Original Article

Epidemiological study of prevalence, determinants, and outcomes of infections in medical ICU at a tertiary care hospital in India

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ABSTRACT

Objectives: To determine the prevalence of infections, risk factors, and outcomes in a medical intensive care unit (ICU), we performed a hospital-based study. **Materials and Methods:** Consecutive patients were enrolled and details of risk factors and bacteriological data were obtained. Outcomes were death/transfer to palliative care or recovery. Statistical analyses were performed. **Results:** Four hundred and eighty-seven patients were admitted during the study period (age 55.6 ± 19 yr, men 68%). Diseases responsible were respiratory (37%), gastrointestinal/liver (22%), neurological (20%), renal (8%), and trauma (6%) related. Majority of admissions were direct (45%) or transfers from other hospitals (41%). Most important comorbidities were hypertension (41%), diabetes (31%), and chronic obstructive pulmonary disease (15%). Median APACHE-2 score was 13.0 (IQR 1–25). Antibiotics were administered in 98%. Bacteriological cultures were positive in 28% (n = 623). Respiratory infections were the most common (45.5%) followed by blood (23.3%) and urinary (16.1%). Gram-negative bacteria were common–*Acinetobacter baumannii* (20.9%), *Klebsiella pneumoniae* (19.7%), *Escherichia coli* (18.3%), and *Pseudomonas aeruginosa* (14.0%). There a high prevalence of resistance to common antibiotics. Patients with positive cultures were older, transferees (46 vs 37%, $P = 0.07$), with respiratory disease (48 vs. 33%, $P = 0.003$), with more than two comorbidities (33 vs 21%, $P = 0.009$), and higher APACHE-2 score (17.7 ± 8 vs. 13.3 ± 8, $P = 0.07$). Three hundred and fifty-two (72.3%) recovered, 68 (13.9%) died, and 67 (13.8%) were transferred to palliative care. Survival was associated with younger age, lower APACHE-2 score, negative cultures, and shorter duration in ICU ($P < 0.05$). Mortality was greater in patients with *Acinetobacter* (OR 2.36, 1.17–4.73), *Klebsiella* (OR 2.81, 1.33–5.92), *Pseudomonas* (OR 8.03, 2.83–22.76), or *Enterobacter* (OR 6.73, 1.29–35.12) infection. **Conclusions:** There is high prevalence of infections in patients in a medical ICU in India. Gram-negative bacteria are the most prevalent and resistance to antibiotics is high. Risk factors are age, hospital transfers, APACHE-2 score, and multiple comorbidities.

KEY WORDS: *Acinetobacter baumannii*, drug resistance, epidemiology, gram-negative infections, intensive care units, *Klebsiella pneumoniae*

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INTRODUCTION

Infections are one of the most important causes of mortality in the world, more so in low and lower-middle income countries.[1,2] The Global Burden of Diseases Study reported that although the mortality due to infections has decreased in the last 30 years, they still remain an important cause of death[2] and persist as the most important cause of disability.[1,3] Multiple factors are responsible. Rapid urbanization, aging of the population, and emerging viral and bacterial infections combined with the age-old upstream predisposing factors such as poverty, inequality, and illiteracy.[4-6] In India, too, infections remain an important cause of morbidity and mortality.[7,8] In the last century, the infectious diseases in India were mainly parasitic (malaria, leishmaniasis), viral (measles, poliomyelitis, and others) or bacterial and were mostly confined to children and young age groups.[7] Bacterial infections were mild and easily treatable. Control

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of viral and parasitic diseases has led to serious bacterial infections at all age groups, especially in middle-aged and the elderly patients.[8,9]

Intensive care units (ICUs) are an important source of infections, especially bacterial.[10-15] Studies in Europe and North America have reported that primary (at the time of admission) as well as secondary (nosocomial, ventilator-associated, device-related, and others) infections are common in ICUs. The European Studies on Prevalence of Infections in ICU (EPIC-1 and EPIC-2) reported a high prevalence of infections in a number of European countries.[11,14] High prevalence of infections, especially nosocomial, has also been reported from medical ICUs in the United States.[12] This is associated with higher age and APACHE-2 scores and high prevalence of comorbid conditions.[14]

