Microbes have been around longer than anything else on the earth! Microbes became so good at
survival that they have continued to live on the planet till today and are present everywhere.

Microbes mainly comprise bacteria, fungi, viruses, protozoa and helminths. Very few microbes
are always pathogenic, many microbes are potentially pathogenic, and most microbes are never
pathogenic. However, the present global scenario shows that it is the drug resistant variants/ mutants of
the microbes that now predominate in the health care set-up, and, to a lesser extent, in the community
too.

For the past many decades, clinicians across the world are facing the challenge of the growing problem
of antimicrobial resistance that is recognized globally as a major public health threat. That microbial
resistance will be rampant one day was forecast long back in 1945 by Alexander Fleming who is
credited with discovering the first antibiotic, penicillin.

**Antimicrobial resistance** may be:

I. **Inherent/ intrinsic resistance:**
   - This is a species characteristic, viz. resistance of:
     - Gram-negative bacilli to glycopeptides
     - Gram-positive cocci to monobactams
     - *Proteaceae* to tetracyclines, polymixins, nitrofurantoin
     - *Salmonellae and Shigellae* to 1st and 2nd generation cephalosporins and aminoglycosides
     - Non-fermenting Gram-negative bacilli to ertapenem
     - *Burkholderia sp.* to polymixins
     - Anaerobes to aminoglycosides
     - *Enterococci* to cephalosporins, low level aminoglycosides, cotrimoxazole, clindamycin
     - *MRSA, Enterococcus faecium* and *Stenotrophomonas maltophilia* to carbapenems
     - *Candida krusei* and *C. inconspicua* to fluconazole

II. **Acquired resistance:** By mutation in existing DNA or acquisition of new DNA from other
drug-resistant microbes in the immediate environment.

Selection for antimicrobial-resistant strains occur depending on the environmental conditions, viz.
resistant strains are rare in the community where antibiotic pressure is low, while they dominate in
the hospital environment where the antimicrobial pressure is very high.

**Established and emerging resistant strains** include:

I. *MRSA* (Methicillin resistant *Staphylococcus aureus*), *GISA* (Glycopeptide intermediate sensitive
*S. aureus*), hGISA (heterogeneous GISA), *GRSA* (Glycopeptide resistant *S. aureus*)

II. Methicillin – resistant Coagulase negative *Staphylococci*
Table 1: Eastern India: Prevalent Bugs and their Resistance Pattern (%)

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<tbody>
<tr>
<td>MRSA</td>
<td>35</td>
<td>30</td>
<td>20</td>
<td>18</td>
<td>18</td>
<td>35</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>VRE</td>
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<td>2</td>
<td>5</td>
<td>2</td>
<td>5</td>
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<td>50</td>
<td>68</td>
<td>70</td>
<td>65</td>
<td>50</td>
<td>72</td>
<td>45</td>
<td>68</td>
</tr>
<tr>
<td>AmpC/Co-producer</td>
<td>15</td>
<td>18</td>
<td>20</td>
<td>NA</td>
<td>NA</td>
<td>18</td>
<td>NA</td>
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<tr>
<td>Carb-penem-R Enterobact.</td>
<td>20</td>
<td>18</td>
<td>18</td>
<td>&gt;5</td>
<td>&gt;5</td>
<td>0</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>0</td>
</tr>
<tr>
<td>Carb-penem-R Pseudo.</td>
<td>35</td>
<td>30</td>
<td>40</td>
<td>45</td>
<td>32</td>
<td>25</td>
<td>18</td>
<td>36</td>
<td>12</td>
</tr>
<tr>
<td>Carb-penem-R Acinet.</td>
<td>90</td>
<td>75</td>
<td>75</td>
<td>45</td>
<td>65</td>
<td>35</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Tigecycline-R Acinet.</td>
<td>1</td>
<td>&lt;1</td>
<td>1</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Polymixin-R</td>
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<td>0</td>
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<tr>
<td>Non-albicans Candida</td>
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<td>50</td>
<td>25</td>
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<td>50</td>
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<tr>
<td>Flucona-zole-R Candida</td>
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<td>0</td>
<td>NA</td>
<td>NA</td>
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</table>

III. GRE (Glycopeptide resistant Enterococci)
IV. Penicillin-tolerant/ resistant Pneumococci
V. β-lactamase producing H. influenzae and M. catarrhalis
VI. Gram-negative bacilli, mainly Enterobacteriaceae with ESBL’s (extended spectrum beta-lactamases), OXA’s, AmpC β lactamases; and co-producers of different β lactamases
VII. Carbapenem-resistant non-fermenting Gram-negative bacilli, e.g. S. maltophilia, B. cepacia, Acinetobacter, Pseudomonas strains
VIII. Carbapenem-resistant Enterobacteriaceae, e.g. KPC (Klebsiella pneumoniae carbapenemase) producers, NDM (New Delhi metallo-beta-lactamase)-1 and 2 producers
IX. Polymixin resistance emerging in Gram-negative bacilli
X. Fluconazole-resistant Candida spp. and other fungi

BUGS ARE NOT THE SAME EVERYWHERE

The global scenario shows that Gram-positive infections are more prevalent in the West, viz. infections with MRSA, VRE, Penicillin-R Pneumococcus, C. difficile colitis etc. However, Gram-negative bugs dominate in India and Asia-Pacific region, viz. ESBLs, AmpCs, co-producers and carbapenemases. Variations in regional scenario also occur, viz. different countries in the Asia-Pacific region have different resistant flora; prevalence of ESBLs is highest in India. There occur variations within the country, too - state to state, urban vs. rural, healthcare vs. community, government vs. corporate/private hospitals, primary, secondary and tertiary care hospitals, etc. (Table 1). Local variations occur within a locality, community, different hospitals of a city, different wards of a hospital (ICU vs. general wards; and different ICUs like SICU, CCU, MICU, NICU, PICU, etc. have different infections and bugs).

Infection may be community acquired, hospital acquired (nosocomial) and healthcare associated infection. Nosocomial infection is prevalent in all hospitals of the globe and nosocomial infection (N. I) rate varies between <1 and 10% in different hospitals. However, the rate is higher in developing countries. And, in the hospitals, nosocomial sepsis and its complications are 3-4 times higher in critical care areas compared with the general wards. But, amongst the intensive care units, the coronary care units are the cleanest with infection rates of <1 to 7% compared to rates as high as 35% in units like surgical ITU.

BUGS ARE THE SAME EVERYWHERE

On the other hand, similar pattern of flora and resistant bugs are seen in different countries, different states of a country, different hospitals of a state/city, different wards of a hospital, and in the community. MRSA, VRE, ESBLs, AmpCs, Carbapenemases are seen in almost all hospitals and health care institutions. CA (community acquired)-MRSA, penicillin-resistant Pneumococci and ESBLs are now prevalent in the community of almost all the countries of the world.

EASTERN INDIA: RESISTANCE PATTERN

The author has compiled the data provided by the Consultant Microbiologists of different health institutions of East India, over the last two years. The institutions include five tertiary care corporate hospitals and one private medical college in Kolkata, two corporate hospitals in Guwahati and one private diagnostic centre of Patna. The data is as follows:

The SMART Study, 2007 (published in JAPI, May, 2011) and many other national and international studies show a similar pattern of prevalent bugs and antimicrobial resistance in the private and corporate hospitals of different cities of India. However, data is scarce from charitable, government and rural hospitals of India.

In conclusion, it may be stated that the microbes remain ahead of us as they are genetically better evolved than us. However, man, despite all his limitations, does not want to give up easily the war against the harmful microbes.