Data integration and processing of COVID-19 Infectious Disease events

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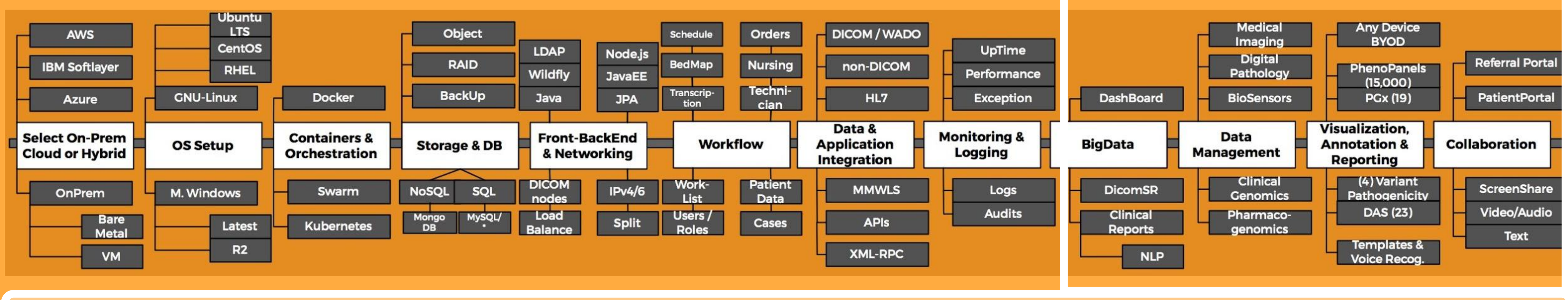
Kanteron Systems has developed a platform that integrates medical imaging (PACS-RIS), digital pathology (WSI), clinical genomics (NGS data analysis workflows), and creates automatic technical reports for precision medicine with fully integrated QC and LIMS procedures. All that patient-centric data can be easily integrated in HIS systems and use HL7 standard protocols.

Once this data is integrated both at a workflow level and at a patient level, it can then form part of larger population health and epidemiologic alert systems for an efficient processing of infectious disease events, such as COVID-19.

KANTERON PLATFORM



DATA INTEGRATION AND PROCESSING

COVID-19[2]:

COVID-19 is the infectious disease caused by the most recently discovered coronavirus. This new virus and disease were unknown before the outbreak began in Wuhan, China, in December 2019.

With the absence of licensed vaccines or specific antiviral therapies for COVID-19, containing the spread of contagion remains a priority. Prompt and early diagnosis of COVID-19 viral infection though rRT-PCR kits remains crucial. Laboratory confirmation is important due to difficulties in making accurate diagnosis due to the mild appearance of initial symptoms, but both digital pathology and medical imaging can help. So a coordinated healthcare data exchange platform becomes a key resource to help achieve those objectives at scale.

Example screening / diagnosis for COVID-19:

Clinical disease onsets 4-6 days after infection. Early and proper diagnosis can reduce symptoms, complications, contagions and deaths.

1. Minutes: Lung US
2. Hours: XRay/CT scan
3. 1 day: Portable genome sequencing to screen or investigate reported virus transmission (example: Angola[1]) allows for early detection (Nasopharyngeal swab RT-PCR)
4. 2-5 days: Immunohistochemistry (digital pathology)
5. 1 week: Virus isolation (cell line culture with patient serum)

In the future: micro/paper fluidics, in vivo micropatches, isothermal PCR, electrochemical and piezoelectric...

Summary

The integration of medical imaging, digital pathology, and clinical genomics can accelerate time to diagnosis, facilitate interdisciplinary team care management, and enable multi-omic analysis at scale, both patient-centric and population-wide.

Here we present an enterprise platform for the ingestion, normalization, analysis, reporting (including remote), and sharing of all clinical data.

This platform is vendor-neutral, zero-footprint, and browser-based. Additionally, the ability to handle data in any language, and almost any format, makes it ideal for deployment in large hospital-clinic networks, remote locations, and international collaboration initiatives.

