Enzo Biochem Inc.

Comprehensive COVID-19 Program

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BACKGROUND:

The current global health crisis shines light on the systemic issues inherent in our healthcare system. From chasms within the supply chain to lack of readiness, staff and capacity, the Coronavirus pandemic has brought numerous inadequacies to the forefront. The central importance of the clinical laboratory as well as supply within the healthcare ecosystem has been diminished in recent years by government and regulatory bodies. While many believed there was an overcapacity of testing capabilities, the opposite has proven to be the case. The clinical laboratory is the one who must provide the testing, processing and detection/analytics for the entire market.

Based on the amount of diagnostic capital equipment in the marketplace, more than 20 million molecular diagnostic tests per day should be feasible within the United States. Closed diagnostic systems offered by the leading diagnostic companies have exacerbated the issues. These closed platforms provide little or no flexibility with regards to their workflow, enforce restrictive and limited supplier relationships, and have no direct connection with the patient or the event. These underlying problems have manifested themselves in the current COVID-19 crisis.

ENZO APPROACH:

We are offering molecular diagnostic testing, and serological "antibody" diagnostic testing for the novel Coronavirus, and are working on repurposing a drug candidate in our pipeline for the treatment of COVID-19. 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 critical reagents in-house. Enzo's diagnostics equipment and kits are validated in its own lab prior to being released for sale in the marketplace for other labs and end users. Enzo is a fully integrated company with a comprehensive, end-to-end solutions for modern clinical diagnostics.

Molecular detection of the Coronavirus is the first line of defense in identifying infection. SARS-CoV-2 detection is performed using the GENFLEX™ Platform with its interlocking modules that include: AMPICOLLECT™ Collection Kit, AMPIXTRACT™ Extraction Kit, and AMPIPROBE® Detection Kit.

Serological testing, while it should not be the sole basis for diagnosing COVID-19 can play an important role in identifying individuals who have overcome an infection in the past and developed an immune response. Detection of the body's immune defense response – "antibody detection" – is performed using the Enzo IgG/IgM ELISA assay.

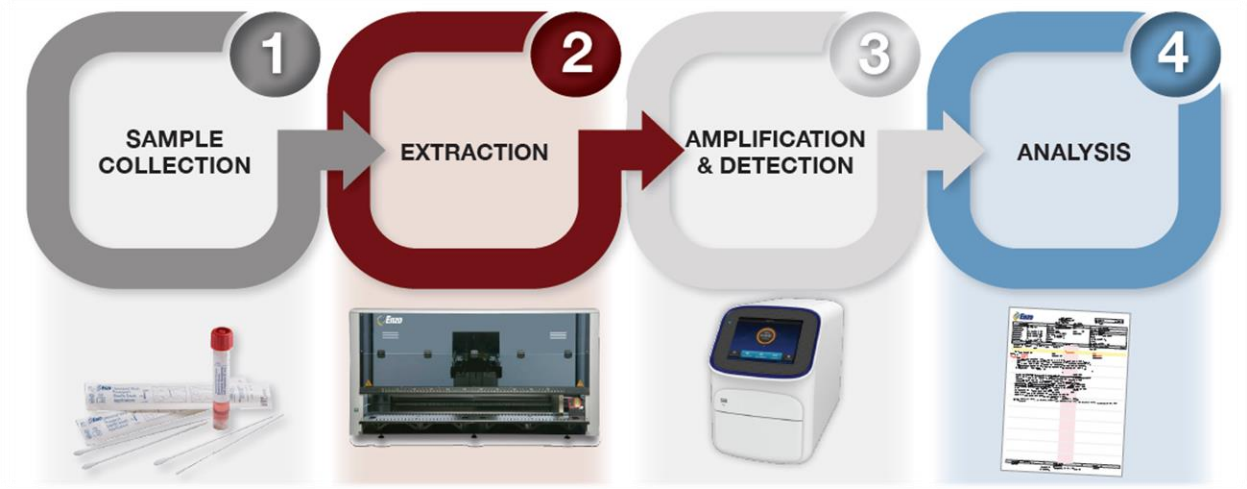
Infection with SARS-Cov-2 can cause the immune system to overreact and release inflammatory mediators to a detrimental extent in a process sometimes referred to as a "cytokine storm." This response can be detected using Enzo's ELISA cytokine storm assays.

