Early lactate clearance rate is an indicator of Outcome in severe sepsis and septic shock

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Introduction

❖ Serum lactate level can help in determining prognosis and to risk stratify patients with severe sepsis & septic shock.

❖ Lactate clearance rate, derived from calculating the changes in lactate concentration from 2 blood specimens drawn at different times.

❖ **The lactate clearance was defined by the equation**

[(Lactate $_{initial}$ −Lactate $_{delayed}$)/Lactate $_{initial}$] × 100%.

❖ **In this study lactate level was measured at 0 hour and at**

6 hour for calculation of lactate clearance .

So here lactate clearance rate is:

[(lactate $_{during\ ICU\ admission}$ − lactate $_{Hour\ 6}$)/lactate $_{during\ ICU\ admission}$] × 100%

❖ **During resuscitation, a lactate clearance of > 10% from its baseline value in as brief a period as 6 hours is achievable**

Rationale of the study

❖ **Previous work has found that lactate clearance of 10% or more predicts survival from septic shock.**

❖ **Several studies in severe septic patients, pointed out the value of blood lactate clearance in the first 6 hours of resuscitation for the prediction of day 28 survival**

❖   **But no data are available regarding the outcome of the patients of severe sepsis and septic shock during the ICU admission period in our country.**

❖   **The data obtain from this study may guide the Intensivists to concentrate about the concept of lactate normalization during early therapeutic intervention.**

Objectives

General objective:

To find the association between high lactate clearance and the outcome of the patients of severe sepsis and septic shock.

Specific objectives:

- **To observe whether HLC in severe sepsis associated with decreased mortality.**

- **To observe whether LLC in severe sepsis associated with increased mortality.**

- **To observe whether HLC in septic shock associated with decreased mortality.**

- **To observe whether LLC in septic shock associated with increased mortality.**

- **To compare HLC & LLC group mortality in severe sepsis and septic shock.**

Methodology

Study Design: **Prospective observational study**

Study Place:

    Department of Critical Care Medicine (ICU) of BIRDEM General Hospital, Dhaka.

Study Duration: **1ˢᵗ August 2015 to 31ˢᵗ July 2016**

Sample Size: 186

Selection of Patients

Inclusion criteria:

1. **Age ≥18years**

2. **All patients admitted to ICU with the features of severe sepsis and septic shock according to SSC guidelines.**

3. **Patient having no history of IHD, Trauma & CLD**

Exclusion criteria:

1. Patient with Myocardial infarction, Left ventricular failure, seizure, pregnancy, malignancy or requiring immediate surgery were excluded

2. History of acute alcohol ingestion or poisoning

3. Readmission to the ICU during the same hospitalization episode

4. Denials of the patient.

5. Any accidental death not related to septicaemia.

Results

Table 1: Distribution of patients by their age

Age (years)	Frequency (n)	Percentage (%)
$\leq$ 40	19	10.2
41-50	15	8.1
51 - 60	37	19.9
61 - 70	63	33.9
71-80	35	18.8
$\geq$ 81	17	9.1
Total	**186**	**100.00**
Mean ± SD = 63.07 ± 14.17; range = 24- 92 years		

The peak age distribution was 61- 70 (n = 63) years. So severe sepsis and septic shock are more common in elderly patients