Infections are common in medical ICUs in India. Recent studies from different regions of the country have reported that both primary and secondary infections with gram-positive and gram-negative bacteria are widespread.[15-28] Studies have also reported high prevalence of gram-negative bacterial infections such as with *Acinetobacter baumannii*, extended spectrum beta-lactamase, and metallo-beta-lactamase producing organisms (e.g., *Escherichia coli*, *Klebsiella pneumoniae*) and drug-resistant gram-positive organisms (methicillin-resistant *Staphylococcus aureus*, *vancomycin*-resistant *Enterococci*, and others).[25-28] Recent reports of multidrug resistant gram-negative organisms in India have generated considerable scientific interest and public health response.[29-32] To determine prevalence of infections, demographic and clinical risk factors, bacteriological profile, drug sensitivity patterns, outcomes, and determinants, we performed an epidemiological study in a large tertiary care hospital in Rajasthan. This is one of the larger studies of ICU infections in India with a focus on current patterns of bacteriological isolates at a tertiary care hospital in Rajasthan. There are no previous data available from this part of the country.

MATERIALS AND METHODS

The study was performed at a tertiary care hospital in Rajasthan, India. Protocol was approved by institutional ethics committee. Consent was obtained from the hospital administration and academic and research committee of the hospital for use of anonymized data of the patients. Individual patient consent was not obtained. Consecutive patients admitted to the medical ICU over 12 months from June 2011 to May 2012 were enrolled.

A case-report form was developed. We obtained the details of demographic characteristics (age, gender, education, residence), clinical history, primary diagnosis, comorbidities, bacteriological profile, outcomes, and risk factors. Infection was defined according to International Sepsis Forum. Patients who had undergone surgery in the 4 weeks preceding admission were considered surgical admissions. Trauma admissions were defined as ICU admissions directly related to, or occurring as a complication of, a traumatic event in the 30 days preceding admission. All other admissions were considered medical. The presence of the following comorbid conditions were noted: diabetes mellitus, hypertension, chronic obstructive pulmonary disease (COPD), chronic renal failure (need for chronic renal support or history of chronic renal insufficiency, with a serum creatinine level greater than 3.6 g/dL [300 μmol/L]), coronary heart disease, heart failure (New York Heart Association class III–IV), human immunodeficiency virus (HIV) infection (HIV-positive patients with clinical complications such as *Pneumocystis jirovecii pneumonia*, Kaposi sarcoma, lymphoma, tuberculosis, or toxoplasmosis), liver cirrhosis, cancers, and anemia.

In each patient admitted to the ICU, we obtained cultures of blood, urine, wound swab, sputum or endotracheal secretions, and other relevant specimens were collected using standard procedures at admission and when indicated. Identification of the causative organisms was performed by standard microbiological methods. Organism identification and susceptibility testing was performed on Microscan Autoscan-4 (Siemens Healthcare, Germany). The interpretation was based on the recommendations of Clinical Laboratory Standards Institute (CLSI).[33] APACHE-2 score was calculated at admission for every patient.[34] This score is a composite of multiple components and clinical variables. The four components are: age, major disease category (reason for ICU admission), acute (current) physiology, and prior site of health care (e.g., hospital floor, emergency room). The physiologic variables are the following vital sign and laboratory abnormalities: Pulse rate, mean blood pressure, temperature, respiratory rate, PaO_2/P (A-a) O_2, hematocrit, white blood cell count, creatinine, urine output, blood urea nitrogen, serum sodium, albumin, bilirubin, glucose, acid–base status, and neurologic status.[34] Outcomes included death, transfer to palliative care/other hospitals, and recovery.

Statistical analysis

All the case-report forms were computerized and entered into a database (Microsoft Excel) and analyses performed within this program. Descriptive statistics are reported. Numerical data are reported as mean ± 1 SD when variables were normally distributed and median and interquartile intervals (IQR) when skewed. Categorical variables are reported as percent. Intergroup comparisons were performed with χ^2 test for categorical variables and unpaired *t*-test for numerical variables. Univariate odds ratios were calculated using χ^2 test with death or transfer to palliative care as dependent variable and others as independent variables. *P* values less than 0.05 were considered significant.

