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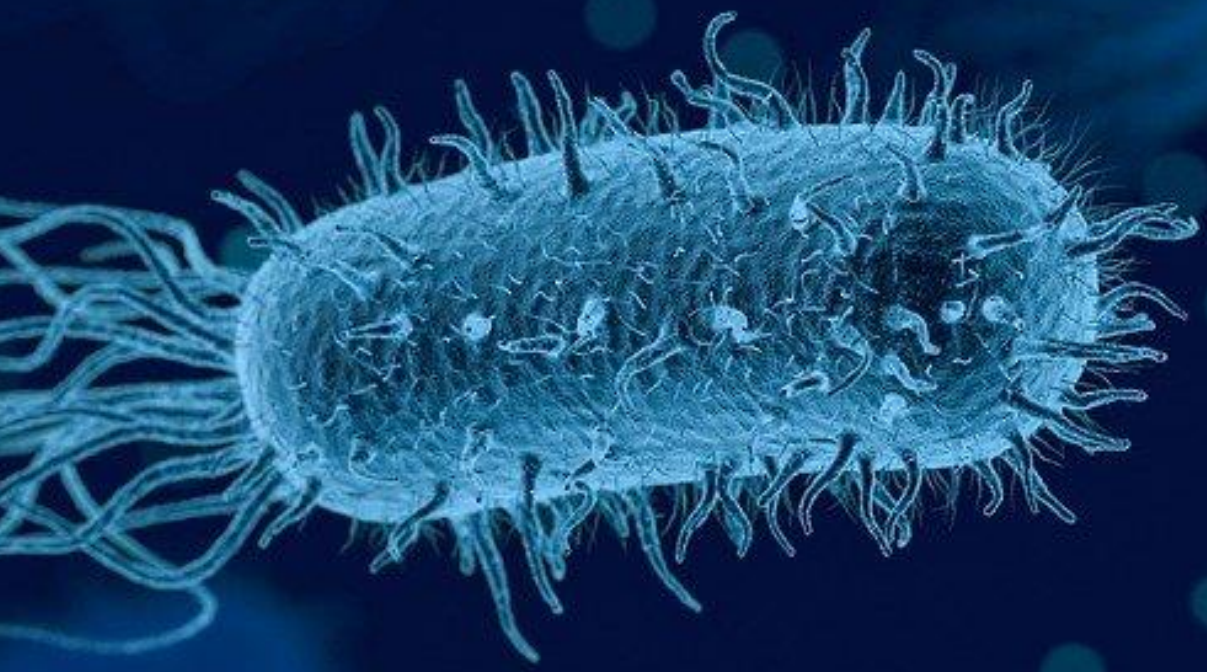
TECHNOLOGY BRIEFINGS



ANTIMICROBIAL RESISTANCE

THE SILENT PANDEMIC

DECEMBER 2021 - SUMMARY

THE JOINT EUROPEAN DISRUPTIVE INITIATIVE

The Joint European Disruptive Initiative (JEDI) is the European advanced research projects agency (ARPA) with a mission to bring Europe in a leadership position in emerging and breakthrough technologies.

To achieve this goal, JEDI is launching GrandChallenges to push the frontiers of science & innovation, with a radical new method based on purpose-driven research, maximum speed, full focus on excellence, deep interdisciplinarity, and bold 'moonshot' risk-taking.

JEDI aims to provide Europeans and free societies with the means of technological and scientific power, for prosperity and societal resilience. Driven by humanistic values, JEDI is focused on solving major societal challenges of our time (environment, healthcare, digital, education, oceans, space) through innovation.

To be always ahead of the curve, JEDI has developed cutting-edge technology foresight and is actively engaged in high-level tech & policy recommendations.

JEDI is working for the common good, powered by more than 4.600 technology and scientific leaders from academia, industry and deeptech startups in 29 countries in Europe and globally. It is fully independent and financed by engaged foundations, companies, individuals and public institutions.

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KEY TAKEAWAYS

AMR is causing **700.000 deaths a year** — a figure that might significantly increase up to **10 million of deaths a year in 2050**.