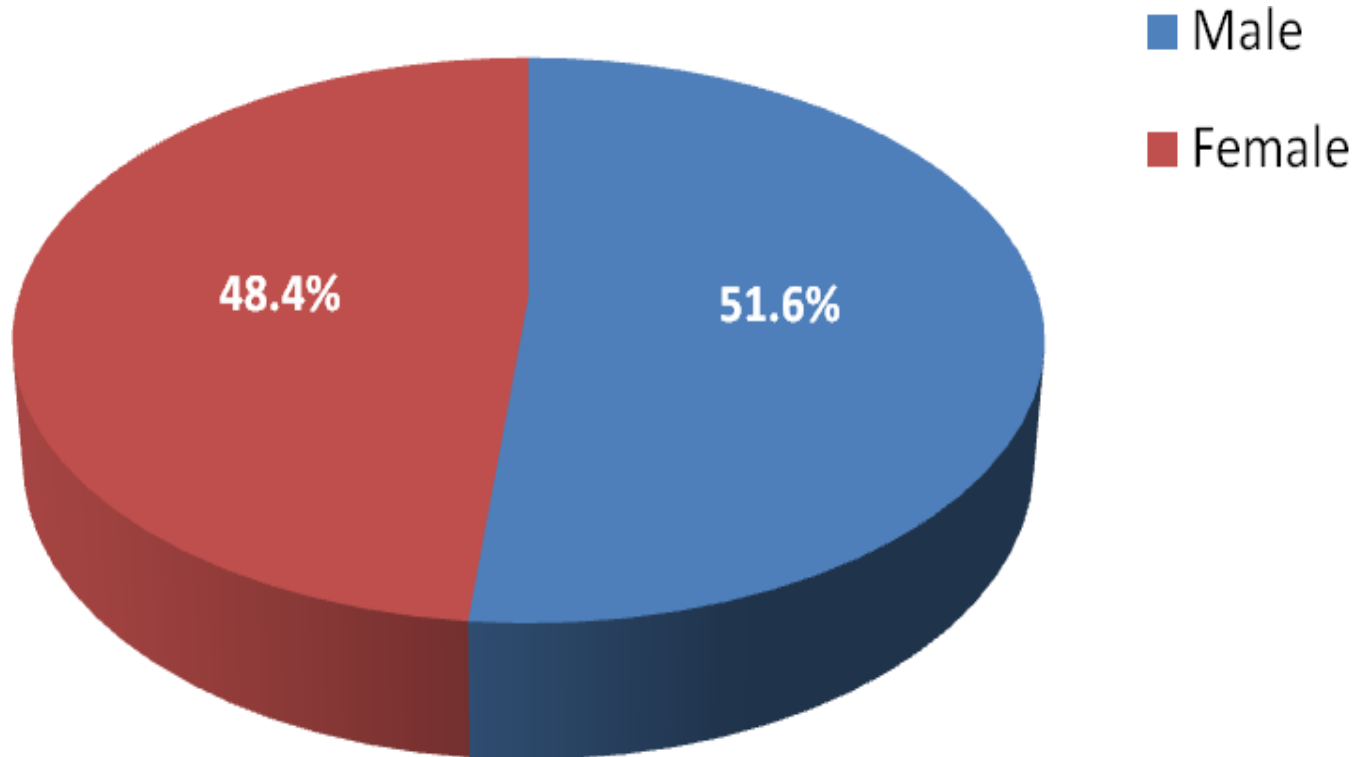# Figure 1: Pie chart of gender distribution of the patients