The Enzo patented SK1-I compound has been demonstrated to suppress the level of inflammatory cytokines in animal models of diseases such as lupus and in cytokine release assays performed with human cells *ex vivo*. Therefore, it is believed that SK1-I may hold promise for preventing and/or treating cytokine storm in COVID-19 patients.

Enzo advances diagnostics by providing a complete picture of the SARS-CoV-2 virus through an integrated and comprehensive end-to-end solution backed by scientist enabling healthcare.

1. **GENFLEX™ Molecular Diagnostic Modular System**
   (for SARS-CoV-2 Detection)
   A. AMPICOLLECT™ Sample Collection Kit
   B. AMPIXTRACT™ Sample Preparation (Genetic Extraction from Patient Sample)
   C. AMPIPROBE® PCR Detection & Analytics
   D. GENFLEX™ Automated Instrument for Sample Processing

Enzo's Molecular Diagnostic Modular System consists of four modules that can be used together or independently depending on the requirements of the customer. They can be individually connected to third-party platforms or adopted as needed by other laboratories and healthcare entities. For example, for Sample Processing, one can utilize (a) the GENFLEX™ automated instrument for high-throughput testing, (b) semi-automated plate-based processing for lower-throughput or (c) manual tube-based processing for low-throughput. Below we have outlined each of these four modules:



This modular system was launched based on EUA authorization submitted April 10, 2020.
To validate the robustness of this modular system, samples were run comparing all of the interacting modules to each other and also to the standard reagents within the market. We validated the system using hundreds of samples, and during the trial period used a national laboratory as a comparator site sending the samples to their lab for confirmation of concordance.

Clinical trials continue on site to further expand the flexibility of Enzo's modular open system.

The corresponding data within Enzo's submission indicates that of the clinical samples evaluated, of the positive samples, 63% were spiked at 2x LoD and 37% were spiked at 10x LoD with synthetic SARS-CoV-2 RNA. Positive and Negative Percent Agreement was 100% in patient samples.

A. AMPICOLLECT ™ Sample Collection Kit

A key component of the workflow is the unique sample collection offered by Enzo. The Company has a three-pronged approach for sample collection. Each one of these requires validation and optimization on the GENFLEX™ system: (a) a conventional Dacron swab with conventional transport medium, (b) a conventional Dacron swab and collection tube with a proprietary inactivating transport medium, and (c) the AMPICOLLECT™ Inactivating Transport Collection kit which contains a cotton swab and collection tube with a proprietary medium for inactivating the virus upon sample collection. Enzo has conceptualized and designed all aspects of the AMPICOLLECT™ kit to address supply limitations and

to provide safety and scale at an affordable price. In addition, the AMPICOLLECT™ Collection Kit enables a simplified collection from the mid-nasal area rather than the point where the nasal cavity connects with the throat. This makes the collection possible by anyone including by the patients themselves. By combining cotton swabs and mid-nasal collection with a virus inactivating transport medium, mass collection of samples for testing without the requirement of healthcare personnel is possible. At a minimum, the virus-inactivating transport medium will increase safety with regards to samples collected by a healthcare professional.

