Enzo Biochem, Inc.

Enzo's Emergency Use Authorized AMPIPROBE® SARS-CoV-2 Test System

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Kara Cannon
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Background

The current Coronavirus (COVID-19) pandemic has brought to the forefront numerous challenges facing clinical laboratories, which play a central role in combating this virus. Enzo is assisting those on the frontlines of the crisis by offering the scientific and healthcare communities the necessary tools and support needed to tackle this disease from different angles across research, diagnostics, therapeutics, and clinical services. The current global health crisis has revealed systemic issues inherent in our healthcare system, including those facing clinical laboratories such as:

1. Availability of reagents authorized by the Food and Drug Administration (FDA) under an Emergency Use Authorization (EUA)
2. Manufacturing and supply limitations
3. The inability to use third-party reagents on existing closed diagnostic platform

Enzo's Approach

Addressing the availability of EUA authorized reagents

The Emergency Use Authorization from the FDA enables authorized laboratories to use products without requiring additional validation of reagents. Enzo's EUA approved AMPIPROBE® SARS-CoV-2 Test System is a complete workflow solution designed for the molecular detection of SARS-CoV-2 virus that includes:

1. AMPICOLLECT™ for sample collection*
2. AMPIXTRACT™ SARS-CoV-2 Extraction Kit for sample processing - nucleic acid extraction from patient specimens
3. AMPIPROBE® SARS-CoV-2 Assay Kit and Controls for amplification and detection

** Note: AMPICOLLECT™ sample collection is not required by the FDA but it is manufactured by Enzo to offer a complete integrated solution with EUA authorized products. It is equivalent to sample collection offered by competing brands.*

Addressing Manufacturing and Supply Limitations

Capacity and supply limitations have arisen in the diagnostics market since the outset of the COVID-19 pandemic. Enzo manufactures high quality products, reagents and supplies by utilizing in-house expertise, technology, Intellectual Property (IP), and Research and Development (R&D). Manufacturing of all reagents and supplies, from sample collection to sample processing, amplification and detection, are completed at Enzo's GMP-certified facilities.

Sample Collection

Enzo manufactures its own sample collection kit, AMPICOLLECT™, at its GMP-certified facilities. A clinical trial was conducted at Enzo Clinical Labs to compare samples collected with AMPICOLLECT™ versus competitors' sample collection products. The performance of Enzo's sample collection kit was comparable to and, in some cases, better than competitors' sample collection products.

AMPICOLLECT™ can be used to collect any upper respiratory specimens (such as nasal, mid-turbinate, nasopharyngeal, oropharyngeal swab specimens and nasopharyngeal wash/aspirate or nasal aspirate specimens). AMPICOLLECT™ sample collection can be used with AMPIPROBE® SARS-CoV-2 Test System, which is our EUA authorized full reagent solution for sample processing, amplification and detection of SARS-Cov-2. Specimens collected using AMPICOLLECT™ can also be processed with other manufacturers' nucleic acid extraction systems (e.g., Qiagen's QIAsymphony® SP) and then processed for detection.

Sample Processing - Nucleic Acid Extraction

The AMPIXTRACT™ SARS-CoV-2 Extraction Kit utilizes magnetic-beads technology for isolation and purification of viral RNA, from any upper respiratory specimen. Magnetic-beads technology enables high-quality purification of nucleic acids that are free of proteins, nucleases, and other impurities. The purified nucleic acids are ready for direct use in downstream applications, such as amplification and qualitative detection of viruses or microorganisms in biological specimens, enzymatic reactions or for storage for later use.

The flexible kit design can be readily applied to manual or lower throughput extraction processes as well as to automated high-throughput extraction processes such as with Enzo's GENFLEX™ platform (Figure 1). This kit is intended to be used in combination with Enzo's EUA authorized AMPIPROBE® SARS-CoV-2 Assay and Controls Kit but can also be used in combination with other manufacturers' collection (e.g., Universal Transport Media) or detection kits.

Sample Amplification and Detection

The AMPIPROBE® SARS-CoV-2 Assay Kit is a multiplexed assay that contains two primer/probe sets specific to different SARS- CoV-2 genomic regions and primers/probes for positive and internal controls.

These reagents are packaged as ready to use kits for high to medium throughput processing, but can also be used for manual processing in settings that only require the processing of a handful of samples (Figure 1). Regardless of the scale, these kits provide reliable performance with high sensitivity. An internal control is built into the test kit to ensure proper results and deliver reduction in false negative results.