Table 2: Baseline characteristics of the patients

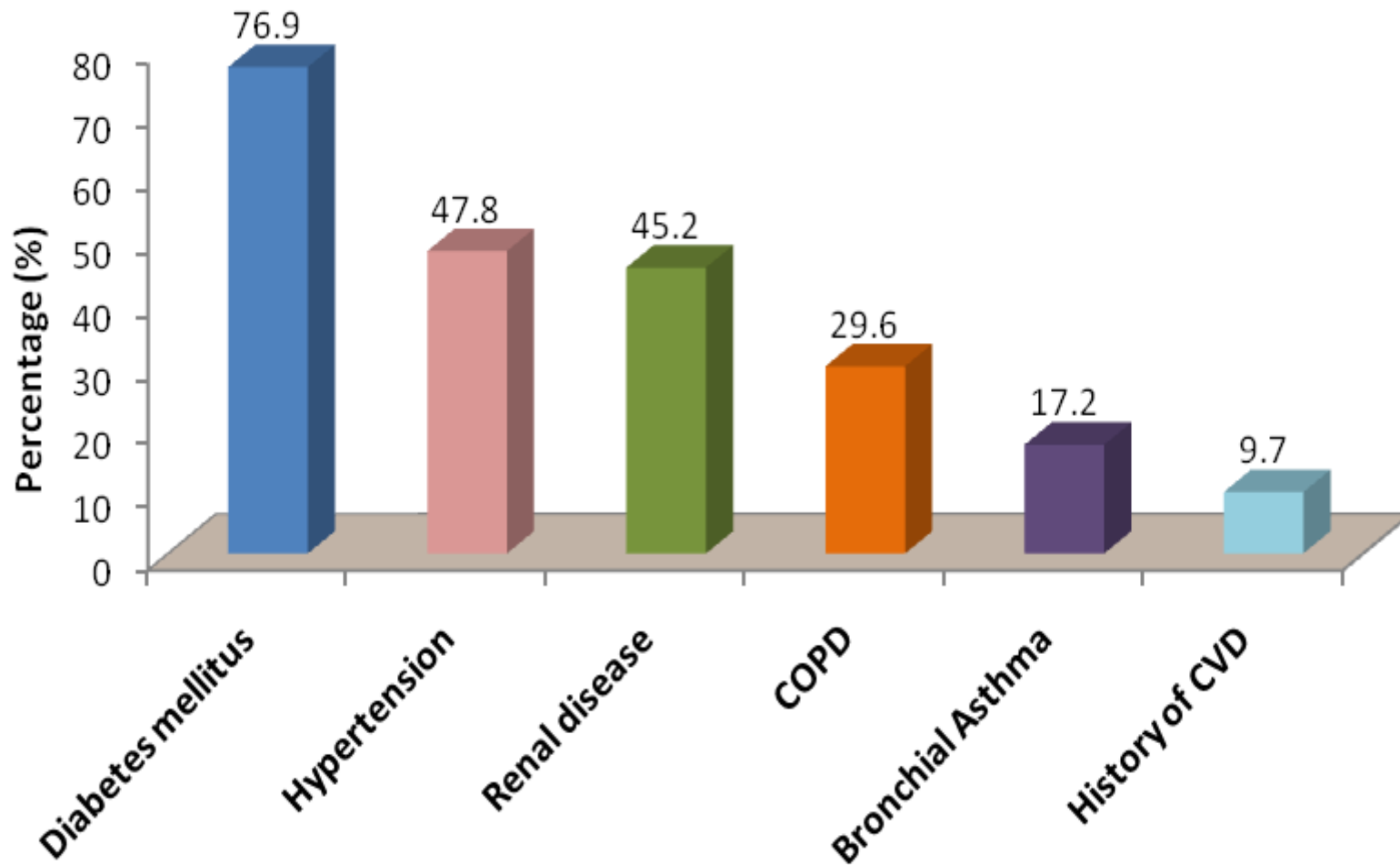| Variables	Mean ± SD	Range (Min-max)
Systolic BP (mmHg)	84.6 ± 20.2	33.0 - 150.0
Diastolic BP (mmHg)	52.7 ± 13.9	26.0 - 100.0
MAP	48.6 ± 12.5	21.2 - 90.0
Hb% (gm/dl)	10.8 ± 1.9	3.3 - 16.6
TC	24.2 ± 7.5	2.38– 47.4
Platelet	184401±100003	7000-599000
S. Creatinine (mg/dl)	4.2 ± 3.4	0.7 - 19.2
Lactate level (mg/dl)	37.5 ± 18.3	12 - 112