RESULTS

Four hundred and eighty-seven patients were admitted during the study period from June 2011 to May 2012. Mean age of the subjects was 55.6 ± 19 years and there were 331 men (68%) and 156 women (32%). Other demographic details are reported in Table 1. Majority of admissions were direct (n = 221, 47.0%) or transfers from other hospitals (n = 198, 40.6%), whereas 14.0% were from within hospital. Diseases responsible for admission were respiratory 37.2%, digestive/liver 22.4%, neurological 20.1%, renal 8.2%, trauma 5.9%, and others. Most important comorbidities were hypertension (41.5%), diabetes (31.0%), COPD (14.8%), and more than two comorbidities were seen in 32.0%. Mean APACHE-2 score at admission was 14.5 ± 8 (median 13, IQR 1–25).

Table 1: Demographic and clinical characteristics of the patients

Parameters	Patients *N*=487
Age (years)	
≤30	79 (16.2)
31-59	169 (34.7)
≥60	239 (49.1)
Gender	
Male	331 (67.9)
Female	156 (32.0)
Resident status	
Rural	141 (28.9)
Urban	346 (71.7)
Source of admission	
Direct admissions	221 (45.4)
Transfer from other hospitals	198 (40.6)
Transfer from hospital floor	68 (14.0)
Socioeconomic status	
Professional/executive	85 (17.4)
Business/administration	88 (18.1)
Office clerk	43 (8.8)
Skilled labor, manual, nonmanual	26 (5.3)
Unemployed or retired or housewife	243 (49.7)
Smoking/alcohol abuse	
Smoking	82 (16.8)
Alcohol abuse	45 (9.2)
Both smoking and alcohol	26 (5.3)
Reason for ICU admission	
Respiratory	181 (37.2)
Digestive/liver	109 (22.4)
Neurological	98 (20.1)
Renal	40 (8.2)
Trauma	29 (5.9)
Cardiovascular	6 (1.2)
Others	24 (4.9)
Comorbidities	
Hypertension	202 (41.5)
Diabetes	151 (31.0)
COPD	72 (14.8)
Coronary heart disease	42 (8.6)
Chronic renal failure	16 (3.3)
Others	10 (1.8)
Number of comorbidities	
None	207 (42.5)
1	119 (42.5)
2	113 (24.4)
3+	48 (9.8)
APACHE-2 score	
<10	160 (32.9)
10-19	195 (40.0)
≥20	132 (27.1)
Mean±SD	14.5±8.0
Median (IQR)	13.0 (1-25)

ICU: Intensive care unit, COPD: Chronic obstructive pulmonary disease, IQR: Interquartile range. Numbers in parentheses are percent unless specified

Antibiotics were administered for suspected infections in 478 (98%). Bacteriological cultures were positive in 134 (28%). There were 623 bacteriological isolates from 134 patients [Table 2]. Gram-negative bacteria were the most common and included *A. baumannii* (20.9%), *K. pneumoniae* (19.7%), *E. coli* (18.3%), and *Pseudomonas aeruginosa* (14.0%). Gram-positive infections were *S. aureus* (8.2%) and *Enterococcus* species (5.0%). Respiratory tract isolates were the most common (44.5%) followed by blood stream (23.3%), urinary tract (16.1%), skin/soft tissue (9.1%), and intra-abdominal (4.3%).

Bacteriological profile in infections of respiratory tract, blood stream, urinary tract, and skin and soft tissue infections are shown in Figure 1. Gram-negative bacteria (*Acinetobacter*, *Pseudomonas*, and *Klebsiella*) were the most prevalent in respiratory tract, urinary tract, and blood stream infections and less common in skin and soft tissue. Bacteriological drug sensitivity patterns revealed high prevalence of resistance to commonly used as well as third- and fourth-generation antibiotics [Figure 2]. Less than 50% *K. pneumoniae* isolates were susceptible to carbapenems, whereas these drugs were effective in about 80% of *E. coli* isolates. Prevalence of extended spectrum beta-lactamase producing *K. pneumoniae* was in 18.9% and *E. coli* in 36.4%. However, the absolute number of enterococci grown was low (n = 31) resistance to vancomycin was observed in 30.9%.

Risk factors in subjects with or without bacteriological isolation are shown in Table 3. Significant proportions of patients with positive cultures were older (58.8 ± 18 vs 54.7 ± 20 yr), transferred from other hospitals (48% vs 38%, P = 0.07), had respiratory disease (48% vs 33%, P = 0.003) and higher APACHE-2 score (17.7 + 8 vs 13.3 ± 8, P = 0.07) [Table 3].