This kit is intended to be used in combination with the AMPIXTRACT™ SARS-CoV-2 Extraction Kit but for flexibility and mindfulness of supply, Enzo has also validated these components for use with other manufacturers' collection products (e.g., Universal Transport Media) and extraction kits (e.g., Qiagen DSP Virus/Pathogen Midi Kit) on third party instruments (Qiagen QIAsymphony® SP), (Figure 1).

Addressing the inability to use of third-party reagents on existing closed diagnostic platforms

One common issue faced by clinical laboratories is the inability to use third-party diagnostic reagents on their existing closed diagnostic platforms. In response, Enzo has received Emergency Use Authorization for the AMPIPROBE® SARS-Cov-2 Test System to be used with three distinct workflows based on laboratory needs:

1. **High-throughput Fully Automated Solution**
   Enzo's proprietary extraction and detection reagents along with GENFLEX™ an automated sample-to-result open molecular diagnostics system.

2. **Medium to Low-Throughput Automated Solution**
   Enzo's proprietary reagents for detection and analysis in conjunction with the Qiagen's automated QIAsymphony® SP for nucleic acid extraction.

3. **Low Throughput Manual Solution**
   Manual workflow using Enzo's extraction and detection reagents.

Figure 1

Instruments	EUA Authorized Reagents
HIGH THROUGHPUT SOLUTION	
GENFLEX™ Platform (sample processing, amplification and detection) 	AMPIXTRACT™ SARS-CoV-2 Extraction Kit (EUA) AMPIPROBE® SARS-CoV-2 Assay Kit (EUA) AMPIPROBE® SARS-CoV-2 Controls (EUA)
MID to LOW THROUGHPUT SOLUTION	
QIAsymphony SP (Qiagen®) for extraction + QuantStudio® 5 (Applied Biosystems®) for amplification detection 	QIAsymphony DSP Virus/Pathogen Midi Kit (Qiagen®) AMPIPROBE® SARS-CoV-2 Assay Kit (EUA) AMPIPROBE® SARS-CoV-2 Controls (EUA)
MID to LOW THROUGHPUT SOLUTION	
Manual + QuantStudio® 5 (Applied Biosystems®) 	AMPIXTRACT™ SARS-CoV-2 Extraction Kit (EUA) AMPIPROBE® SARS-CoV-2 Assay Kit (EUA) AMPIPROBE® SARS-CoV-2 Controls (EUA)

GENFLEX™, Enzo's First Automated High-Throughput Open Platform

In addition to manufacturing reagents, Enzo developed GENFLEX™, its first automated molecular diagnostics platform for easy and accurate processing of common molecular diagnostic tests within a clinical production setting. GENFLEX™ is a reliable, high-throughput, open, scalable, adaptable, and fully automated system that offers a complete solution from sample-to-result, while delivering efficiency and flexibility at a lower price point than competing systems. We are currently using our EUA authorized AMPIPROBE® SARS-CoV-2 Test System (AMPIXTRACT™ SARS-CoV-2 Extraction Kit, AMPIPROBE® SARS-CoV-2 RT-PCR Assay Kit, AMPIPROBE® SARS-CoV-2 Controls) on the GENFLEX™ at our full service, CLIA-certified clinical laboratory, Enzo Clinical Labs, to satisfy the needs of Coronavirus testing. In addition, GENFLEX™ supports a comprehensive menu of molecular assays including the high volume tests typically performed in clinical laboratories, such as HPV, Women Health Panel (Chlamydia, Gonorrhea, Trichomonas, Bacterial Vaginosis, Candida, Ureaplasma, Mycoplasma), and Viral Load (HIV, HBV, HCV).

By leveraging all of Enzo's expertise and capabilities and by employing our own reagents and technology, Enzo is able to deeply understand the needs of the clinical laboratory and to develop compelling solutions, like GENFLEX™, that address those needs. Enzo is currently working towards providing complete support for customers in connection with building inventory of instruments, consumables, customer service, technical and service support.

About Enzo

Enzo's Comprehensive COVID-19 Program is indicative of Enzo's ability to respond to the current challenges plaguing the healthcare market. The integrated company structure provides Enzo with an advantage of having direct access to patients while keeping control of the testing reagents and supply chain. Enzo utilizes its technological and research and development capabilities, manufacturing infrastructure strength, and clinical diagnostic knowledge to develop products that address gaps in performance, cost, obtainability and safety. Enzo is one of few companies to incorporate a biotech entity, diagnostics division, and a CLIA certified clinical laboratory within the same company. Enzo has addressed challenges of the supply chain by manufacturing all of its reagents in-house. Its diagnostics equipment and kits are proven in its own lab prior to being released for sale in the marketplace for other labs and end users.