Figure 2: Bar chart of associated co-morbidities of the patients

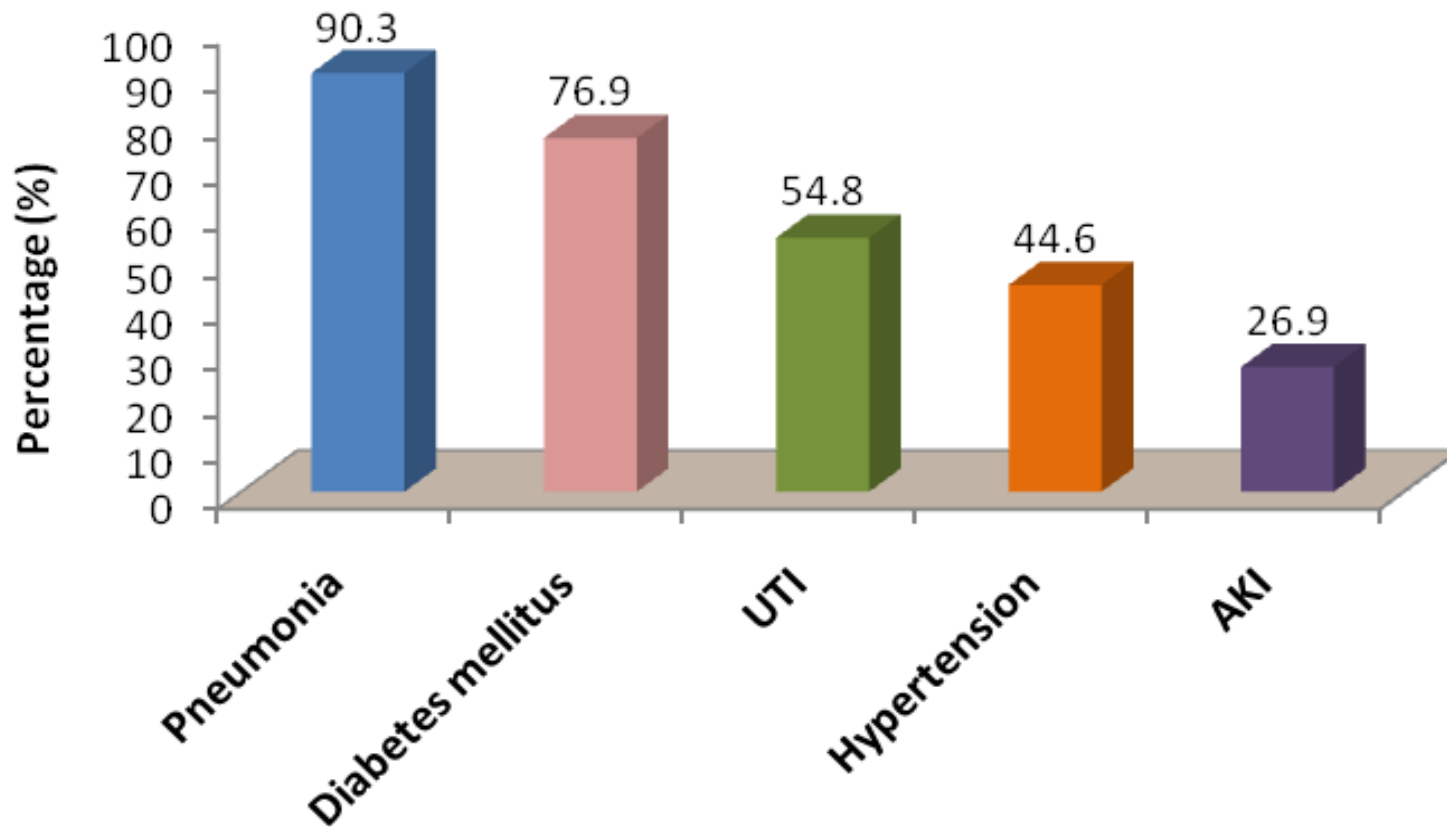# Figure 3: Bar chart of diagnosis of the patients

Table 3: Proportion of LLC and HLC in severe sepsis and septic shock

	Group		Total
	LLC	HLC	
Septic Shock	55 (51.9)	51 (48.1)	106 (57.0)
Severe Sepsis	23 (28.8)	57 (71.3)	80 (43.0)
Total	78	106	186

Table 4: Comparison of Lactate clearance between survivor and non-survivors groups of Severe sepsis patients

Variable	Group		Total	p-value
	Survivors	Non-survivors		
HLC	42 (87.5)	15 (46.9)	57 (71.3)	<0.001
LLC	6 (12.5)	17 (53.1)	23 (28.8)	
Total	48 (100.0)	32 (100.0)	80 (100.0)	

Table 5: The Validity test results of lactate clearance in prediction of outcome (severe sepsis group)

| Parameter	Estimated Value (%)	95% CI (min – max)
Sensitivity	87.5	78.4-94.2
Specificity	53.1	39.4-63.2
PPV	73.7	66.0-79.3
NPV	73.9	54.8-87.9
Accuracy	73.8	62.8-81.8

Table 6: Comparison of Lactate clearance between survivor and non-survivors groups of Septic shock patients

Variable	Group		Total	p-value
	Survivors	Non-survivors		
HLC	40 (71.4%)	11 (22.0%)	51 (48.1)	<0.001
LLC	16 (28.6%)	39 (78.0%)	55 (51.9)	
Total	98 (100.0)	50 (100.0)	106 (100.0)	

