DISCUSSION
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Nosocomial infections reflect the overall state of sanitation and aseptic measures employed in the hospital by its personnel and awareness among patients utilising these services.

The estimated incidence of hospital acquired infections, as per WHO survey (1992), is in the range of 8-21%. Various factors have been implicated in the causation of infection in the hospitalised patients. Among known agents _Escherichia coli, Staphylococcus aureus_, and _Pseudomonas_ spp. are predominant. One striking feature is the occurrence of _Enterobacter_ spp. in the suspected cases of hospital acquired infections, although the number of cases is small. In the National Nosocomial Infection Surveillance System (NNIS), USA, survey (1986, 1989) _Enterobacter_ spp. were the sixth leading cause of hospital acquired infections, but they are rising in frequency since then. In this study the approximated percentage occurrence was 3.19%. The traceable factors responsible for development of hospital acquired infections were vacuum suction apparatus, catheters IV solution perfusion lines, blood gas analyser gauze and sinks. Many studies have documented instances in which contaminated devices or instrumentation led to colonization or infection with _Enterobacter_ species. Factors other than the ones found in present study, have been heart-lung machine, hemodialysers, pressure monitoring devices, blood products toilet shelf and scale etc.

In the present study the _Enterobacter_ was responsible for bacteremia in 9 patients (23.07%) of the 39 isolates of gram-negative bacteremia. _Escherichia coli_ 12 (30.7%) and _Klebsiella_ 10 (25.6%) were the other leading causes.
*Staphylococcus aureus* was incriminated in 12 (30.7%) cases among the gram-positive organisms. Some published reports on *Enterobacter* bacteremia suggest it to vary from 4-12%.

The rates of bacteremia tend to cluster around 1 per 1,000 admissions for university hospitals or tertiary-care centers. These rates tend to be two-to three fold higher in specialized units, such as cancer centers, and two-to threelfold lowers in community hospitals. Although rates are lower in the community, the problem is significant and has a growing trend.

*Enterobacter* bacteremia tends to occur more commonly in males in a ratio of 1.3-2.5:1.0. Males predominate among both infected adults and children (Table-20). Bacteremia is more commonly encountered at the extremes of age, i.e., in neonates and the elderly. The majority of bacteremia are acquired institutionally (range, 56 to 100%) *Enterobacter cloacae* predominaates in most series (range, 46 to 91%) followed in order by *Enterobacter aerogenes* (range, 9 to 43%), *Enterobacter agglomerans*, *Enterobacter sakazakii* and others range (14 to 53%). Institutional bacteremias appear to be randomly involving *Enterobacter* spp. and are ploymicrobial.

**Characterisation of bacteremia in hospitals Table-20:**

<table>
<thead>
<tr>
<th>S. N.</th>
<th>Study</th>
<th>Year</th>
<th>Patient Population</th>
<th>Total episodes</th>
<th>M/F rd</th>
<th>Age (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weischer</td>
<td>1984-89</td>
<td>Uni. Teaching</td>
<td>53</td>
<td>1.4</td>
<td>30–76</td>
</tr>
<tr>
<td>2</td>
<td>Jhonson &amp; Ramphal</td>
<td>1985-89</td>
<td>Uni. Teaching</td>
<td>51</td>
<td>NDa</td>
<td>Adults</td>
</tr>
<tr>
<td>3</td>
<td>Andersen</td>
<td>1987-88</td>
<td>Uni. Teaching</td>
<td>10</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>4</td>
<td>Al Ansari et al.</td>
<td>1990-92</td>
<td>Teaching Hospital</td>
<td>22</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>5</td>
<td>Present Study</td>
<td>2002-03</td>
<td>Teaching Hospital</td>
<td>9</td>
<td>1.8</td>
<td>All</td>
</tr>
</tbody>
</table>

aND, Not Determined.
The age group and sex affected the most was older men (>60 y). Fever as a symptom, most commonly occurring with the onset of bacteremia, was seen in 8 cases (88.8%). Other important features in bacteremia were, leucocytosis 6 (66.6%), shock & hypotension in 4 (44.4%), altered mentate & leucopaenia in 3 (33.3%) followed by cyanosis and metabolic acidosis. Similar finding on clinical presentation of Enterobacter bacteremia have also been reported.\textsuperscript{49,103,104} Risk factors associated with Enterobacter bacteremia in present study appear to be urinary and arterial catheterisation and surgical proceeding. However, apart from these well known factors central venous catheterisation, endotracheal tubes and stay in ICU have also been documented in other series.\textsuperscript{49,104,105}

\textit{Enterobacter cloacaee} was the Enterobacter spp. most frequently isolated from blood 6 out of 9 (66.6%) showed blood culture positivity, followed by, \textit{Enterobacter aerogenes} in 2 and \textit{Enterobacter sakazakii} in 1 patients respectively. The combination of third generation cephalosporin and aminoglycoside proved successful in most instances. In neonatal intensive care unit use of third generation cephalosporin as first line mono therapy was found to be effective. The emergence of multi drug resistant Enterobacter strains may pose therapeutic challenges.

