Innovation at the Interface of Nanotechnology and Diagnostics

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Respiratory infections remain a leading cause of morbidity and mortality worldwide, particularly among patients with chronic respiratory diseases (CRD). Each year, more than three million CRD patients die prematurely, often from respiratory infections1,2. Many of these infections are bacterial and increasingly drug-resistant, resulting in one CRD-related death every minute. CRDs are now the third leading cause of death among non-communicable diseases, accounting for over 112 million lost Disability-Adjusted Life Years (DALYs) annually3.

For clinicians, timely identification of pathogens remains a critical bottleneck. No decentralized diagnostic tools currently exist at the point of patient entry, such as emergency rooms or primary care, that can provide rapid, reliable, and accurate results. Gold-standard methods like qPCR and culture require hours to days, delaying clinical decisions and driving empirical antibiotic use, and further fueling antimicrobial resistance (AMR).

At the interface of nanotechnology and biomedical innovation, IPLEXMED is developing NEXAGUARD®, a graphene-based, AI-integrated molecular diagnostic platform that enables rapid, and multiplexed detection of respiratory pathogens and AMR markers directly from non-invasive sputum samples at the point of care. The system employs smart disposable cartridges with integrated graphene field-effect transistor (GFET) sensors, capable of performing automated on-chip sample preparation followed by target detection through functionalized graphene.

Delivering laboratory-grade accuracy within 20 minutes, this platform bridges molecular precision with digital connectivity, supporting evidence-based treatment while reducing hospitalization rates, healthcare costs, and environmental impact.
Beyond respiratory infections, the sensing modular architecture of NEXAGUARD® can be scaled for other genetic-based disorders and infectious diseases, paving the way for a new generation decentralized diagnostic technologies that combine molecular precision, portability, and sustainability at the front line of patient care.

References

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[3] World Health Organization. (2021). Global health estimates: Leading causes of death

Figures

Figure 1. Nexaguard® Diagnostic platform.