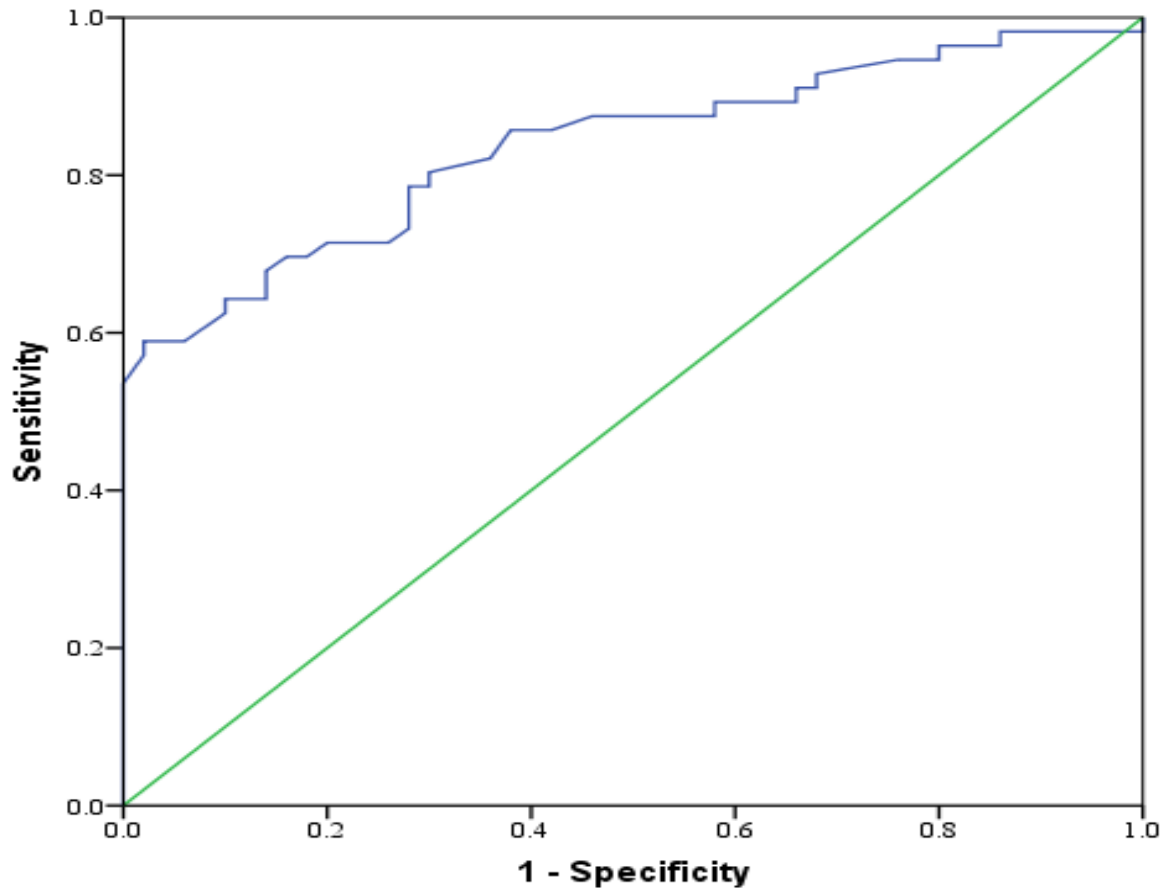Chi-square test was done to measure the level of significance.

Table 7: The Validity test results of lactate clearance in prediction of outcome (septic shock group)

