and liver cancer. This risk is particularly high in infants and young children who are more likely to develop chronic infections. Public health initiatives should focus on early detection and treatment of hepatitis B, as well as preventive measures such as vaccination and antiviral prophylaxis for pregnant women to prevent mother-to-child transmission.

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ANTIMICROBIAL NOSOCOMIAL RESISTANCE ON ESKAPE PATHOGENS

Introduction

Antimicrobial resistance (AMR) is now a global concern. Furthermore, the global and rapid spread of multi-drug-resistant (MDR), extensively drug resistant (XDR) and pan-drug resistant bacteria (PDR), which cannot be treated using the current antimicrobials and other drugs that we have in our arsenal is frightening as even common infections can become life-threatening to living populations.

The ESKAPE pathogens (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter species)* are critical not only because they cause the majority of nosocomial infections, but also because they represent transmission, pathogenesis, and resistance paradigms [1]. The World Health Organisation (WHO) developed a list of antibiotic resistant, global priority pathogens to aid the research and development of new and effective antibiotic treatments (World Health Organisation, 2024). Established according to multi-criteria analyses, the list was ranked into three priority tiers: medium, high, and critical.

Within the "Priority 1: Critical" pathogen group on the WHO's priority pathogens list are the multidrug resistant (MDR; bacteria that are resistant to three or more classes of antibiotics) Gram-negative ESKAPE (Rice, 2008) pathogens; *Acinetobacter spp.* (carbapenem-resistant), *Enterobacterales* (third generation cephalosporin resistant and carbapenem resistant), The "Priority 2: High" pathogen group contains the Gram-positive ESKAPE pathogens; *E. faecium* (vancomycin-resistant), *P. aeruginosa* (carbapenems resistant) and *S.aureus* (methicillin-resistant, vancomycin intermediate and resistant). These pathogens contribute significantly to the burden of disease in developed and developing nations and are frequently isolated from clinical settings where they are associated with several life-threatening, hospital-acquired (HA) infections, e.g., bacteraemia, urinary tract infections (UTIs), pneumonia, meningitis, and wound

infections, amongst others, particularly in intensive care units (ICUs). Consequently, infections caused by the ESKAPE pathogens are a leading cause of mortality and morbidity worldwide.

Risk factors for infections include prolonged hospital stays, invasive medical devices, and prior antimicrobial use must be avoided. Effective infection control measures, such as hand hygiene, contact precautions, and environmental cleaning, are crucial in preventing the spread of ESKAPE pathogens.

While there are no licensed vaccines against ESKAPE pathogens, researchers are actively exploring vaccine development using various approaches, including: Machine learning – Researchers have developed a machine learning framework, VacSol-ML(ESKAPE), to predict potential vaccine candidates against ESKAPE pathogens. Glycoconjugate vaccines – Glycoconjugate vaccines, which combine polysaccharide and proteinaceous virulence factors, are being explored for Enterococcus and other ESKAPE pathogens. Protein-based vaccines – Protein-based vaccines targeting specific antigens are being developed for Staphylococcus aureus and other ESKAPE pathogens.

Goal

To study evaluate antimicrobial resistance on ESKAPE pathogens in different countries [2, 3].

Material and methods of research

Collected information from different countries (India, Iran, Belarus, Mexico and United Kingdom) from worldwide antibiotic resistance on ESKAPE pathogenesis.

The results of the research and their discussion

From the data collected, ESKAPE pathogens include both gram positive bacteria (*E.faecium, S.aureus*) which are resistant to vancomycin, linezolid and gram negative bacteria (*K.pneumoniae*, *Acinetobacter spp. P.aeruginosa, Enterobacter species*) which are resistant to carbapenems (meropenem), third generation cephalosporin (ceftizidime) (table 1, 2).

For *E. faecium,* India (>80%), Iran, UK (~25%) have maximum resistance to the drugs vancomycin and linezolid whereas Mexico and Belarus are least resistant (≤10%) to the drugs.

For *S. aureus,* India (>80%), Iran (~50%), Belarus (30%) have maximum resistance to the drugs vancomycin and linezolid whereas Mexico (0%) and UK (~5%) are least resistant to the drugs.

