



What if fungal fuel cells powered medical devices in remote communities?

03

Power Fungi

Within Reach

Transitional

Visionary

UNCERTAINTIES

Nature, Technology

MEGATREND (Most significant)

Materials Revolution

TRENDS

Biomimetics

Communicable & Non-communicable Diseases

Longevity & Vitality

Mobilising Innovation

TECHNOLOGIES

Fuel Cells

HealthTech

Sensor Technologies

SECTORS IMPACTED

Agriculture & Food

Communication Technologies & Systems

Government Services

Health & Healthcare

Materials & Biotechnology

KEYWORDS

Chronic Disease Management

Fungal Fuel Cells

Off-Grid Medical Technology

Remote Diagnostics

Rural Healthcare

Bioelectricity generated by fungi powers small medical devices in remote areas, letting doctors check on patients even where there are limited sources of micropower, allowing advanced monitoring capabilities in previously unreachable areas.





WHY IT MATTERS TODAY

While the global rural population today consists of 3.4 billion people, it is projected to decline to 3.1 billion by 2050, with China and India having the largest rural populations.⁵¹⁰ In the Middle East and North Africa, following a period of steady migration, only 37% of the population lived in rural areas in 2023 compared with 66% in 1960.⁵¹¹ Nevertheless, despite these reductions, the number of people living in rural areas in the future will still be significant.

Rural residents are affected by chronic disease more than people living in urban areas. In a study carried out in China in 2015, rural residents had a higher prevalence of chronic disease than urban residents, at nearly 83% and 80%, respectively.⁵¹² Similarly, in the United States, the 46 million Americans (13.8% of the population)⁵¹³ living in rural areas face higher rates of premature death from heart disease, cancer, lung disease, and stroke.⁵¹⁴

Implementing behavioural interventions for chronic disease prevention in rural areas is often challenging.⁵¹⁵ Due to technological and staffing barriers, rural areas face a shortage of healthcare specialists and primary care providers, and residents have limited access to the network connectivity that could help them seek healthcare remotely.⁵¹⁶ Nearly 70% of people without internet access (2.6 billion globally) live in rural areas.⁵¹⁷



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THE OPPORTUNITY



BENEFITS

Increased access to healthcare;
sustainable, low-cost electricity
generation from organic waste;
support for disaster relief;
reduced battery waste.



RISKS

Potential biosafety concerns
with fungal species; reduced cell
performance over time; potential
toxicity and pathogenic infection.

Mycelium cells within fungi produce bioelectricity through cellular interaction with other living cells.⁵¹⁸ Fungal fuel cells (FFCs) power small medical devices in rural, off-grid locations that do not have consistent micropower sources, such as batteries, enabling remote diagnostics and healthcare monitoring. Using technologies ranging from digital stethoscopes and electrocardiogram monitors to ultrasound probes and implantable medical devices,⁵¹⁹ healthcare providers in community-based healthcare services can remotely assess people and share diagnostic data with other global experts for evaluation.

FFCs generate electricity by breaking down biomass (i.e. organic materials such as wood, leather and paper)⁵²⁰ using an anode that contains fungi and a cathode that allows proton and oxygen exchange.⁵²¹ These cells can provide power as long as biomass or organic waste is available,⁵²² offering longer operational lifetimes than batteries and supporting the use of portable medical equipment in rural areas, field clinics, and disaster relief efforts.





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