OPPORTUNITY 7

SCOPE TRANSITIONAL

UNCERTAINTIES

Technology, Collaboration

MEGATRENDS

Advanced Health and Nutrition

TRENDS

Artificial Intelligence
Biotechnology
Mobilising Innovation
Nanotechnology
Sensor Technologies

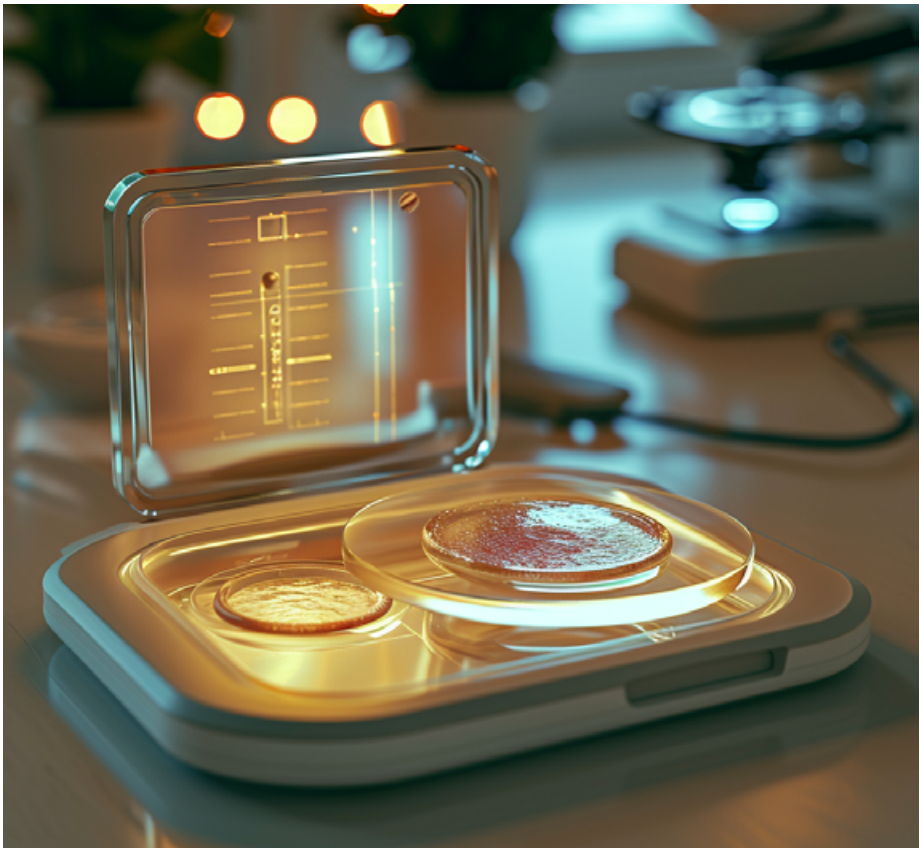
SECTORS IMPACTED

Agriculture & Food
Chemicals & Petrochemicals
Communication Technologies & Systems
Consumer Goods, Services & Retail
Data Science, AI & Machine Learning
Health & Healthcare
Manufacturing
Materials & Biotechnology

What if we knew about infections in seconds?

PETRI DISH ON THE GO

Portable devices and advanced nanotechnology allow real-time identification of bacteria, enabling more precise and timely treatment and the bypassing of lengthy bacterial culture tests.

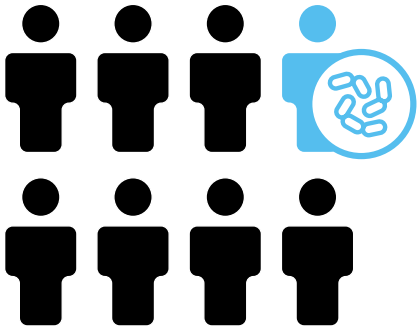


WHY IT MATTERS TODAY

Although they have saved millions of lives, the overuse and misuse of antibiotics in humans and animals have given rise to antimicrobial-resistant strains of bacteria.[301] Recent global estimates put deaths related to antimicrobial resistance at 1.27 million in 2019, with a further 4.95 million indirect deaths.[302] Bacterial infections, both antimicrobial susceptible and resistant, cause 1 in 8 deaths worldwide annually, the second leading cause of death after ischaemic heart disease.[303] Over half of those deaths were due to five types of bacteria, including Staphylococcus aureus, Escherichia coli, and Streptococcus pneumoniae.[304]

To accurately identify the bacteria causing an infection, a culture test is usually conducted through a sample or swab taken from the throat, nose, urine, phlegm, blood, stool, or wound.[305] The key to a bacterial culture test is that a substantial number of bacterial cells are needed, which most initial samples lack.[306] Thus, these samples are cultivated in a laboratory for one to five days or more until sufficient cells are grown for testing.[307] Samples cultivated for tuberculosis typically take 40 days.[308]

Besides delayed diagnosis because of testing, 47% of the global population have little or no access to diagnostics for infectious or communicable diseases.[309] There is a need to improve the quality of laboratory testing accuracy,[310] particularly in medium- to low-income countries, and to reduce turnaround times in efforts to resolve antimicrobial resistance and reduce deaths due to infections.[311]



Bacteria causes 1 in 8 deaths worldwide annually

OPPORTUNITY

Portable devices enable the immediate and precise identification of bacterial strains without the need for long culture testing and growth. Miniaturisation, advanced computing, and advanced machine intelligence with access to a global microbiome database make real-time identification of bacterial infection and treatment strategies a possibility.

While approaches may differ depending on where the infection is present,[312] there are some advances that hold promise. Molecular diagnostics are meant to provide faster, more sensitive alternatives to traditional culture tests at the molecular level, i.e. DNA, RNA, or proteins recently illustrated in polymerase chain reaction (PCR) testing during the COVID-19 pandemic.[313] A next-generation Raman (spectroscopy) microscope[314] also holds promise in picking up different biological markers on cells and tissues,[315] and inkjet printing technology has inspired a new technique whereby the light reflecting from bacterial cells in dots of blood is isolated and amplified by nanotechnology, allowing, by machine learning, identification of bacteria from the spectra.[316]

BENEFITS

Affordable, portable testing devices improve healthcare in lower-income and remote areas. Rapid diagnosis reduces the costs and negative impacts of unnecessary antibiotic treatments, limiting the spread of antimicrobial-resistant strains and contributing to improved global health outcomes.

RISKS

Increased ease of testing, without corresponding advances in antibiotic development, results in the broader use of a variety of antibiotics, which in turn leads to more prevalent antimicrobial resistance. Misdiagnoses result from false-positive or false-negative test results, i.e. type I or type II errors.

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