Of the 487 study subjects, 353 (72.3%) recovered, 68 (13.9%) died, and 67 (13.8%) were transferred to palliative care or other hospitals. Thus, 27.7% patients died or were transferred to palliative care. Details of patient outcomes and the associated risk factors are shown in Table 4. Recovery was associated with direct admissions (48% vs 39%, OR 0.71, CI 0.47–1.06), lower APACHE-2 score (12.5 + 7.3 vs 19.8 + 8.2), negative cultures (24% vs 36%, OR 0.58, CI 0.38–0.90) and shorter duration of ICU care (P < 0.01). There was a significant linear relationship of APACHE-2 score with adverse outcomes [Figure 3]. Greater mortality was observed in patients with *A. baumannii* (OR 2.36, CI 1.17–4.73), *K. pneumoniae* (OR 2.81, CI 1.33–5.92), *P. aeruginosa* (OR 8.03, CI 2.83–22.76), and *Enterobacter* (OR 6.73, CI 1.29–35.12) infections [Table 5].

DISCUSSION

This study shows that infections are common in a medical ICU at a tertiary care hospital in India. Infection was suspected at admission in 98% and in 28% patients, bacterial isolation with multiple organisms was observed. Risk factors for infections are transfer from other hospitals, greater age, multiple comorbidities and high APACHE-2 score. Gram-negative bacteria (*Acinetobacter*, *Klebsiella*, *Escherichia*, and *Pseudomonas*) are the most prevalent and resistance to common antibiotics is high. Mortality (and transfer to palliative care) is high and risk factors are greater APACHE-2 score and gram-negative infections.

Critical care illnesses are a major problem in health care worldwide. The Global Burden of Critical Care Diseases study reported a high prevalence and mortality from such diseases, especially in low and middle income countries. ICU mortality in unselected patients in high income countries varies from 8% to 18%. However, in patients with acute lung injury the mortality rates vary from 35% to 45% and in patients with septic shock it is as high as 50%–60%.[35] Rates could be higher in low income countries and studies have reported mortality rates from 15% to 60% in various studies.[36] Results of a surveillance study of International Nosocomial Infection Control Consortium (INICC) in 422 ICUs of 36 countries in Latin America, Asia, Africa, and Europe reported on prospective data from 313,008 patients were obtained and reported a high rate of mortality.[37] MOSAICS Study in Asia prospectively studied 1285 patients admitted to medical ICUs in 16 Asian countries with severe sepsis and reported a mortality of 44.5%.[38] The INDICAP Study reported a high mortality in medical ICUs in India with a greater mortality in patients with infections among 4000 patients admitted to medical ICUs in different parts of the country.[39] The present study shows that in-hospital mortality was 14% and another 13% patients were transferred to palliative care or other hospitals, most of these patients were very sick and qualitative evaluation indicated that they were unlikely to survive. Transfer to palliative care of terminally ill patients has been reported from a study in Mumbai[40] and elsewhere and is a common practice in medical ICUs, especially in low income countries.[41] We do not have outcomes data on these subjects and this is a study limitation. High mortality in the present series of patients could be related to high prevalence of infections, especially drug-resistant gram-negative bacterial infections [Figures 1 and 2] as well as an older population with high prevalence of comorbidities [Table 1]. A median APACHE-2 score of 14 indicates a high proportion of seriously ill patients.

Bacteriological profile in Indian ICUs differs from that in the west. West Gram-negative organisms are the most common.[8] Our study is consistent with these observations.

Table 2: Bacteriological isolates in culture positive patients (623 isolates)

Organisms	Numbers (*n*=623)
Gram-negative bacteria	
Acinetobacter baumannii	130 (20.9)
Klebsiella pneumoniae	123 (19.7)
Escherichia coli	114 (18.3)
Pseudomonas aeruginosa	87 (14.0)
Enterobacter spp.	21 (3.4)
Gram-positive bacteria	
Staphylococcus aureus	51 (8.2)
Enterococcus spp.	31 (5.0)
Streptococcus spp.	17 (2.7)
Fungi	
Candida albicans	26 (4.2)
Non-*Candida albicans*	23 (3.7)

