Beyond emergency testing: staying ahead of SARS-CoV-2 with NGS to help disrupt the current trajectory

The pivotal case of Children's Hospital Los Angeles (CHLA) to help mitigate a crisis

Key highlights

- The continuing spread of SARS-CoV-2 shows that emergency testing alone is not enough to manage the crisis
- Accessible next-generation sequencing (NGS) can help optimize mitigation policies for both country-level and localized interventions
- Using Ion Torrent™ targeted NGS technology, CHLA analyzed viral isolates in under 48 hours to mitigate potential spread and ensured the pediatric intensive care unit (PICU) remained open

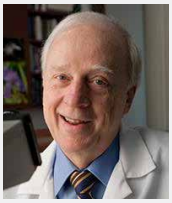
Introduction

Effective tracking and monitoring of SARS-CoV-2 is critical to help address the current global crisis. But with the continuing spread of SARS-CoV-2 in the United States [**1**] and numbers rising in Europe at a higher rate than during the peak in March 2020 [**2**], increasing emergency testing is simply not enough. While the mutation rate of this virus is ~30–50% slower than influenza virus [**3**], the ability of SARS-CoV-2 to rapidly spread means that new strains can still appear, which in turn means that attempts to contain the spread are made more difficult.

Multiple studies report that the complex biology of SARS-CoV-2 makes mitigation of the crisis even more challenging. Epidemiological modeling shows that most transmission occurs either during the presymptomatic or asymptomatic infection stage [**4**]. During the presymptomatic stage, which potentially lasts up to 14 days [**5**], carriers may shed more virus particles and thus be more contagious [**6**]. Interestingly, 40–45% of SARS-CoV-2–infected individuals are asymptomatic [**7**,**8**], with children suggested as a notable group of carriers [**9**].

These concerning aspects add to the difficulty of mitigating SARS-CoV-2 compared with similar coronaviruses [**10**].

> "Only the NGS data could allow us to draw such important conclusions … within two days of receipt of the samples. This information gave leaders at our institution greater confidence in our ability to provide a safe environment for our patients and our team members."



Timothy J. Triche, MD, PhD, Co-Director, Center for Personalized Medicine at CHLA

Each strain needs to be correctly identified for proper viral surveillance, to potentially guide preventative measures, and to help inform development of future treatments. Researchers have identified a multitude of SARS-CoV-2 strains [**11**] by using NGS. Experienced professionals now recognize the need for epidemiological insights regarding SARS-CoV-2 and favor the rapid turnaround time and highly automated workflows of Ion Torrent NGS. These critical factors help communities track and contain the virus, and keep essential facilities open.

The impact of Ion Torrent technology at CHLA: understanding SARS-CoV-2 transmission

The ability to track and identify potential SARS-CoV-2 transmission in vital institutions such as hospitals and schools is critical to protect essential workers and the community as a whole. CHLA is a global and pioneering center for the diagnosis and treatment of childhood cancers. Recently, a patient and his mother showed signs of SARS-CoV-2 infection at the same time as four health care workers in the PICU. All six individuals were positive for SARS-CoV-2 by real-time PCR testing, resulting in immediate concern about transmission between patients and frontline staff.

ion torrent

To verify the safety of the hospital and address the potential closure of the PICU, the crisis mitigation team at CHLA used Ion Torrent NGS to sequence the viral isolates. The analysis, led by Dr. Timothy J. Triche, showed the mother and son had nearly identical strains of the virus while the four health care workers had different strains found in the local community. Important conclusions were made regarding the local transmission of the virus within two days of receiving the samples. Concerns regarding the ability to adequately protect essential workers were immediately addressed, and the PICU remained open to continue to facilitate patient care.

For more details about Dr. Triche's efforts, watch his webinar at **thermofisher.com/sarscov2-chlawebinar**

The need for NGS and Ion Torrent technology to address a global crisis

Unlike emergency tests, NGS identifies mutations that make each SARS-CoV-2 strain unique. Relationships between strains can then be determined to develop a "family tree", providing a deeper understanding of its origin and transmission dynamics, and improve overall surveillance efforts (Figure 1).

Figure 1. Global surveillance of SARS-CoV-2 from nextstrain.org. Shown with permission under a **Creative Commons Attribution 4.0 International Public License**.

High-quality genetic resolution of the virus helps public health agencies establish more targeted, community-specific policies to supplement broad-based efforts such as country-wide lockdowns.

Medical professionals can use NGS analysis to understand how, when, where, and with whom transmission occurs. The data can even expose the strains associated with "super spreaders" that may drive an inordinate number of secondary cases. NGS surveillance data on virus transmission patterns offers insights that cannot be provided by conventional testing and epidemiological research methods, thus enabling authorities to improve public confidence in health policy directives.

Thermo Fisher Scientific is helping to expedite efforts with its molecular technologies, empowering researchers with SARS-CoV-2 detection assays and semiconductor sequencing technology to characterize millions of viral genomes. A targeted sequencing approach with Ion AmpliSeq™ technology enables:

- **Rapid turnaround time**—nucleic acid–to-variant report* in a single day using the Ion Torrent™ Genexus™ Integrated Sequencer
- **Automation**—minimal user touch points, to reduce variability and maximize reproducibility
- **Accuracy of variant detection**—lower substitution error rate helps identify strains and serotypes more accurately
- **Higher success rate**—helps analyze viral loads as low as 20 copies

Conclusions

With wide availability of an effective vaccine still many months away at best [**12**] and the safety of such a vaccine unclear [**13**], it is critical we continue to innovate and invest to advance our ability to address SARS-CoV-2 and potential future viruses.

Thermo Fisher Scientific has a history of responding promptly and efficiently to public health emergencies. Customers like Dr. Triche use our NGS solutions to aid their investigations and keep the communities they serve safe. With our latest innovation—the Ion Torrent™ Genexus™ System—we continue to lead the way and enable health agencies to determine their next steps in controlling the SARS-CoV-2 crisis, and help get the global economy moving again responsibly.

* Specimen-to-report workflow will be available after the Ion Torrent™ Genexus™ Purification System and integrated reporting capabilities are added in 2021.

Request a virtual demo at **thermofisher.com/genexusdemo**

ThermoFisher SCIENTIFIC