What if a single breath diagnosed communicable diseases and automatically triggered treatment?

09

Breath of Intelligence

Within Reach | **Transitional** | Visionary

Autonomous nanobiomaterial-based breath diagnostics enable rapid and precise detection of communicable diseases, automatically initiating personalised treatment.

UNCERTAINTIES

Systems, Technology

MEGATREND (Most significant)

Advanced Health and Nutrition

TRENDS

Bioinformatics
Biomaterials
Mobilising Innovation
Neuroscience
Precision/Personalised Medicine

TECHNOLOGIES

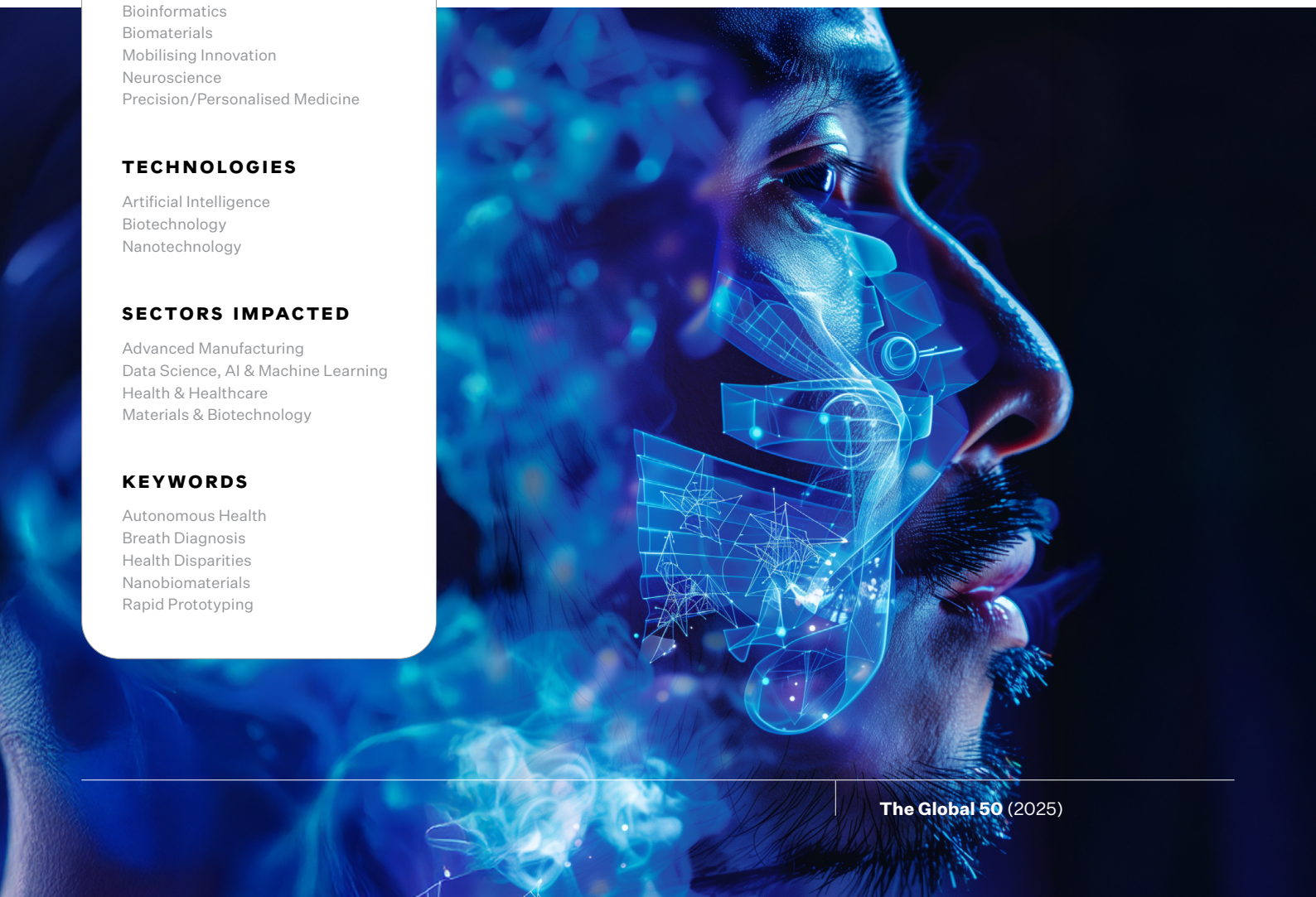
Artificial Intelligence
Biotechnology
Nanotechnology

SECTORS IMPACTED

Advanced Manufacturing
Data Science, AI & Machine Learning
Health & Healthcare
Materials & Biotechnology

KEYWORDS

Autonomous Health
Breath Diagnosis
Health Disparities
Nanobiomaterials
Rapid Prototyping



WHY IT MATTERS TODAY

GenAI achieved

90%

accuracy in diagnosing medical conditions, while doctors using **conventional medical diagnosis scored**

74%

Global health disparities remain significant across regions, with many populations facing barriers to accessing quality healthcare services. Global life expectancy variations are stark, with up to 30-year differences between countries such as Japan and Nigeria.[617] Even within single cities, life expectancy can vary by up to 20 years between neighbourhoods.[618] These disparities often stem from socio-economic, geographical and cultural factors, leading to unequal health outcomes and a widening gap in health equity.

Diagnostic errors contribute significantly to patient mortality and morbidity. In the United States, an estimated 371,000 deaths and 424,000 permanent disabilities each year because of diagnostic errors.[619] Many diseases present with non-specific symptoms, such as weight loss, fatigue, pain, and loss of appetite, or have complex secondary effects, making them challenging to diagnose using traditional methods.[620]

Artificial intelligence (AI) systems demonstrate superior diagnostic accuracy compared with conventional medical diagnosis. In one study covering emergency medicine, family medicine, and internal medicine,GenAI alone performed better than doctors at diagnosing medical conditions, achieving 90% accuracy, while physicians using conventional methods scored 74%.[621] Even when physicians had access to AI assistance, their performance only marginally improved, to 76%.[622]

Using breath for diagnosis is not new. The technique has been tested with tuberculosis,[623] COVID-19,[624] influenza,[625] fungal infections,[626] malaria[627] and some bacterial infections,[628] especially in the gut.[629] For example, highly sensitive nanomaterial-based sensors can detect pathogen-specific volatile compounds in exhaled breath.[630]

THE OPPORTUNITY

Nanobiomaterials (i.e. nanostructured materials for biomedical applications[631]) enable autonomous diagnosis and treatment initiation through a person's breath.[632] As diagnostic sensors, nanobiomaterials can be incorporated into handheld devices[633] and wearables[634] or they can be integrated into homes or healthcare spaces.

While rigorous clinical trials remain essential, advanced machine intelligence enhances both diagnosis[635] and materials design.[636] Training on vast datasets of breath profiles from both healthy individuals and those with various disease profiles enables accurate diagnosis, predicts disease progression,[637,638] and triggers treatment protocols.[639] Additionally, 3D printing could accelerate the development and deployment of devices[640] and enable customisation based on local disease patterns across geographies.[641]

BENEFITS

Accessible health; improved disease outbreak prevention; enhanced treatment; improved health outcomes.

RISKS

Misdiagnosis; bias in training data; poor detection due to weakening sensor materials over time; despite diagnosis, treatment remains inaccessible.