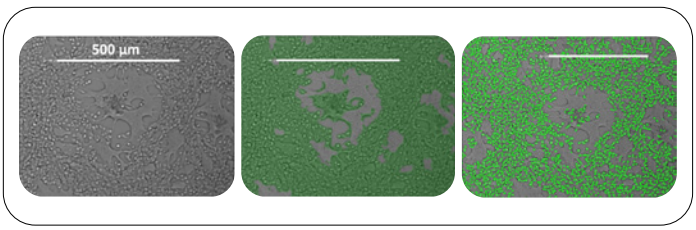
Modern virology applications of image cytometry.

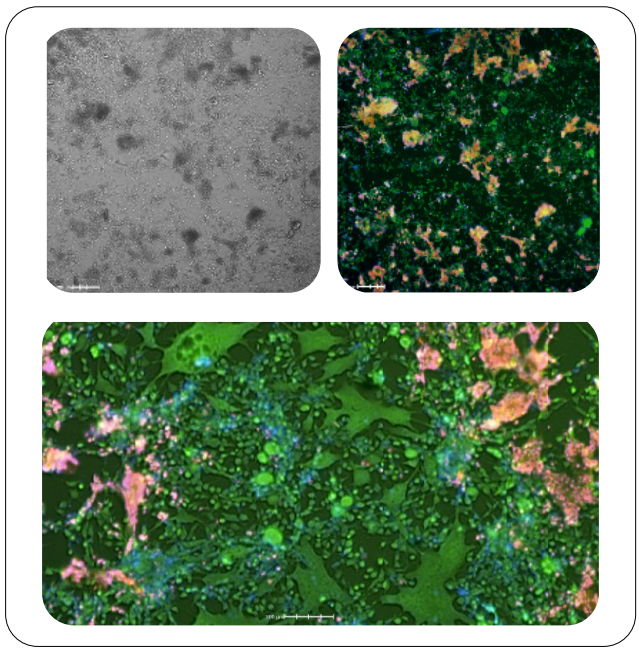
Rapidly image and analyze cultured cells in a variety of key cell-based virology assays

Cytopathic Effect (CPE) and Median Tissue Culture Infectious Dose ($TCID_{50}$)

Cytopathic effect (CPE) is a hallmark of viral infection in many host cells resulting in morphologic changes to the cell monolayer including swelling, localized degeneration, and/or syncytia formation. The Celigo® image cytometer provides a streamlined automated imaging and analysis platform to quickly and consistently quantify CPE with brightfield imaging using confluence measurements or direct cell counting to determine $TCID_{50}$. Fluorescent dyes provide additional insights into the kinetics of viral pathogenesis by quantifying metabolic activity and apoptosis.



Brightfield (BF) imaging of CPE analyzed with confluence (center) and direct cell counting (right)

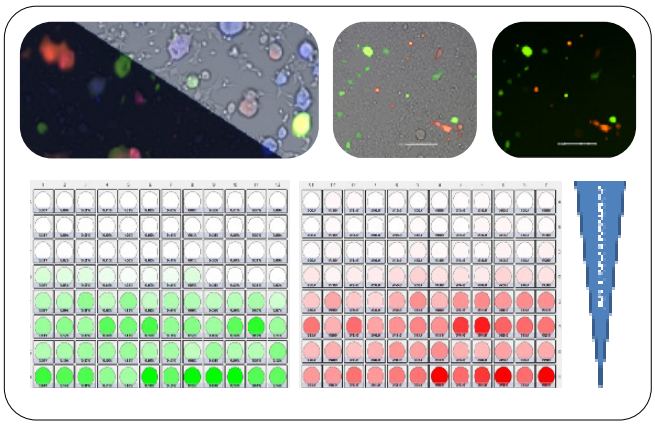


Brightfield and fluorescence imaging of CPE morphology following coronavirus infection. Calcein AM (green) stains metabolically active cells, Propidium Iodide (PI, red) stains dead cells, and Hoechst (blue) stains all nuclei.

Plaque assays and fluorescence multiplex microneutralization

Plaque assays are a core method for assessing viral titers and infectivity by quantifying the number of plaques, foci, or individually infected cells. Additionally, plaque reduction neutralization tests (PRNTs) are commonly used to quantify the ability of therapeutics to reduce infection. The Celigo image cytometer is a high-throughput instrument capable of rapidly imaging and analyzing an entire plate for a high-content imaging-based neutralization test (HINT). Brightfield and fluorescence images produce accurate cell counts, morphology characteristics, and intensity measurements. Modern microneutralization assays in 96- or 384-well plates enhance capabilities to generate more data, obtain results earlier, and finish projects faster.

Fluorescence multiplexing can also be integrated into a variety of cell-assays, including traditional neutralization experiments. For example, imaging cells exposed to multiple viral variants (expressing up to four unique fluorescent proteins) provides a quick method to quantify the neutralizing effects of antibodies on different variants. Individual fluorescent cell populations are quantified to characterize the neutralization efficacy of antibodies or sera and determine dilution-dependent neutralization curves.

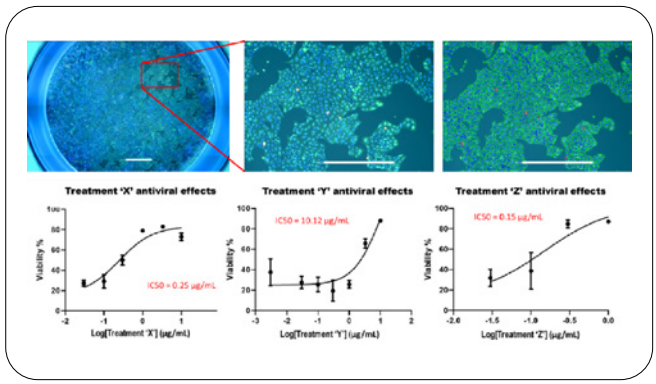


(Top) Fluorescent protein multiplexing with four viral variants expressing blue, green, red, and far-red fluorophores. (Bottom) Concentration dependent antibody neutralization data displayed as a plate-based heatmap.

