THE PREMED SCENE - Virtual Research Competition

PROMPT

The year is **2055**. Antimicrobial resistance (AMR) has escalated into a global crisis, with bacteria and other pathogens becoming resistant to all known medications, leading to the uncontrollable spread of infectious diseases. It is your job to **devise a solution to mitigate the effects of AMR and slow the spread of these resistant diseases.**

You may **only** consider the information stated below when creating your solution. **Your solution may be a biochemical, biomedical, engineering, public health, or political/legal solution.** You can build off current research and knowledge of existing antimicrobial resistance mechanisms and the impact of previous pandemics.

Your results will be different per team, because this condition is not on Google. You may refer to it as the **Pan-Resistant Pathogen Crisis (PRPC)**.

DISEASE DETAILS

Pan-Resistant Pathogen Crisis (PRPC) is caused by a range of bacteria that have acquired resistance to multiple antibiotics, making them untreatable with existing medications. Once-controllable illnesses including tuberculosis, pneumonia, and urinary tract infections have returned as a result of this catastrophe. It is well recognized that the pathogens causing PRPC quickly acquire and transfer resistance genes to one another through horizontal gene transfer, making the control of resistance spreading even more difficult.

PRPC infections are distinguished by their quick start and quick spread. Severe problems may result from infections that impact different body systems. Respiratory infections such as pneumonia and multidrug-resistant tuberculosis can cause breathing difficulties, chest pain, persistent coughing, and respiratory failure. Severe discomfort, fever, and frequent urination are the symptoms of resistant urinary tract infections, which can also induce renal damage or sepsis. Severe diarrhea, cramping in the

abdomen, and dehydration are symptoms of gastrointestinal tract infections caused by resistant microorganisms, which frequently result in potentially fatal illnesses like colitis. Skin and soft tissue infections, such as those caused by MRSA (methicillin-resistant Staphylococcus aureus), can result in painful boils and abscesses, as well as the spread of infection to the bones and organs and sepsis.

PRPC pathogens utilize several sophisticated mechanisms to evade the effects of antibiotics. Efflux pumps are one such mechanism that lowers the intracellular concentration of antibiotics to ineffective levels by ejecting the medication from bacterial cells. These bacteria also generate beta-lactamases, which are enzymes that break down antibiotics and negate their therapeutic effects. A different tactic is target modification, in which the targets of the bacterial cells are changed so that the antibiotics can no longer effectively disturb bacterial operations. Moreover, the development of biofilms shields bacterial colonies from immune system attacks and drug penetration.

There are various phases that these illnesses go through, each characterized by increasing complexity and severity. The initial symptoms in the early stages include localized discomfort, tiredness, and fever. Conventional antibiotics don't work as intended. Treatment is often delayed since early diagnosis is so important but is frequently overlooked. As the infection grows during the intermediate period, symptoms typically get worse. Ineffective therapy leads to problems and secondary infections. Systemic symptoms like a high fever, chills, and excruciating pain are possible for patients. As patients advance to the severe stage, they face systemic symptoms that include multiple organ failure, sepsis, and an increased risk of mortality. Both hospitalization and critical care are necessary. It becomes important to have long-term care and invasive procedures. Finally, the terminal stage results in the spread and uncontrollability of diseases. Mortality rates are extremely high, and palliative care is often the only option. Patients suffer from extreme pain, organ failure, and mental distress.

The effects of PRPC vary depending on the demographic and geographic groupings. Due to their weakened immune systems, small children and the elderly are especially susceptible to this virus. Children are more prone to face a quick progression of disease

and lifelong consequences, whereas older adults frequently have more severe symptoms that contribute to greater death rates. Low-income and marginalized communities also exhibit low immunization rates, a lack of access to healthcare, increased exposure to unhygienic environments, socioeconomic status, and racial disparities. Furthermore, because of their inadequate healthcare systems, limited access to novel drugs, and greater prevalence of treatment-resistant illnesses, less developed nations bear the brunt of the burden. Urban areas spread more quickly due to their larger population density, whereas rural areas struggle with a lack of qualified medical staff and infrastructure.

This virus's advent has had a catastrophic effect on global health and societal structures. Hospitals are overrun by patients suffering from incurable infections, which leads to high rates of inpatient mortality and extended hospital stays. When adequate therapies are unavailable, healthcare providers are obliged to utilize less effective or more hazardous alternatives, which increases the risk of complications and adverse effects. The financial impact is significant due to increased healthcare costs, lower productivity, and the requirement for more expensive and time-consuming therapies. Businesses suffer from high absenteeism and the departure of skilled employees. The quality of life for those who are infected and their families is significantly reduced by the general public's pervasive dread and mistrust of the healthcare system. The potential for social stigma associated with resistant infections.

Due to the complexity and urgency of PRPC, new techniques are needed in many different industries. By investigating antimicrobial peptides, employing bacteriophage therapy, and developing new antibiotics, AMR can be combated biochemically. Biomedical advancements like as vaccinations, prompt diagnosis, and innovative drug delivery can significantly influence the management of antimicrobial resistance. Engineering solutions like sophisticated sanitation systems and wearable infection monitoring devices can stop the development of resistant microorganisms. Public health interventions must include education campaigns, robust surveillance systems, and community-based programs to improve cleanliness and reduce transmission. Political and legal actions such as promoting research, enforcing infection control laws, and limiting the use of antibiotics are essential in the battle against AMR.

By focusing on these areas, your team can develop a comprehensive and innovative strategy to address the Pan-Resistant Pathogen Crisis and mitigate its devastating effects on global health.