Our clinical data integration and workflow solution has been leveraged for machine learning / AI, big data analytics, NLP, and precision medicine, in 12 countries and 80 million patients, by public and private institutions as relevant as the NHS (UK), EsSalud (Peru), IMSS-ISSSTE (Mexico), MHS (USA), Seguridad Social (Spain), CGI (Canada), AMC (Ethiopia), HUSI (Colombia), or ITMS (Chile).

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Digital Pathology[4]:

The first COVID-19 (SARS-CoV-2 pneumonia) case biopsy pathological diagnosis report was released in Shenzhen, China on Feb 18, 2020.
A digital slide scanner was used to determine the diagnosis of a patient's lung tissue sampled for examination, and immunohistochemistry results led to a diagnosis of COVID-19.

Medical Imaging[5]:

Ground-glass opacity detected in bilateral lung emergency ultrasound[6] or XRays, and conspicuous ground grass opacity lesions in the peripheral and posterior lungs on CT images are indicative of Covid-19 pneumonia.

Genomics[3]:

For pathogen evolution: COVID-19 variants from publicly available 48 genomes.
For multifactorial risk analysis[7]: susceptibility to infection, severity if infected, and treatment reaction can be analyzed via NGS genomic sequencing.

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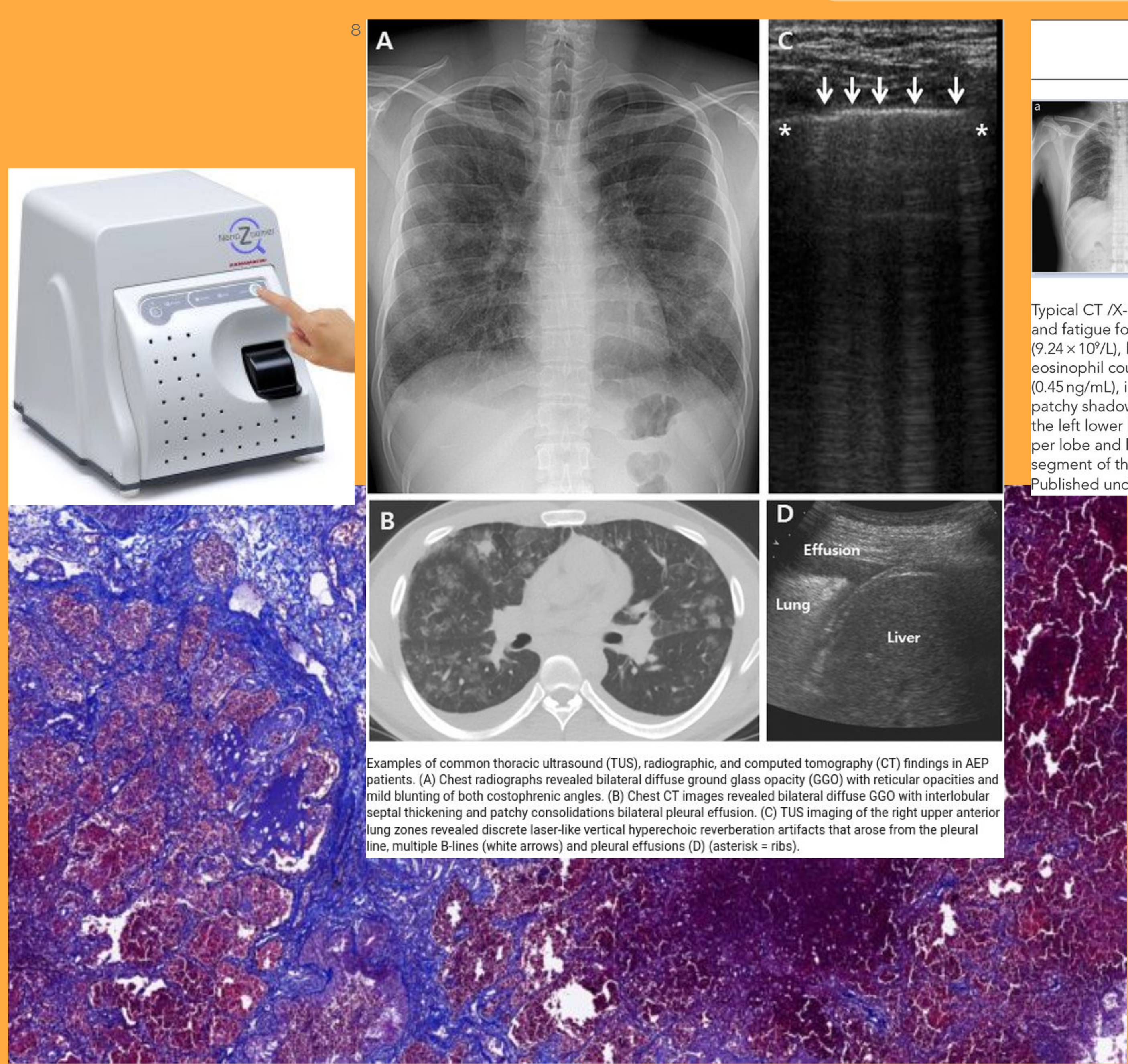
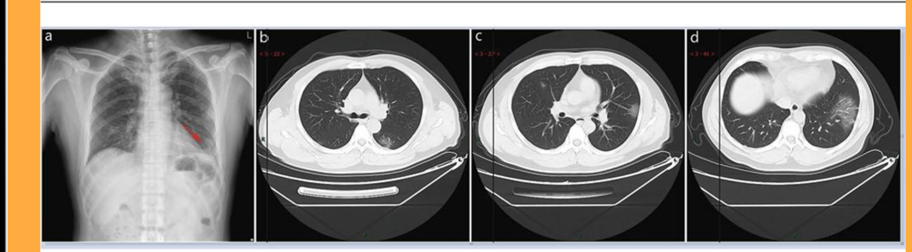
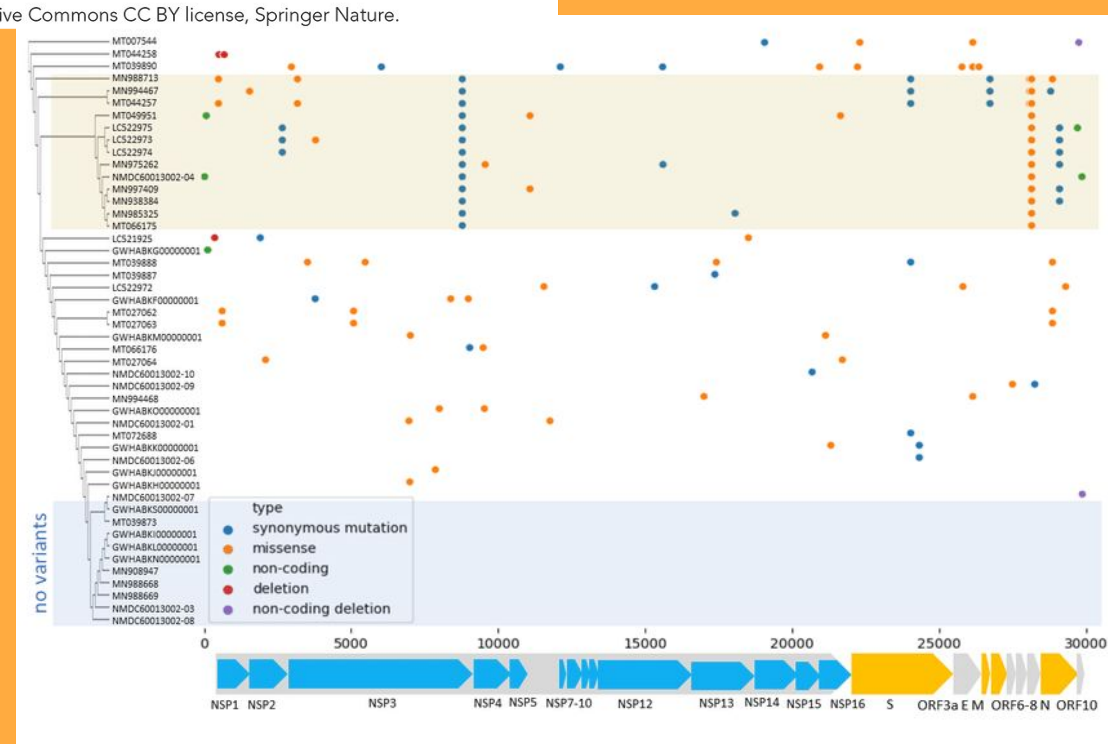