The clinical manifestations of urinary tract infection, due to Enterobacter spp. differ little from those due to other gram-negative bacilli. The spectrum of illness ranges from asymptomatic bacteriuria to pyelonephritis and urosepsis. In this study, among the causative agents it was placed behind uropathogens \textit{Escherichia coli}, Enterococci and \textit{Klebsiella} spp. There is reason to believe that the incidence of Enterobacter among nosocomial urinary pathogen is slowly
increasing. *Enterobacter* spp. have accounted for 2.4% of childhood urinary tract infection in Saudi Arabia and 6.7% of nosocomial infection in the United State.\textsuperscript{106,107} *Enterobacter aerogenes* was the predominant spp. 6 (66%) followed by *Enterobacter cloacae* and *Enterobacter gergoviae*.

An uncommon but severe sequel of *Enterobacter* bacteremia is central nervous systems (CNS) disease, especially meningitis. Among 16 cases of gram-negative meningitis, *Haemophilus* was the commonest followed closely by *Neisseria meningitidis* and *Escherichia coli* and *Enterobacter*. *Enterobacter* meningitis occurs in both children and adult, although runs a severe course in the former. Most instances of *Enterobacter* meningitis in pediatric patients have occurred in neonates predisposed of prematurity, low birth weight (< 2500g) or prolong rupture of membranes (PROM).\textsuperscript{52}

The most common species associate with meningitis was *Enterobacter sakazakii*. Similar finding have been reported which have implicated contaminated powdered milk as portal of entry.\textsuperscript{52}

It has been reported that although the incidence of community-acquired *Enterobacter* pneumonia was very low the rate of nosocomially transmitted infection (i.e., in hospitals, nursing homes) was much higher (5%-14.3%).\textsuperscript{108}

*Enterobacter aerogenes* was second behind *Klebsiella* in culture from respiratory tract infections. *Streptococcus* pneumoniae was by far the commonest organism in the present study. The criteria used to establish infection were; fever and leucocytosis (>10\textsuperscript{5}ml\textsuperscript{-1}) associated with *Enterobacter* spp. In tracheobronchial secretions, chest radiography.
Consistent with present study, a number of other diseases have occasionally been associated with infections caused by genus *Enterobacter*. They have been isolated from the bile (7-37%) of persons with common bile duct stones, biliary strictures *Enterobacter cloacae* has been isolated from ascites in a woman with peritonitis caused by small bowel obstruction. In rare instances *Enterobacter* species are involved in ocular disease corneal ulceration. A number of clinical syndromes mimicked by *Enterobacter* species, that are traditionally associated with other pathogens, have also been described.

Bacteriological analysis of water is necessary to know the magnitude of water pollution. For bacteriological analysis two widely accepted methods, viz: (a) Presumptive coliform count and (b) Eijkman test are used.

It is known that pathogens that gain entry into bodies or sources of water reach there via intestinal discharge of human and other animals thus *Escherichia coli*, other coliforms, *Faecal streptococci*, *Clostridium perfringens* provide evidence of fecal pollution of human or animal origin. It was our endeavor to seek a possible association between *Enterobacter* spp. and sewage pollution. It is well known that *Enterobacter aerogenes* is most frequently found on grains and plants but may occur in human or animal feces.

A striking feature is association of *Enterobacter* spp. with *Escherichia coli* (70%) in polluted/contaminated water. This association percentage is higher than the association values with other enterobacteria, viz; *Proteus* ssp. (36.6%), *Klebsiella* (23.3%) and another known indicator *Faecal streptococci* (33.3%).

The sudden emergence of *Enterobacter* spp. as nosocomial pathogen compels to search for community acquired infections, which may eventually, serve as
precursor to hospital acquired infections. From this study it is quite evident that *Enterobacter* spp. may not yet be taken as indicator organism for fecal pollution, but its stronger association with *Escherichia coli*, as compared to its association with other coliform bacteria, at least in non fecal pollution of water sources, make it a well sought after organism.

A more detailed clinical epidemiological study using state of the art of molecular technique would enable us to unravel the mystery of growing reputation of *Enterobacter* spp. as nosocomial pathogen.