- Using validated standard cotton swab provides a path to dealing with the current supply backlog that has been present since the onset of the pandemic. Instead of relying on specialty manufacturing by a few global suppliers, Enzo's kit uses a ubiquitous cotton swab for sample collection.
- The kit, which combines the cotton swab with the Enzo virus-inactivating transport medium tube, ensures safety of collection as well as a more comfortable experience for the patient. Enzo's solution enables the collection of a sample from the mid-nasal region as opposed to competitive industry kits that require upper nasopharyngeal collection that must be administered by a healthcare professional. Several media and industry sources claim that sample collection must be performed by a healthcare professional at the nasopharyngeal site to be effective. However, various technical publications support Enzo's assertion that mid-nasal collection is sufficient for an adequate sample of the virus and surrounding cells from that area that would contain the virus. As an example, other respiratory diseases have used a mid-nasal collection successfully for detection (https://www.who.int/influenza/human_animal_interface/virology_laboratories_and_vaccines/guidelines_collection_h5n1_humans/en/). Using this premise, Enzo is running a clinical trial to demonstrate that coronavirus collection can be self-collected in this less invasive manner instead of by a medical professional. Initial data indicates a high level of correlation with the more invasive methods performed by the medical professional. Since the start of our trial, other entities have now begun a similar path to demonstrate the use of less invasive sample collection methods. (See Appendix regarding other entities now moving in this direction including Gates Foundation).

- This self-administering enables far reaching, affordable, and rapid sample collection for testing as the collection is no longer dependent on the availability of healthcare workers.
- The AMPICOLLECT™ collection kit with its proprietary collection solution (patent pending) inactivates any virus that is collected when the cotton swab is inserted into the collection tube. This feature increases safety for those handling the sample downstream (e.g., sample transport to lab, or lab professional running the test on the sample). This solution also ensures a sufficient amount of sample material for processing after collection with a cotton swab.
- To further increase supply availability, the collection system is being validated for use with industry detection systems starting with Enzo's proprietary GENFLEX™ system.
- Enzo is able to scale AMPICOLLECT™ kits at affordable prices within the first few months of production, scaling rapidly to meet industry demand.

B. AMPIXTRACT™ Sample Preparation (Genetic Extraction From Patient Sample)

The AMPICOLLECT™ collection kit is used alongside of the AMPIXTRACT™ extraction and AMPIPROBE® detection kits. The AMPIXTRACT™ extraction kit is ideal for gently collecting the viral RNA from any patient sample. The isolated RNA is pure and ready for direct input to the target amplification process. The flexible kit design is adaptable to automated, high-throughput processing as easily as it is to manual processing. Here again, Enzo's control of its supply chain comes into play enabling Enzo to provide this important kit at a low cost solution to the market.

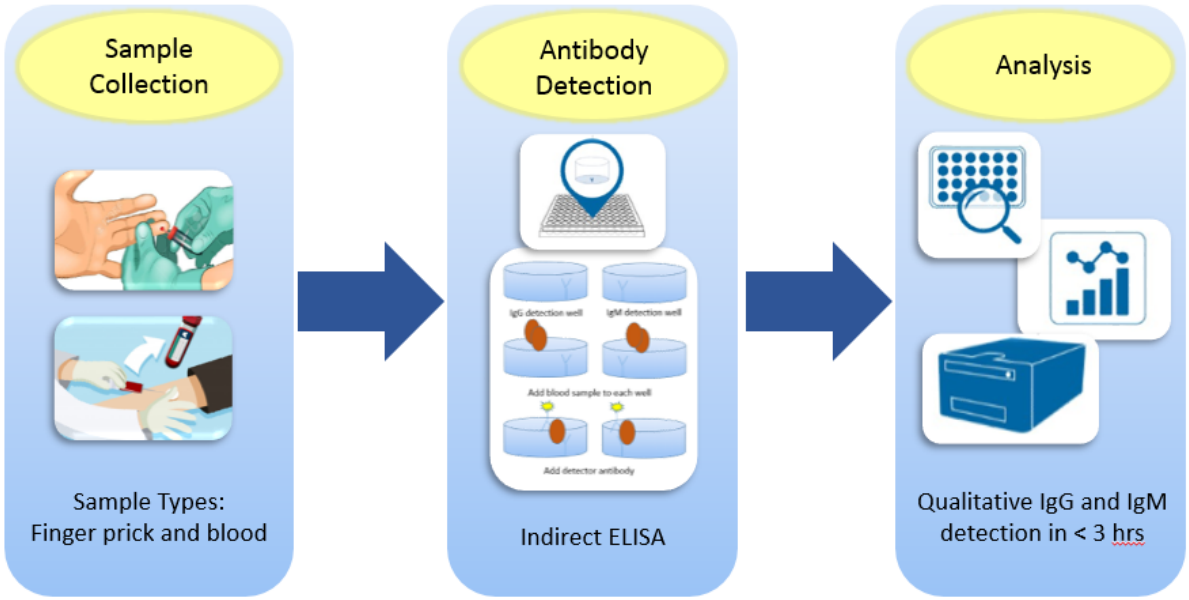
C. AMPIPROBE® Amplification and Detection