Examples of common thoracic ultrasound (TUS), radiographic, and computed tomography (CT) findings in AEP patients. (A) Chest radiographs revealed bilateral diffuse ground glass opacity (GGO) with reticular opacities and mild blunting of both costophrenic angles. (B) Chest CT images revealed bilateral diffuse GGO with interlobular septal thickening and patchy consolidations bilateral pleural effusion. (C) TUS imaging of the right upper anterior lung zones revealed discrete laser-like vertical hyperechoic reverberation artifacts that arose from the pleural line, multiple B-lines (white arrows) and pleural effusions (D) (asterisk = ribs).

Figure 2. X-Ray and Computed Tomography Imaging of COVID-19 Pneumonia



Typical CT /X-ray imaging manifestation (case 2). A 51-year-old male with general muscle ache and fatigue for 1 week, fever for 1 day (39.1°C), anemia. Laboratory tests: normal white blood cells (9.24×10^9/L), lymphocytes percentage (5.1%), decreased lymphocytes (0.47×10^9/ L), decreased eosinophil count (0×10^9/L), increased C-reaction protein (170.91 mg/L), increased procalcitonin (0.45 ng/mL), increased erythrocyte sedimentation rate (48 mm/hr). Imaging examination: **(a)** shows patchy shadows in the outer region of the left lower lobe; **(b)** shows large ground-glass opacity in the left lower lobe; **(c)** shows subpleural patchy ground-glass opacity in posterior part of right upper lobe and lower tongue of left upper lobe; and **(d)** shows large ground-glass opacity in the basal segment of the left lower lobe.



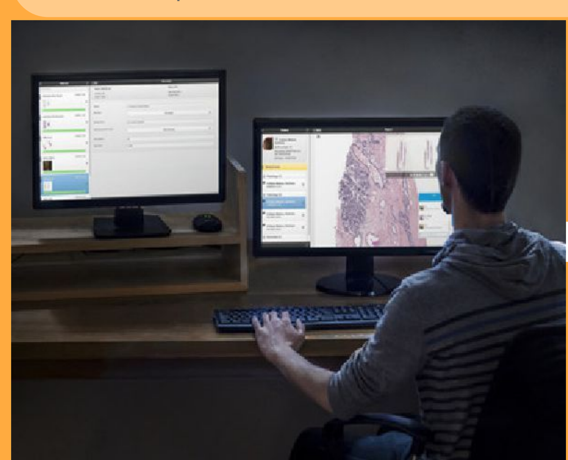
TELE-REPORTING:

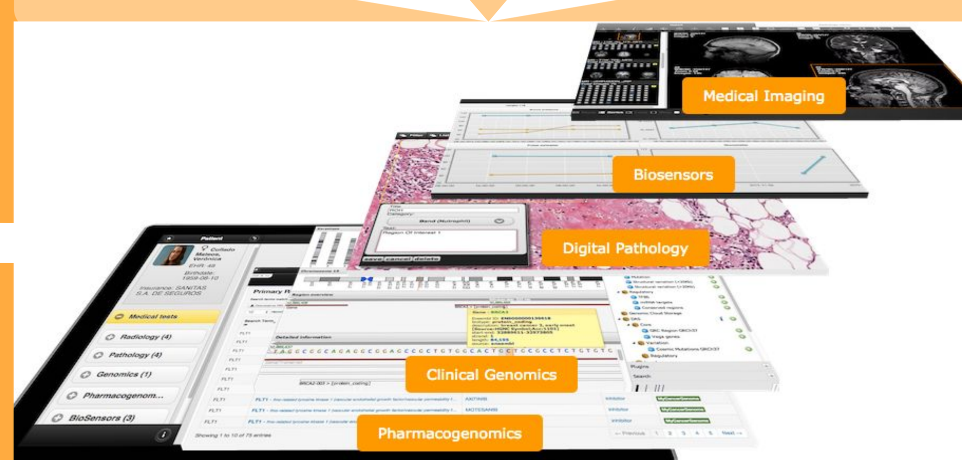
From tele-radiology to tele-pathology to tele-genomics, it allows rapidly scaling services, asynchronously, in a distributed and collaborative manner, so more geographically dispersed cases can be analyzed quicker regardless of the location of the specialist.

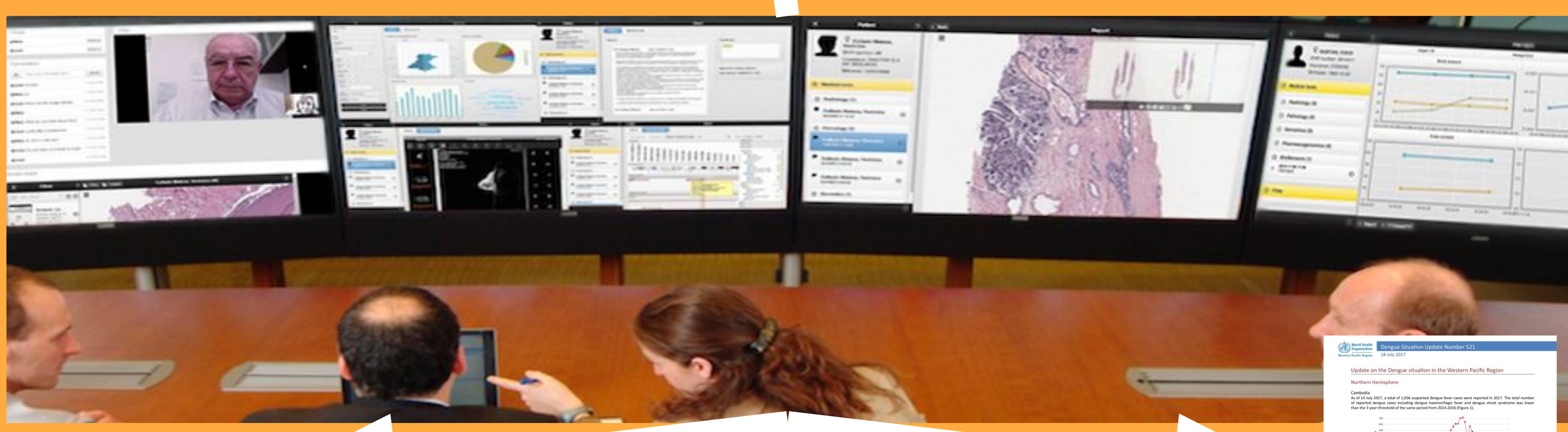
TELE-MEDICINE:

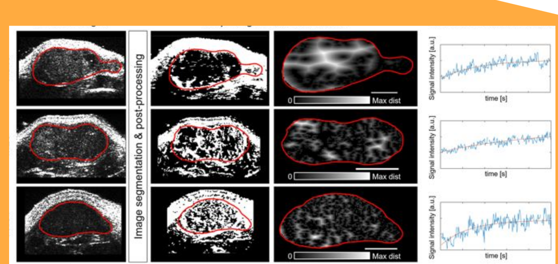
Keeping healthcare workers safe during crises, patients properly taken care of and monitored regardless of their location, and being able to cover a wider geographical area are some of the immediate advantages of having integrated tele-medicine capabilities.

STORE, INTEGRATE, ANALYZE, VISUALIZE









COLLABORATE, ANNOTATE, REPORT