Parameter	Estimated Value (%)	95% CI (min – max)
Sensitivity	71.4	62.0 - 79.0
Specificity	78.0	67.4 - 86.4
PPV	78.4	68.0 - 86.7
NPV	70.9	61.3 - 78.6
Accuracy	74.5	64.5 - 82.5
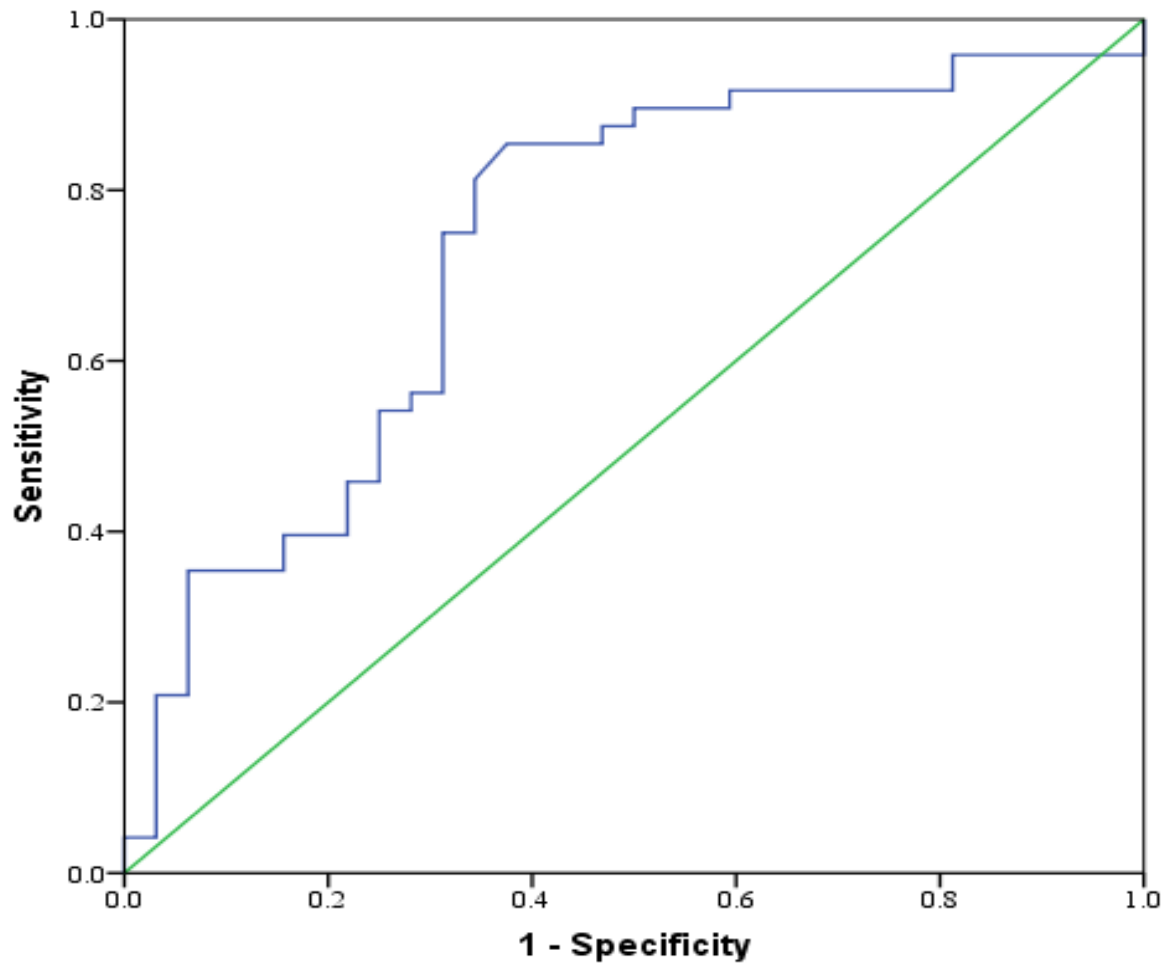
Diagonal segments are produced by ties.

Figure 4 : ROC curve of lactate clearance in prediction of outcome (severe sepsis group) [AUC = 0.736]

Figure 5 : ROC curve of lactate clearance in prediction of outcome (septic shock groups) [AUC = 0.837]

Table 8: Outcome in LLC and HLC patients

Group	LLC	HLC	Total	P- value
Transferred	22 (28.2%)	82 (75.9%)	104 (55.9%)	<0.001
Death	56 (71.8%)	26 (24.1%)	82 (44.01%)	<0.001
Total	**78 (100.0%)**	**108 (100.0%)**	**186 (100.0%)**	

- **Among 78 Low Lactate Clearance group of patients, 28.2% (n=22) patients were transferred from ICU after clinical improvement and 71.8% (n=56) patients were died. (P value <0.001).**

- **Among 108 High Lactate Clearance group of patients, 75.9% (n=82) patients were transferred and 24.1% (n=26) patients were died (P value <0.001).**

Limitations

- As the sample size was small, the findings derived from study cannot be generalized to reference population.

- This study was carried out in an adult intensive Care Unit (ICU). So pediatric group of population was not included in the study.

Limitations (contd)

- **Study was conducted in a tertiary care hospital where most of the patient population were diabetic and having preexisting multiple comorbidities.**

- **The study was conducted in a selected hospital. So the study population might not represent the whole country**

Conclusion & recommendations

- **Lactate clearance in improved morbidity and mortality rates.**

- **This is consistent with current efforts that emphasize the importance of identifying and treating tissue hypo perfusion during the first 6 hours of resuscitation.**

- **Further clinical trials are needed to conclusively establish lactate clearance as a resuscitation end point and an outcome measure.**

- **We need guidelines for early identification, management & prevention of sepsis for resource limited country like Bangladesh**.

- **Future studies should include a larger number of patients and ICU to better understand and treat patients with severe sepsis and septic shock.**