Numbers in parentheses are percent

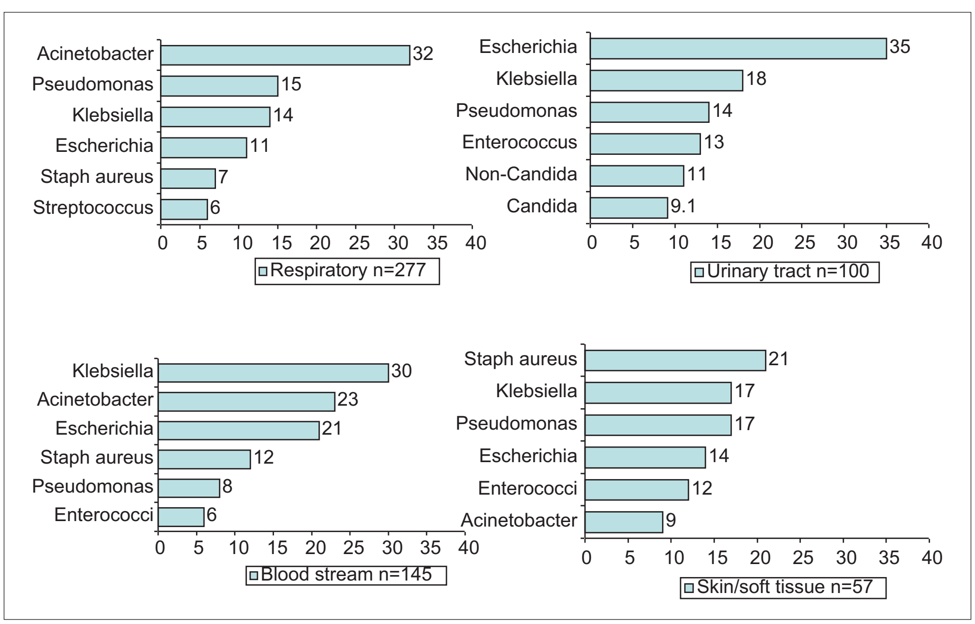

Figure 1: Bacteriological isolates at different sites in percent

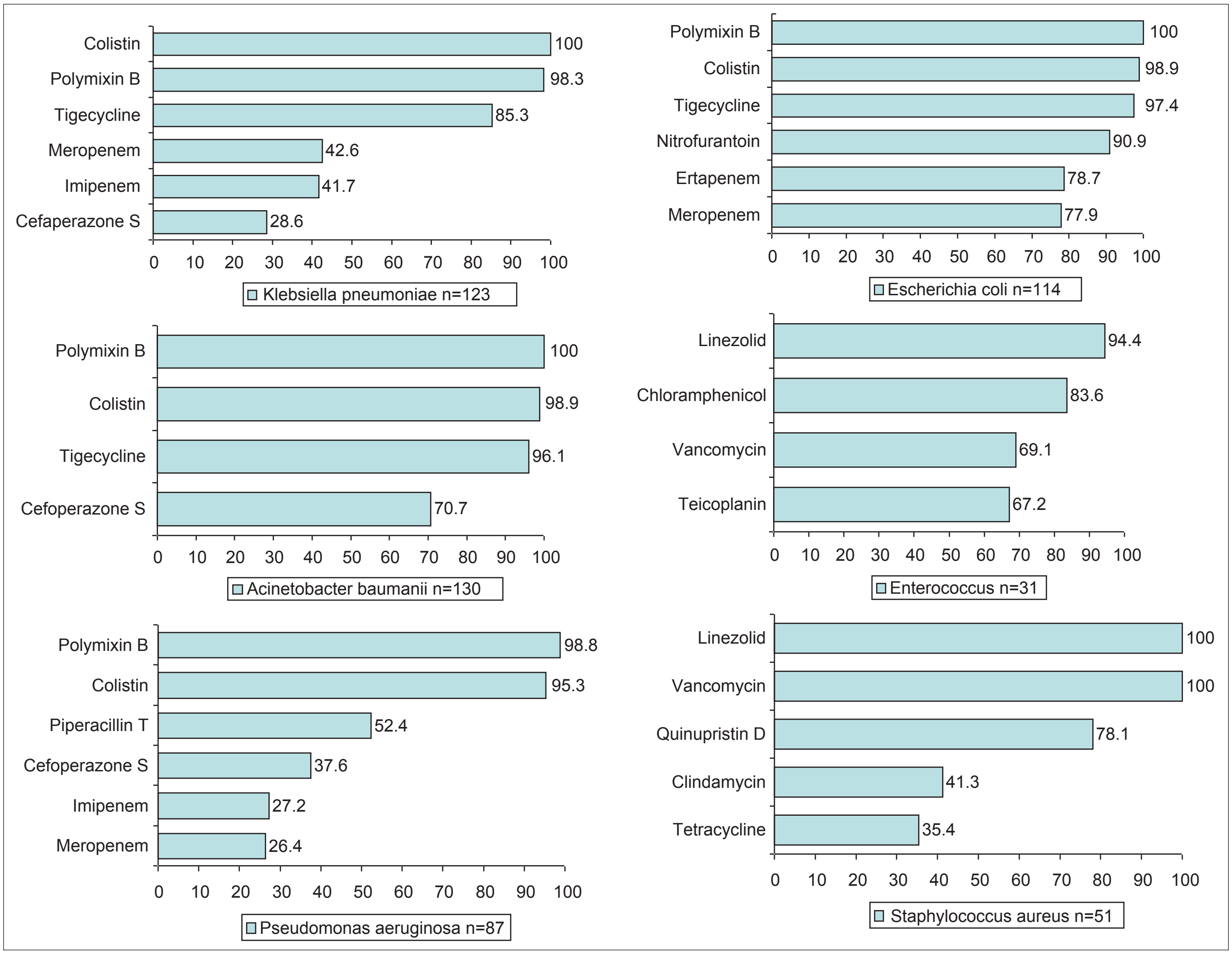

Figure 2: Pharmacological antibiotic sensitivity patterns for various bacteriological species. Numbers in each figure legend are bacterial isolates and numbers in bars indicate sensitivity %. Cefoperazone-S = cefaperazone sulbactam

In a study conducted at Chennai (South India), 25% patients had a positive bacteriological culture,[42] which is similar to our results. A study on *Acinetobacter* infections in a tertiary level ICU in northern India[27] showed that such infections are highly prevalent in the ICU, with patients being more susceptible to lung infection. Similarly, in a study on nosocomial pathogens in ICU in Pune (West India), major infections found in ICU were due to *A. baumannii*, *E. coli*, *K. pneumoniae*, *P. aeruginosa*, *S. aureus*, and *Streptococcus* spp.[43] *Acinetobacter* isolates in multiple medical ICUs in India and elsewhere have displayed high level of antibiotic resistance[12,13] similar to that observed in the present study. The pharmacological sensitivity profile for common bacteria such as *Escherichia* and *Klebsiella* reveal a disturbing trend. There is a high prevalence of resistance to common antibiotics and *carbapenem* resistance is observed in more than 50% of *Klebsiella* isolates and in about 20% of *E. coli* isolates [Figure 2]. We have not performed detailed gene identification but such high incidence suggests the presence of NDM-1 gene, this is similar to reports from other Indian ICUs.[29]

In the present study, more than 95% patients were prescribed antibiotics at admission. This is despite a well-established antibiotic policy and significant control on third- and fourth-generation antibiotic use in our hospital. Global Antibiotic Resistance Partnership (GARP) guidelines recommend multipronged strategy in low and middle income countries to optimize the use of antibiotics and to reduce antibiotic resistance.[9] The priority actions recommended are (1) national surveillance of antibiotic use and antibiotic resistance, (2) increasing use of diagnostic tests, especially microbiological tests, (3) strengthening of infection control committees in hospitals, and (4) restricting the use of antibiotics for nontherapeutic use such as in agriculture. However, most of the hospitals in our region lack these practices and empirical use of antibiotics is high in critically ill patients. High use of antibiotics in the present study is a reflection of clinical certainty regarding the presence of infections with limited evidence. Positive bacterial cultures in only a third of patients could be due to empirical antibiotic