High-throughput drug screening

High-throughput image cytometry is a powerful tool to investigate cellular responses to drugs in both 2D and 3D models. Direct cell counting with brightfield images or fluorescent probes may be used to quantify cell populations and characterize structural and functional changes to individual cells, providing insight into the underlying mechanisms of action for a given drug treatment.

Screening potential therapeutic candidates and repurposing approved drugs is also a critical step in mitigating pandemic outbreaks for emerging infectious diseases. Hundreds of candidate drugs may be integrated into a streamlined analysis of cell viability using multiple concentrations to quickly establish EC_{50} and IC_{50} curves to determine effective therapeutic ranges as well as compare both candidate potency and cellular toxicity.



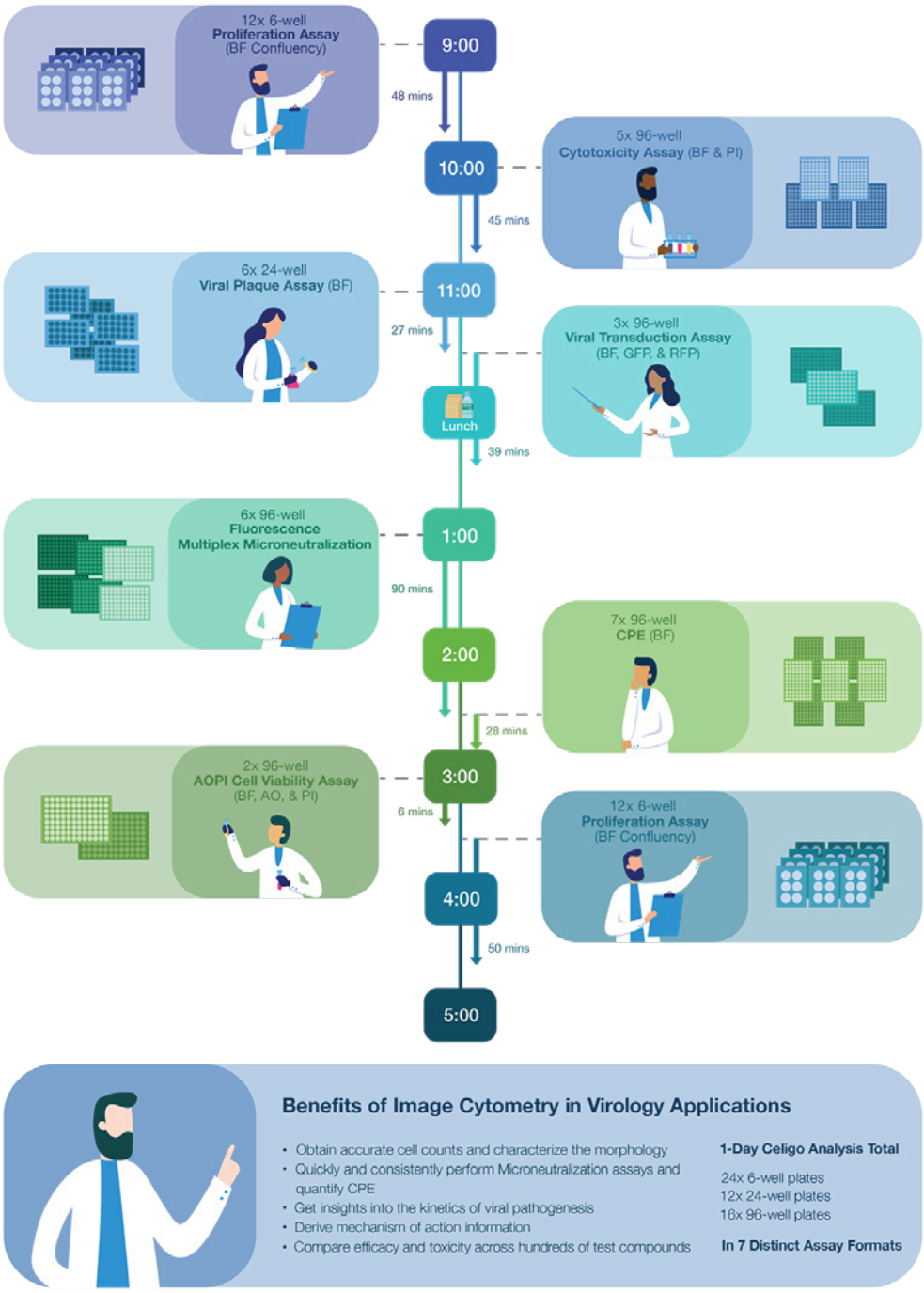
Fluorescence imaging of Vero cells infected with SARS-CoV-2. Calcein AM (green) stains metabolically active cells, Propidium Iodide (PI, red) stains dead cells, and Hoechst (blue) stains all nuclei. Viability measurements at different drug concentrations were generated within the analysis software to establish the IC_{50} curves for multiple candidate therapies.

Maximizing productivity in a virology lab

High-throughput, accurate cell-based assays using the Celigo image cytometer

The fast, highly versatile Celigo fluorescent image cytometer can transform the productivity of a virology lab by easily performing a diverse range of cell-based assays, so you can generate more data, obtain results earlier and finish projects faster.

Take a look at the throughput you could achieve in a typical working day with a Celigo image cytometer:



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