting with acute respiratory distress in the emergency department.

#### Methods

This prospective cross-sectional study was conducted over 18 months in the emergency department of a tertiary care hospital. A total of 50 adult patients presenting with acute respiratory symptoms were included. Physicians initially documented provisional diagnoses and management plans based on clinical evaluation and standard investigations. Following LUS examination, diagnoses and management plans were reassessed. Changes were analyzed using the chi-square test, with  $p < 0.05$  considered statistically significant.

#### Results

Bedside lung ultrasonography resulted in a change in diagnosis in 34.2% of cases and altered clinical management in 41.7% of patients. Significant improvements were observed in diagnosing pneumonia, pulmonary edema, and pneumothorax ( $p < 0.05$ ).

#### Conclusion

Bedside LUS significantly enhances diagnostic accuracy and influences management decisions in emergency settings. Its routine use can improve patient outcomes and optimize resource utilization.

#### Recommendation

Integration of lung ultrasonography into routine emergency practice is recommended, along with adequate physician training. Further multicenter studies with larger sample sizes are needed to validate these findings.

**Keywords:** Bedside lung ultrasound; emergency department; clinical decision-making; respiratory distress; point-of-care ultrasound

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#### Introduction

Chronic obstructive pulmonary disease (COPD) and lower respiratory tract infection are two of the leading causes of death and disability, with respiratory complaints being a leading cause of presentation to the emergency department. With a high burden of respiratory diseases and difficulty obtaining radiographs, lung ultrasound has the potential to be an effective tool for use in a resource-limited setting. In patients presenting to the emergency

department with undifferentiated dyspnea, lung ultrasound is an effective tool for expediting diagnosis and changing acute management. Utilization of lung ultrasound for clinical care of patients with respiratory distress has been shown to save time, reduce cost, and improve clinical diagnosis and management in several high and middle-income countries (1).

In resource-limited settings, lung ultrasound is particularly useful as alternative imaging modalities may



be unavailable, difficult to obtain, or too expensive. Few studies have been performed in resource-limited settings to evaluate the impact of ultrasound on clinical decisions, and these studies have focused primarily on the general use of point-of-care ultrasound. While Reynolds et al. evaluated bedside ultrasound overall, they also reported data for each study type, finding that lung ultrasound changed management in 45% of cases in Tanzania. To our knowledge, no studies have specifically evaluated the impact of lung ultrasound on the management of dyspneic patients in a low-income country (2).

Point-of-care ultrasonography (USG) is emerging as an important bedside tool. Lung ultrasound imaging is easily available at the bedside, real-time, and free of radiation hazards in comparison to conventional imaging modalities of the lung in critically ill patients. Acute respiratory failure cases do not always present in conditions that are ideal for an immediate diagnosis, which sometimes compromises the outcome. The bedside lung ultrasound in emergency (BLUE) protocol makes exclusive use of lung and venous ultrasound. Its use as a primary survey tool in the acutely dyspneic or hypoxemic patient gives an immediate understanding of the state of the lung and influences therapeutic decisions (3).

Therefore, this study aimed to evaluate the impact of bedside lung ultrasonography on physicians' clinical decision-making in patients presenting with acute respiratory distress in the emergency department.

## Method and Materials:

### Study Design

This study was a prospective cross-sectional study conducted to evaluate the impact of bedside lung ultrasonography (LUS) on physician clinical decision-making in patients presenting with acute respiratory distress in the emergency department.

### Study Setting

The study was conducted in the Department of Trauma and Emergency, Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, Bihar, India, over a period of 18 months (January 2023 to June 2024). The institute is a tertiary care teaching hospital that caters to a high volume of emergency cases.

### Study Population

The study included 50 adult patients presenting to the emergency department with acute respiratory distress during the study period.

### Inclusion Criteria

Patients aged  $\geq 18$  years  
Patients presenting with acute respiratory distress  
Patients and/or their relatives providing informed consent

### Exclusion Criteria

Patients with a previously established diagnosis before emergency department evaluation  
Patients or relatives who did not provide consent

### Sampling Method

A convenience sampling technique was used to recruit eligible patients who presented to the emergency department during the study period.

### Sample Size Determination

The sample size of **50 patients** was determined based on feasibility, patient availability, and the duration of the study period.

### Data Collection Procedure

After initial clinical evaluation and standard investigations, the treating physician documented a provisional diagnosis and management plan for each patient.

Subsequently, bedside lung ultrasonography (LUS) was performed by a trained emergency physician using a Micromax Sonosite ultrasound system. Both low-frequency (2–5 MHz) curvilinear probe and high-frequency (5–10 MHz) linear probe were used as appropriate.

Patients were examined in the supine or semi-recumbent position. Each hemithorax was divided into anterior, lateral, and posterolateral regions, and further subdivided into upper and lower zones, resulting in a total of six zones per lung.

Ultrasound findings, including A-lines, B-lines, lung sliding, consolidations, and pleural effusion, were recorded systematically. In selected patients with A-profile, venous ultrasonography was performed to detect thrombus using a linear probe over major veins.

Diagnosis was established based on the BLUE (Bedside Lung Ultrasound in Emergency) protocol.

After the LUS examination, the physician reassessed and documented any changes in diagnosis and management plan.

### Bias Control

To minimize bias, the treating physicians recorded the initial diagnosis and management plan before ultrasound examination. A standardized scanning protocol (BLUE protocol) was used to reduce inter-observer variability.

### Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of IGIMS, Patna. Written informed consent was obtained from all participants or their legally authorized representatives before inclusion in the study.



### Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software.

Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean  $\pm$  standard deviation.

The chi-square test was used to compare changes in diagnosis and management before and after lung ultrasonography. A p-value  $<0.05$  was considered statistically significant.

Results

**Table 1: Demographic Characteristics of Study Population (n = 50)**

Variable	Frequency	Percentage (%)
Male	25	50%
Female	25	50%
Mean Age (years)	52 $\pm$ 16	—
Dyspnea	18	36%
Chest Pain	14	28%
Cough/Fever	18	36%

The study population showed equal gender distribution. Dyspnea and cough/fever were the most common presenting symptoms.

### Impact of Lung Ultrasound on Diagnosis

**Table 2: Comparison of Provisional Diagnosis before and After Lung Ultrasound**

Diagnosis	Before LUS	After LUS	p-value
Pneumonia	20	30	0.03
Pulmonary Edema	18	25	0.02
Pneumothorax	6	10	0.04
Pleural Effusion	14	19	0.05
COPD/Asthma	30	20	0.01
Others	22	6	0.001

Following lung ultrasound, there was a significant improvement in diagnostic accuracy, particularly for pneumonia, pulmonary edema, and pneumothorax ( $p < 0.05$ ). The reduction in “others” category indicates better diagnostic clarity.

### Participant Characteristics

A total of 50 patients presenting with acute respiratory distress were included in the study. Among them, 25 (50%) were males, and 25 (50%) were females. The mean age of the study population was 52  $\pm$  16 years.

The most common presenting complaints were dyspnea (36%), followed by cough/fever (36%) and chest pain (28%).

Beside lung ultrasonography led to a change in diagnosis in 34.2% of patients. There was a statistically significant increase in the diagnosis of pneumonia, pulmonary edema, pneumothorax, and pleural effusion after LUS evaluation, while cases categorized as “others” and COPD/asthma decreased significantly.

### Impact of Lung Ultrasound on Clinical Management

Lung ultrasonography resulted in a change in clinical management in 41.7% of patients, indicating its significant role in guiding treatment decisions.

**Table 3: Impact of Lung Ultrasound on Clinical Management**

Management Change	Number of Patients	Percentage (%)	p-value
No change	22	44%	—
Change in medication	12	24%	0.02
Change in admission decision	8	16%	0.03



Additional procedures (thoracentesis/chest tube)	5	10%	0.01
Referral to ICU	3	6%	0.04

### Overall change in management: 41.7% (p = 0.001)

The most common change in management was the modification of medication, followed by changes in admission decisions and additional procedures. These findings highlight the clinical utility of LUS in real-time decision-making.

### Discussion

In emergency rooms, quick diagnostic evaluation is essential, especially for patients who have acute respiratory distress. In unstable patients, conventional imaging modalities like computed tomography and chest radiography might not always be accessible or practical. As a quick, non-invasive, and radiation-free diagnostic method, bedside lung ultrasonography has grown in popularity in recent years (4).

The current study showed that physicians' decisions in the emergency room were greatly impacted by bedside lung ultrasonography. After an ultrasonography evaluation, about 34.2% of patients had their diagnosis changed. This result is in line with earlier research that found that diagnostic modification rates following the use of point-of-care ultrasound ranged from 30 to 50% (5).

The identification of several important respiratory diseases was enhanced by lung ultrasonography. For instance, an ultrasonography examination improved the identification of pneumonia and pulmonary edema. Doctors were able to distinguish between cardiogenic and non-cardiogenic causes of dyspnea by visualizing B-lines, consolidations, pleural effusion, and lung sliding. Similarly, distinctive ultrasonography findings, including the lung point sign and the lack of lung slide, aided the identification of pneumothorax (6).

Lung ultrasonography significantly affected clinical management in addition to diagnostic alterations, impacting therapy choices in 41.7% of patients. Decisions on hospital admission, the start or stop of antibiotics, diuretics, or bronchodilators, and the execution of procedures like thoracentesis or chest tube insertion were examples of management changes (4).

Ultrasound is very helpful in emergencies where quick judgments need to be made because of its quick bedside availability. Furthermore, lung ultrasonography has proven higher sensitivity than chest radiography for diagnosing diseases such as pleural effusion and pneumothorax(7).

### Generalizability

The findings of this study may be generalizable to similar resource-limited emergency settings where rapid diagnostic tools are required.

### Conclusion

By increasing diagnostic precision and affecting patient care, bedside lung ultrasonography has a substantial impact on doctors' clinical decision-making in the emergency room. The method makes it possible to quickly diagnose common respiratory disorders, such as pleural effusion, pneumonia, pulmonary edema, and pneumothorax. Lung ultrasonography can boost diagnostic confidence, enable prompt therapies, and possibly improve patient outcomes when included in standard emergency practice.

### Limitations

Notwithstanding these benefits, the study includes some drawbacks. Because ultrasound interpretation is heavily reliant on physician training, operator experience may have an impact on the outcomes. Furthermore, the study was carried out at a single location with a small sample size, which can have an impact on how broadly applicable the results are.

### Recommendation

Routine use of bedside lung ultrasonography in emergency departments should be encouraged. Training programs should be implemented to improve physician competency. Larger multicenter studies are recommended.

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### Conflict of Interest

The authors declare no conflict of interest.

### Data Availability

Data are available from the corresponding author upon reasonable request.



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### **Authors' Contributions**

VB: Concept and data collection

RS: Study design and supervision

SKN: Data analysis and manuscript review

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