Table 3: Risk factors in subjects with or without bacteriological isolation

Characteristic	Culture negative *N*=353 (72%)	Culture positive *N*=134 (28%)	*P* value
Age (years), mean+2SD	54.7±20.0	58.8±18.0	0.985
Median (IQR)	58 (28-88)	60 (35-85)	-
Men, *n* (%)	239 (68)	93 (69)	0.719
Source of admission			
Direct	176 (50)	45 (34)	0.001
Other hospitals	133 (38)	65 (48)	0.071
Hospital floor	44 (12)	24 (18)	0.129
Reasons for admission			
Respiratory	117 (33)	64 (48)	0.003
Digestive/liver	90 (25)	19 (14)	0.006
Neurological	74 (21)	24 (18)	0.449
Renal	29 (8)	11 (8)	1.000
Trauma	17 (5)	12 (9)	0.097
Others	26 (7)	4 (3.0)	0.055
Comorbidities, *n* (%)			
Hypertension	142 (40)	60 (45)	0.363
Diabetes mellitus	100 (28)	51 (38)	0.040
Chronic obstructive pulmonary disease	48 (14)	24 (18)	0.239
Coronary heart disease	28 (8)	14 (10)	0.386
Chronic renal failure	13 (4)	3 (2)	0.407
Others	8 (2.2)	1 (1)	0.225
Number of comorbidities, *n* (%)			
None	163 (46)	44 (33)	0.007
1	75 (21)	44 (33)	0.009
2	82 (23)	31 (23)	1.000
3+	33 (10)	15 (11)	0.546
APACHE II score			
Mean±SD	13.3+7.9	17.7+8.3	1.000
Median (IQR)	12 (1-24)	17 (5-29)	0.070

Numbers in parentheses are percent. IQR: Interquartile range, SD: Standard deviation, APACHE: Acute Physiology And Chronic Health Evaluation

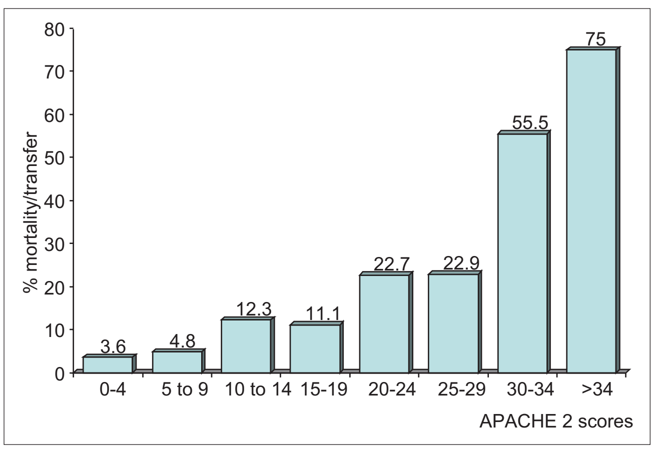

Figure 3: Association of increasing APACHE-2 score with mortality/transfer to palliative care (χ^2 test, *P* for trend <0.05).

use before arriving in the hospital, more when the patients were transferred from other hospitals or other hospital floors [Table 3]. In our study, older patients, those with respiratory diseases, multiple comorbidities, and greater APACHE-2 scores were also more likely to harbor severe infections. These results are similar to the previous EPIC-1 and EPIC-2 studies.[11,14] Risk factors for ICU mortality in the present study–presence of respiratory disease, multiple comorbidities and higher APACHE-2 scores—are similar to previous international studies.[11,14] Risk factors for infections and mortality are not well reported from Indian studies and this is one of the first studies that have prospectively focused on these two issues.

This study has several limitations as well as strengths. Limitations include the fact that the study has been performed at a tertiary care non-governmental hospital hence the patient population may not be representative of all socioeconomic strata. However, most of our patients were from Rajasthan and many were transferred from neighboring states (Haryana, Punjab, Uttar Pradesh, Madhya Pradesh, and so forth) and are representative of the region. Most previous studies from India are from similar hospitals. Second, large proportions of patients were transferred from other hospitals and were already on antibiotics, which would mask the bacteriological infection patterns. We do not have details of previous culture reports as most of the primary- and secondary-level hospitals in the region do not have such facilities. This is a major study limitation. Third, use of antibiotics in >95% patients suggests a high clinical suspicion of infections but culture reports were positive in only a third. All these factors would underestimate the actual prevalence of infections. Fourth, the study is confined to medical ICU and we have no information on cardiological, neurological, and surgical patients. Strengths of the study include a large sample size, detailed information from each patient, and comprehensive bacteriological profiling.