These kits are designed for high-through-put processing, but can also be used in settings that only require the processing of a handful of samples. Regardless of processing scale, these kits are designed to provide high sensitivity testing. An internal control is built into the test kit to ensure accurate results and reduce the possibility of false negative results. For flexibility and mindfulness of supply, Enzo is validating these components to also work with other manufacturers' collection kits.

D. GENFLEX™ Open Instrument Platform

GENFLEX™ Molecular Diagnostic workflow is a high-throughput, automated, and scalable platform for easy and accurate processing of common molecular diagnostic tests within a clinical production setting. Enzo has developed the specific reagents necessary for coronavirus detection that are compatible with this high-throughput platform. The Enzo SARS-CoV-2 assay optimized sample collection, extraction, and detection providing a flexible, yet accurate, approach to testing.

2. IgG/IgM Antibody Test (for Immunity Detection)



Testing for the SARS-CoV-2 virus to determine if a patient is infected is only the first necessary step from a diagnostic point of view. The second, and potentially more crucial, test is to determine whether an individual has antibodies for the virus. The antibodies may be present based on a previous illness or exposure (even if asymptomatic). This "immunity" test may enable individuals to remove their masks and gloves, limit social distancing requirements, and begin returning to work. It also potentially limits the necessity of an anticipated vaccine to those individuals who do not carry these antibodies.

The Enzo high throughput kit for IgG/IgM antibody takes either a standard blood sample administered at a Patient Service Center (PSC), doctor's office, or hospital or potentially a self-collected blood sample using an auto lancet finger-pricking device. The collected blood sample is then sent to the clinical lab to process, detect and analyze the sample. This allows for scalable testing to be performed under

controlled conditions to deliver more accurate and more sensitive results than those obtained using the commonly available serology quick tests. Although the quick tests were initially thought to be a rapid and easy to administer solution, they may lack the required accuracy. As such, rather than providing an emotional relief, they actually could provide a false sense of security that endangers those around the patient who may wrongly believe and act as though they are no longer infected and are incapable of transmitting the disease.

- Enzo 96-well ELISA plate test is performed in a clinical lab using common lab workflow.
- Turnaround time is 24 hours and results are accurate and economical.
- Easily scalable

3. Cytokine Storm Immunoassay (for Inflammation Monitoring)

To manage a Coronavirus patient that tests positive, the following inflammation patterns will continue to be important. It is often not the direct effect of viral infection on cells that creates problems for the patient but the body's immune response to this virus that is thought to contribute to the cause of death. Reported clinical experience suggests that uncontrolled release of cytokines causes a "cytokine release syndrome" or "cytokine storm" in some COVID-19 patients, which is associated with respiratory decline and failure. Accordingly, early monitoring of inflammatory cytokine levels has been suggested as an important diagnostic tool for determination of administering early therapy in managing these patients.