AMR is accelerating: for antibiotics invented between the 1940s and 1990s, **antibiotic resistance started appearing up to 16 years after their launch; today**, this can happen much quicker, **just weeks or months** after deployment of new antibiotics.

Especially worrisome are MDR (multi-drug resistant) bacteria, that are resistant to different antibiotics.

Current research is insufficient. According to WHO, out of 26 new antibiotics targeting priority pathogens in 2020, **only 7 are considered as truly "innovative"**.

Most **AMR diagnostics** will only be truly effective and scalable once they can provide a relevant result **in just 15-20 minutes.**

WHAT IS AT STAKE

Antimicrobial resistance is a process by which antibiotics are becoming less effective, and therefore rendering some diseases more dangerous. Current antibiotics being unable to treat disease that were easily curable some decades ago is one of the reason for which AMR is causing up to to 700.000 deaths a year — a figure that might significantly increase up to 10 million of death a year in 2050 according to a 2016 report led by Jim O'Neill.

The lack of new antibiotics and the lack of scaled up diagnostics against AMR means that we are currently heading towards enduring a "silent pandemic" related to AMR. Low-income countries are already hit hard by antibioresistance, while current worldwide R&D in antibiotics is still insufficient — not only because many technological frontiers remain to be pushed forward, but also because it does not make much sense economically for pharmaceutical companies to develop new antibiotics.

CURRENT STATE OF PLAY

Antimicrobial resistance is the process of microorganism (a bacterium or a funghus for instance) by which a bacteria develops the capacity to defeat treatments (drugs) that were developed to kill them. A bacteria can become resistant to antibiotics either through mutation or through the acquisition of a resistance gene that confers resistance to one or more antibiotics. In those cases, the antibiotic-resistant germs can become impossible to treat.

Most microbes are pretty harmless towards the human organism. But for those that are damaging to the human body (such as the bacteria causing strep throat), themselves becoming antibiotic resistant means that the most common way to treat them (eg using antibiotics) becomes less efficient, or even useless.

This is very concerning since scientists and medical doctors still rely strongly on these very antibiotics that are less and less effective. Even more worryingly, AMR spreads always quicker, sometimes just weeks or months after the launch of new antibiotics. The growing resistance of bacteria against current antibiotics have also led some of them to be multidrug

resistant (MDR) bacteria, on which different antibiotics are now inefficient.

Such a resistance is mostly fueled by the overuse and antibiotics (in human prescription) and the use of animal growth hormones. In the first case, it means that better diagnostic is essential to avoid the (over)prescription of antibiotics when they are not needed. In the second one, the fact that antibiotics used to feed livestock end up in the meat consumed by humans leads to the development of resistance to bacteria in the meat-eater's organisms.

SCIENTIFIC & TECHNOLOGY FRONTIERS

AMR being a multifaceted issue, the technological and scientific frontiers are numerous.

Providing better diagnostics to limit the overuse of antibiotics is critical to limit antibiotic resistance.

Another self-evident pathway relates to the development of new antibiotics. This is even more important since a recent review by WHO of R&D in antibiotics found that few of them were addressing the most pressing issues (multidrug-resistant gram-negative bacteria, pathogens like carbapenem-resistant Acinetobacter baumannii, oral antibiotic options for multidrug-resistant infections that would allow patients to be treated outside of hospitals).

Fighting against bacterial infections and AMR may also possible through vaccination: pneumococcal vaccination, that has diminished antibiotic resistance for this bacterium, is a good example that AMR can be fought by other means than purely new antibiotics.

Some other promising ways to limit AMR are phage therapies (killing bacteria by using specific viruses, phages) to eliminate a specific bacterial species, potentiation (altering another, often non-essential component of the bacterium in order to make the organism more susceptible to antibiotics), host modulation (monoclonal antibodies, targeting a specific bacteria), and membrane transporters (body mechanisms that adjust the circulation of ions or molecules — in the case of AMR, this mostly has to do with regulating iron, which is essential for bacteria to survive).

Nothing in life is to be feared,

it is only to be understood.

Now is the time to understand more,

so that we may fear less.

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