CONCLUSION

This study shows a high prevalence of infections in patients hospitalized in a medical ICU. Risk factors for infections include transfer from other hospitals, age, greater APACHE-2 score, and multiple comorbidities. Gram-negative bacteria (*Acinetobacter*, *Klebsiella*, *Escherichia*, and *Pseudomonas*) are the most common, and resistance to usual antibiotics is common. Mortality (and transfer to palliative care) is high and risk factors include infections with gram-negative bacteria and greater APACHE-2 score. These findings indicate that antibiotic guidelines for empirical management of infections in India should include antibiotics for gram-negative bacteria (in contrast to western guidelines where gram-positive infections are more common). This also suggests that appropriate and effective microbiological surveillance practices, at potential reservoir sites, and standard epidemiological approaches for prevention should be used for these organisms.[9,29] Greater prevalence of infections in patients transferred from other health care facilities suggests rampant nonjudicious use of antibiotics in primary and secondary care.[44] National, regional, and hospital-specific antibiotic policies should be formulated to promote rational use of third- and fourth-generation antibiotics.

Table 4: Association between outcomes and risk factors

Characteristic	Death/transfer to palliative care (*N*=135, 28%)	Recovery (*N*=352, 72%)	Odds ratio (95% confidence interval)	*P* value
Age, years, mean±SD	55.7±18.3	55.6±20.0	-	0.52
Men, *n* (%)	91 (67)	240 (68)	-	0.87
Reason for ICU admission				
Respiratory	55 (41)	126 (36)	1.23 (0.82-1.85)	0.31
Digestive/liver	26 (19)	83 (23.5)	0.77 (0.47-1.27)	0.30
Neurological	26 (19)	72 (20)	0.93 (0.56-1.53)	0.77
Renal	13 (10)	27 (8)	1.28 (0.64-2.57)	0.49
Trauma	9 (7)	20 (6)	1.19 (0.53-2.67)	0.68
Others	6 (1)	24 (6)	0.63 (0.25-1.59)	0.02
Source of admission				
Direct	53 (39)	168 (48)	0.71 (0.47-1.06)	0.006
Other hospital	55 (44)	139 (39)	1.10 (0.74-1.66)	0.61
Hospital floor	23 (17)	45 (13)	1.42 (0.81-2.42)	0.05
			2.66 (0.65-10.78)	0.18
Comorbidities, *n* (%)				
Hypertension	58 (43)	144 (41)	1.09 (0.73-1.63)	0.68
Diabetes mellitus	35 (26)	116 (33)	0.71 (0.46-1.11)	0.13
COPD	24 (18)	48 (14)	1.37 (0.80-2.34)	0.26
Coronary heart disease	13 (10)	29 (8)	1.19 (0.60-2.36)	0.63
Chronic renal failure	7 (5)	9 (3)	2.08 (0.76-5.71)	0.16
Cirrhosis	2 (1)	3 (1)	1.75 (0.29-10.59)	0.55
Number of comorbidities, *n* (%)				
None	52 (39)	155 (44)	0.79 (0.53-1.19)	0.27
1	36 (27)	83 (24)	1.18 (0.75-1.86)	0.48
2	35 (26)	78 (22)	1.23 (0.78-1.95)	0.38
3+	12 (8)	36 (10)	0.86 (0.43-1.70)	1.00
APACHE II score, mean±2SD	19.8±8.2	12.5±7.3	-	1.00
Culture positive	48 (36)	86 (24)	1.71 (1.11-2.62)	0.01

ICU: Intensive care unit, COPD: Chronic obstructive pulmonary disease

Table 5: Association of microbiologic isolates and outcomes

Organisms	Death/transfer to palliative care *n*=135	Recovery *N*=352	Odds ratio (95% confidence intervals)
Gram-negative organisms			
Acinetobacter baumannii	16	19	2.36 (1.17-4.73)*
Klebsiella pneumoniae	15	15	2.81 (1.33-5.92)**
Escherichia coli	9	24	0.98 (0.44-1.6)
Pseudomonas aeruginosa	14	5	8.03 (2.83-22.76)**
Enterobacter spp.	5	2	6.73 (1.29-35.12)*
Gram-positive organisms			
Staphylococcus aureus	10	21	1.26 (0.58-2.75)
Enterococcus spp.	5	8	1.65 (0.53-5.15)
Streptococcus spp.	1	3	0.87 (0.09-8.42)
Fungi			
Candida albicans	9	20	1.18 (0.53-2.67)
Non-Candida albicans	15	18	2.32 (1.13-4.75)*

*$P<0.05$, **$P<0.01$

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