Enzo is in the early stage of development of a diagnostic test for inflammation in COVID-19 patients which is based on an existing ELISA based "research use only" test for clinical purposes and a test that relies on a cytokine storm panel for monitoring including IL-1 (beta), IL-6, IL-8, TNF-alpha, and Gamma Interferon.

- Enzo 96-well ELISA plate test is performed in a clinical lab using common lab workflow.
- Turnaround time is 24 hours and results are accurate and economical.
- Easily scalable

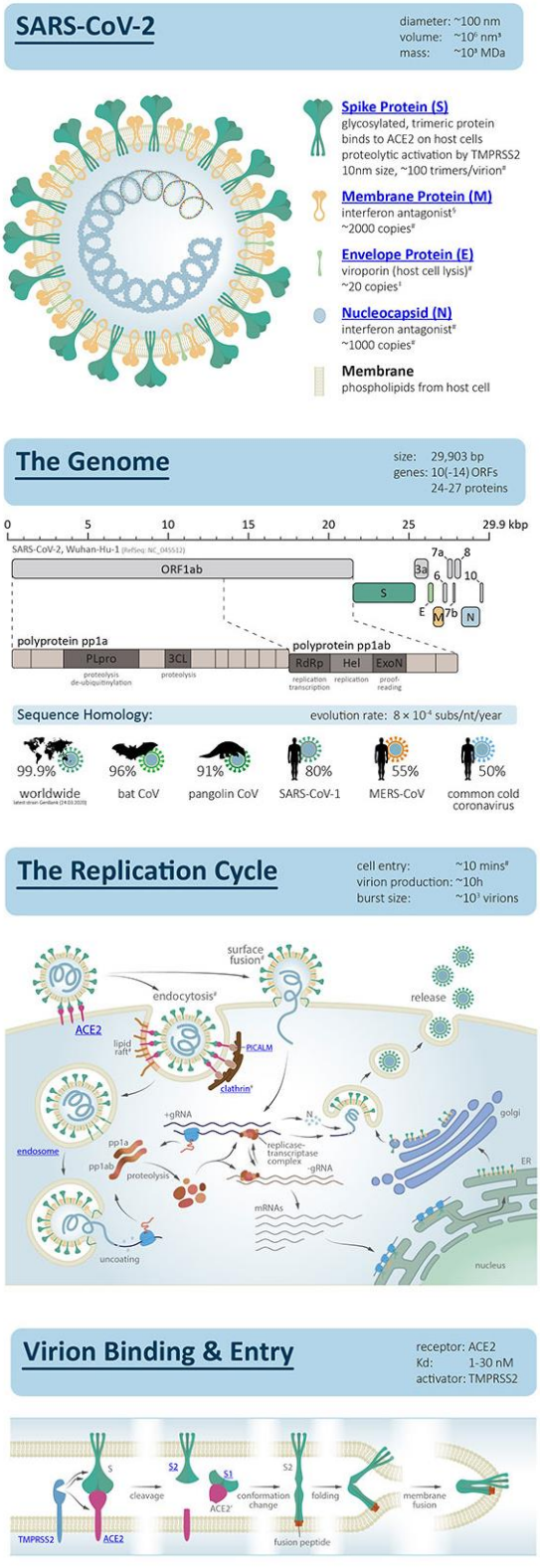
4. **Potential Use of Enzo's Drug Candidate SK1-I (for the Prevention and/or Treatment of Cytokine Release Syndrome and Respiratory Failure in COVID-19 Patients)**

