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Technology landscape and challenges of high throughput vs POC diagnostics

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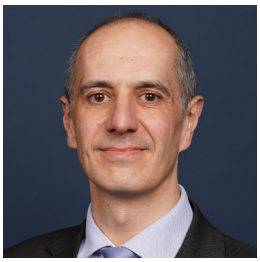

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As the world begins to understand, SARS-CoV-2 poses several unique challenges. Asymptomatic and infected individuals are highly contagious and present unprecedented viral transmissibility. As countries and markets try to fully understand the economic impact of the pandemic, the value of a rapid diagnostic test for a rapidly spreading virus has never been more clearly demonstrated. The IATA projects that worldwide, the airline industry alone will see 2020 full year passenger revenues plummet by $252 billion, or 44% below 2019's figure.

In the absence of a vaccine or a treatment for SARS-CoV-2, the only strategy against the spread of the novel coronavirus is to "detect and isolate." While the number of new cases continues to rise throughout the world, there is a clear escalation of technologies and products to detect SARS-CoV-2. Given the nature and scale of the pandemic, we expect diagnostic trends such as access to point of care, connected systems, and innovative sample collection techniques to accelerate the market landscape.

Currently, the primary opportunity for high-throughput COVID-19 testing remains laboratory-based platforms located at centralized medical centers and large hospital pathology departments. Such high-volume systems produced by Roche and Thermo Fisher are well designed for the task, but the coronavirus has highlighted inherent disadvantages such as the time to results and the need for high genetic content. Additionally, these conventional systems remain slow to adapt or evolve with the ever-increasing molecular characterization of the viral pathogen and resulting disease biomarkers. BGI, a Chinese genetic testing company, has received FDA clearance for their SARS-CoV-2 assay with a reported capacity of producing 600,000 assays daily.

A well-established disadvantage of high-throughput testing is total time to results. Getting a sample to a centralized testing facility can take a significant amount of time, depending on the circumstances. Even once the sample is received, the sample preparation and the run time of the instrumentation can take between 3 to 6 hours. With anecdotal stories of patients waiting days for a result and the population level for asymptotic individuals remaining unknown, the likelihood of increasing community transmission is great.

Additionally, although high-throughput systems are highly accurate in detecting viral DNA or RNA signatures, there must be sufficient genetic material of the virus present in the collected patient sample. Experts claim that SARS-CoV-2 takes longer to produce the sufficient amount of genetic material for these PCR-based systems to detect. This means there is a high probability that people early in their infection might be misdiagnosed by these methods.

Finally, the costs of capital equipment, facilities, and trained staff must be considered when evaluating scalability and accessibility in lower resourced geographies. This is true especially in the case of SARS-CoV-2, where it's expected to have a devastating impact to developing countries in East Asia and Africa in the coming months.

In light of these pitfalls, medical diagnostic companies have developed Point-of-Care (POC) technologies to identify infectious diseases (pulmonary, STDs, meningitis) in the clinical setting, generally delivering results in 1-3 hours. In response to SARS-CoV-2, the United States Human and Health Services (HHS) has multiple active request for proposals (RFP) to promote and accelerate rapid, POC assays. Abbott Lab's ID NOW platform and Cepheid GeneXpress both have recently received FDA emergency use authorization approval. The existing widely available distribution of both systems globally is expected to be a key factor to success moving forward.

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There is a possibility that these instruments may not be as accurate as the sophisticated high-throughput laboratory methods. Some may bias to false-positive or false-negative results depending on how specific and sensitive the technology. Regardless, physicians will always consider laboratory test results in the context of clinical observations and epidemiological data before making a final diagnosis and patient management decisions.

The promise of a rapid, POC test as the key to containing the SARS-CoV-2 virus is achievable. Nonetheless, key challenges will continue to be assay costs and tool availability. With tests currently priced between $100 to $300, innovative design, sourcing, and production volume will be key to bringing down costs. In 2012, the Gates Foundation worked with Cepheid to bring down the cost of a MTB/RIF cartridge from $16.86 to $9.98 for 145 countries. This program helped to place over 10,000 GeneXpress tools worldwide. The latest anecdotal details have emerged that Cepheid's recently approved CoV-2 test will be priced at $20 for developing countries.

Developers of POC assays must carefully balance efficiency and complexity while aiming to reduce cost and simultaneously satisfying stringent quality assurance requirements. The necessary financial and resourcing investments in R&D, including clinical trials, as well as the convoluted logistics to manufacture and transport the detection assays to the location of care also play a major role. In most cases, there are significant opportunities for cost reduction that require a fresh perspective on cartridge and/or system design. Innovators and disruptors are on the horizon to bring novel technologies to market amid the outbreak.

Mesa biotech (San Diego, now owned by Sekisui Diagnostics, Japan) have a hand-held, single-use, uniquely portable molecular diagnostics platform, with the advantage that the instrument can be assembled next to the patient, e.g. on a home visit needed by a vulnerable patient. They have received $500,000 of BARDA funding to develop COVID-19 tests.

Ativa Medical, out of St. Paul MN, has developed a proprietary technology designed for ease-of-use in a clinical setting to produce highly accurate and fast results from a finger stick. Ativa CEO, David Deetz, discussed with us at the Tricon Molecular convention in San Francisco that the initial application for this POC technology is focused on CBC blood analysis. However, he believes the unit could be trained to identify viral components such as COVID-19.

With the benefit of hindsight, we have the luxury of seeing the massive financial and economic impact of the current pandemic and can quantify the value of a widely available rapid point of care assey. It's not too difficult to envision a not distant future, where a nasal swab will be part of airport security checks. Connectivity, data security, and rapid testing will be key components to manage the current and future outbreaks.

As a follow up, we will address the role data and connectivity will have to drive innovation and development in diagnostics for the next decade. Ximedica is actively engaged with stakeholders across academia, startups, government agencies, the investment community, and major MedTech companies to bring together ideas, resources, and expertise. Join the conversation today.

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Ximedica is a full-service ISO 13485-certified and FDA-registered product development firm. For 30 years Ximedica has provided a unique growth platform enabling organizations to successfully deploy medical technology products into the market.

A CALL TO ACTION

Diagnostics Innovation @ Ximedica

SARS-CoV-2 is the diagnostic industry's 'moonshot' moment. Breakthroughs required to substantially increase diagnostics performance or dramatically reduce costs require an 'innovation leap'. Successful examples are the disruptive innovation of lateral flow tests that transferred a previously complex central laboratory test into a handheld inexpensive product (e.g. pregnancy tests or drugs of abuse tests).

Future preparation for pandemics requires molecular diagnostics tests (or even sequencing) to become ubiquitous and inexpensive. Often the innovation leap requires cross-pollination of ideas: transfer of technologies from one technical area into another where the innovation has the needed impact.

Traditionally, IVD companies are fully focused in their own technical fields, a necessary mindset required to achieve excellence of performance and consistent quality manufacture. However, such a repeatable quality mindset is by definition opposed to a mind-set of innovation. Medical diagnostic design and development consultancies with decades of relevant experience, like Ximedica, offer a broad and diverse lens to see beyond the technical challenges and deliver those innovative solutions for our clients required to acheive the needed preparedness for the next pandemic.

Reach out to Juan Roman (jroman@ximedica.com) and Rick Sherak (RSherak@ximedica.com) to learn more about Ximedica's design and engineering capabilities, market research and usability studies, and 70,000 sq. ft. of manufacturing space which can de-risk and accelerate your 'moonshot' product development.