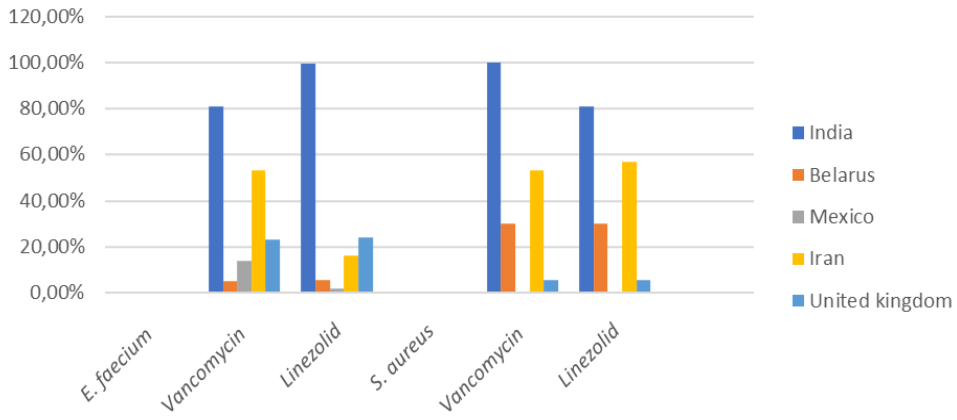

Figure 1 – Represent E.faecium and S.aureus resistant to drugs vancomycin and linezolid in India, Belarus, Mexico and Iran, United kingdom

For *K.pneumoniae,* Belarus, India, Iran have maximum resistant to carbapenems whereas Mexico (1%), UK (0%) have least resistance to the drug. Belarus (92.3%), Iran (89%), Mexico (52%) have maximum resistance to ceftizidime whereas India (25%), UK (13.8%) have least resistance to the drug.

For *Acinetobacter spp.* Iran, Belarus, Mexico have maximum resistance (~90%) to carbapenems and ceftizidime whereas India (~30%), UK (~4%) are least resistance to the drugs.

For *P.aeruginosa.,* Iran (~90%), India and Belarus (~60%) have maximum resistance to carbapenems, ceftizidimes whereas Mexico (24.8%, 52.4%), UK (~6%) are least resistant to the drugs.

For *Enterobacter spp.,* India (75%) and Iran (43%) have maximum resistance to carbapenems whereas Belarus (9.7%), Mexico (1.4%), UK (0%) are least resistant to carbapenems. Iran (92%), Mexico (67.6%), Belarus (46.9%) have maximum resistance to ceftizidime whereas UK (11.1%) is least resistant to ceftizidime.

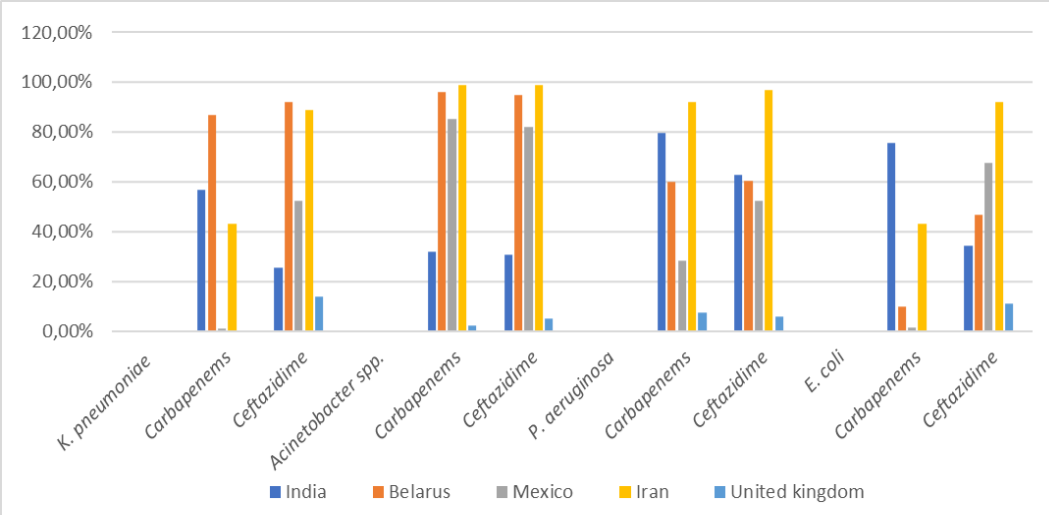

Figure 1 – Represent K.pneumoniae, Acinetobacter spp., P.aeruginosa ., Enterobacter spp. Resistant to drugs carbapenems, ceftizidime, ciprofloxacin, gentamicin in India, Belarus, Mexico, Iran, United kingdom

Conclusions

In the comparative study of different countries India, Iran, Belarus, UK, Mexico antimicrobial resistance in ESCAPE pathogens as follows:

For gram positive bacteria, India has highest resistance to the drugs and Mexico is least resistant to the drugs vancomycin and linezolid.

For gram negative bacteria, Iran has highest resistance to the drugs and UK has least resistance to the drugs carbapenems and ceftizidime.

Antimicrobial stewardship programs can help optimize antimicrobial use and reduce the development of resistance. The development of new antimicrobial agents, such as ceftaroline and ceftolozane-tazobactam, has expanded treatment options for ESKAPE pathogen infection. Combination therapy (Beta lactams, Aminoglycosides, Fluoroquinilones, Colistin) with multiple antimicrobial agents may be effective in treating ESKAPE pathogen infections.

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