Enzo has been developing a patented small molecule sphingosine kinase 1 inhibitor, called SK1-I, as a therapeutic for cancer and autoimmune disorders. The compound has previously demonstrated potent immune modulating activity on human immune cells *in vitro* and in whole-animal models. SK1-I has recently shown strong activity in a mouse model of lupus, including the ability to decrease levels of the inflammatory cytokines IL-6, TNF-alpha, and both Interferon-alpha and -beta. (*See* Mohammed *et al.*, Regulatory role of SphK1 in TLR7/9-dependent type I interferon response and autoimmunity, FASEB J. 2020 Mar; 34(3): 4329-4347.) Further, in unpublished work performed by Enzo, SK1-I was able to suppress Influenza antigen-mediated release of Interferon-gamma by human peripheral blood mononuclear cells (PBMCs) obtained from an Influenza-vaccinated donor. *Significantly*, elevated levels of IL-6 have been shown to be predictive of respiratory failure in COVID-19 patients (*see* Herold *et al.*, Level of IL-6 predicts respiratory failure in hospitalized symptomatic COVID-19 patients, medRxiv 2020.04.01.20047381; doi: https://doi.org/10.1101/2020.04.01.20047381) and it is reported that cytokine release syndrome or "cytokine storm" is associated with poor prognosis and mortality. Preclinical animal toxicology work with SK1-I suggests that the compound could be safely dosed in humans at levels that correlate with those found to reduce inflammatory cytokines in animal models. Accordingly, Enzo believes that SK1-I may have potential for preventing and/or treating cytokine release syndrome and respiratory failure in COVID-19 patients. The Company is reaching out to the Food and Drug Administration for guidance on the further development of SK1-I for COVID-19.

SUMMARY:

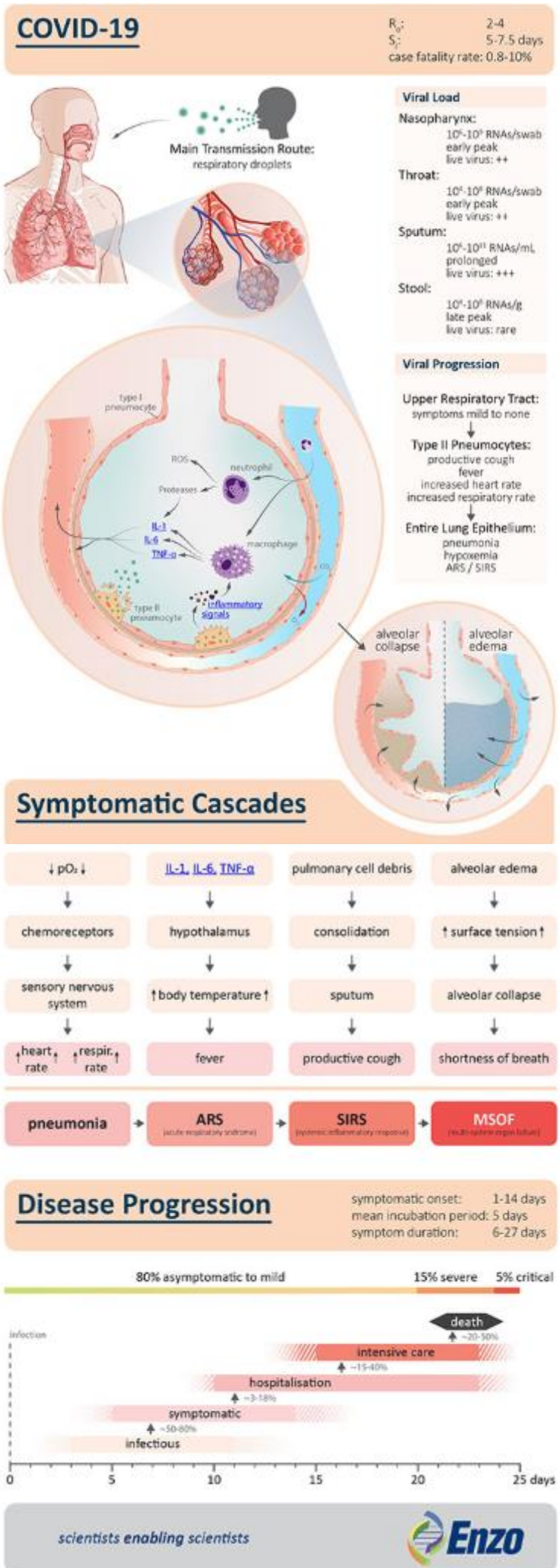
The Enzo Comprehensive COVID-19 Program is indicative of Enzo's ability to respond to the current challenges plaguing the healthcare market. The integrated company structure gives Enzo the advantage of having direct access to patients while maintaining control of the testing reagents and supply chain. Our full system open platform solutions make flexibility, affordability and quality available to a market that currently lacks these needed conditions.

APPENDIX A. ENZO COMPREHENSIVE CORONAVIRUS PROGRAM



Detection of the virus to identify initial infection is performed using the **GENFLEX Molecular Diagnostic** System with its interlocking modules including: AMPICOLLECT Sample Collection Kit; AMPIXTRACT Sample Preparation Kit and AMPIPROBE Detection Kit

Detection of the body's humoral immune response – the presence of antibodies against the Coronavirus – is performed using the **Enzo IgG/IgM ELISA test**.



The immune system reacts to Coronavirus infection in the body by activating various inflammatory responses that, in some patients, go out of control and cause harm. These responses can be detected using **Enzo's ELISA cytokine storm assays.**

The **Enzo patented SK1-I compound** has been demonstrated to reduce inflammatory cytokine levels in animal models of diseases such as lupus and to suppress cytokine release by human cells *ex vivo*. Therefore, it is believed that SK1-I may hold promise for preventing and/or treating cytokine storm in COVID-19 patients.

APPENDIX B. SAMPLE COLLECTION FROM MID-NASAL REGION

FDA NEWS RELEASE

Coronavirus (COVID-19) Update: FDA, Gates Foundation, UnitedHealth Group, Quantigen, and U.S. Cotton Collaborate to Address Testing Supply Needs

For Immediate Release:

April 16, 2020

The U.S. Food and Drug Administration announced a further expansion of COVID-19 testing options through the recognition that spun synthetic swabs – with a design similar to Q-tips – could be used to test patients by collecting a sample from the front of the nose.

As part of this effort, U.S. Cotton, the largest manufacturer of cotton swabs and a subsidiary of Parkdale-Mills, developed a polyester-based Q-tip-type swab that is fully synthetic for compatibility with COVID-19 testing. Harnessing its large-scale U.S.-based manufacturing capabilities, U.S. Cotton plans to produce these new polyester swabs in large quantities to help meet the needs for coronavirus diagnostic testing.

“This action today demonstrates the ingenuity that results from the FDA working in partnership with the private sector. The Trump Administration has been working side-by-side with our industry partners to fight this pandemic, and today is a great example of that work. We appreciate work by UnitedHealth Group, Quantigen, and the Gates Foundation to perform and support the clinical studies necessary for this advancement. We also want to acknowledge U.S. Cotton’s efforts to manufacture a new type of swab for COVID-19 testing that can be produced at scale. We appreciate the work of these collaborators to consider how these test supplies could be broadly distributed to meet not only the testing needs of the United States but also global needs around the pandemic. All of these actions by these American organizations will help continue to expand our testing capability,” said FDA Commissioner Stephen M. Hahn, M.D.

This finding that spun synthetic swabs could be used for COVID-19 testing is based on results from a clinical investigation that represents a collaboration between the FDA, UnitedHealth Group, the Gates Foundation, and Quantigen. The type of testing at the front of the nose used in this study is notable because it allows self-collection by patients thereby limiting exposure of healthcare providers; it is more comfortable for patients and it can be performed by a swab that is more readily available and manufacturable at scale.

The FDA, an agency within the U.S. Department of Health and Human Services, protects the public health by assuring the safety, effectiveness, and security of human and veterinary drugs, vaccines and other biological products for human use, and medical devices. The agency also is responsible for the safety and security of our nation’s food supply, cosmetics, dietary supplements, products that give off electronic radiation, and for regulating tobacco products