



Innovations in diagnostics help contain COVID-19 spread and expedite economic recovery

創新診斷科技幫助遏止新冠肺炎散播和加速經濟復甦

Prof Joseph Tam

Dr HY Poon

JT Technology & Consultant Ltd

JT TECH COMPANY MISSION & HOW IT GOES



Mission and Objective

- To promote biotech development in HK by supporting startups
- We believe in disease prevention hence focus in the areas of diagnostics and related technologies- starting from founding HybriBio to DiagCor and Pangenica



COMPANY MISSION & HOW IT GOES

Portfolio Company (Seed funding and advisory)

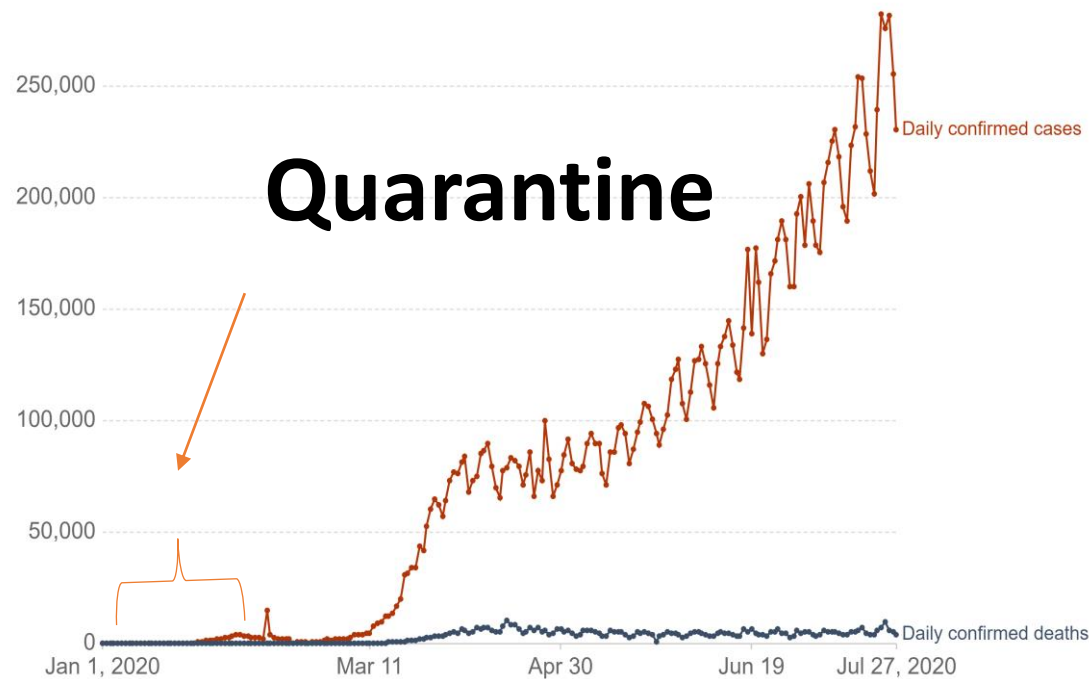
- **Phase Scientific** – Sample isolation platform
- **ThunderBio** – Microfluidic digital PCR and platform
- **AUISET** – AIE based LFI
- **Qi Diagnostics** – VOC detection for disease and healthcare
- **OM Sciences** – Next Generation Spirometer & unique sensor with wide applications
- **Arbele** – Diagnostic and novel cancer therapeutics
- **Myoceo (Pangenia Subsidiary)**– Orphan drug (rare diseases, genomic extension)



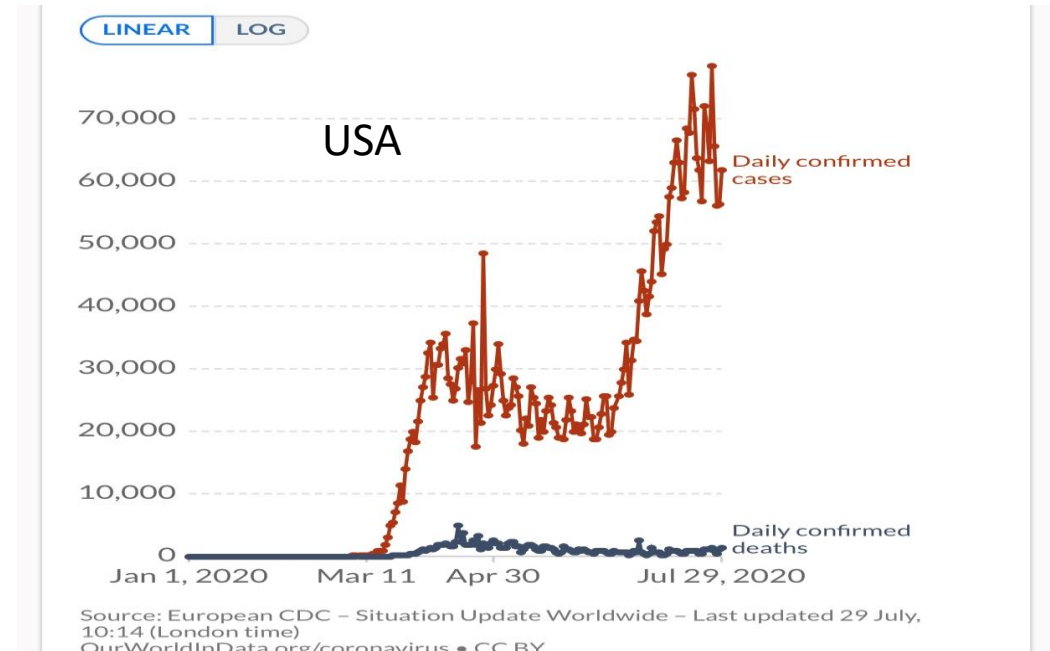
TESTING IS THE KEY TO CONTAIN SARS-COV-2 & ECONOMIC RECOVERY

Daily confirmed COVID-19 cases and deaths, World

The confirmed counts shown here are lower than the total counts. The main reason for this is limited testing and challenges in the attribution of the cause of death.



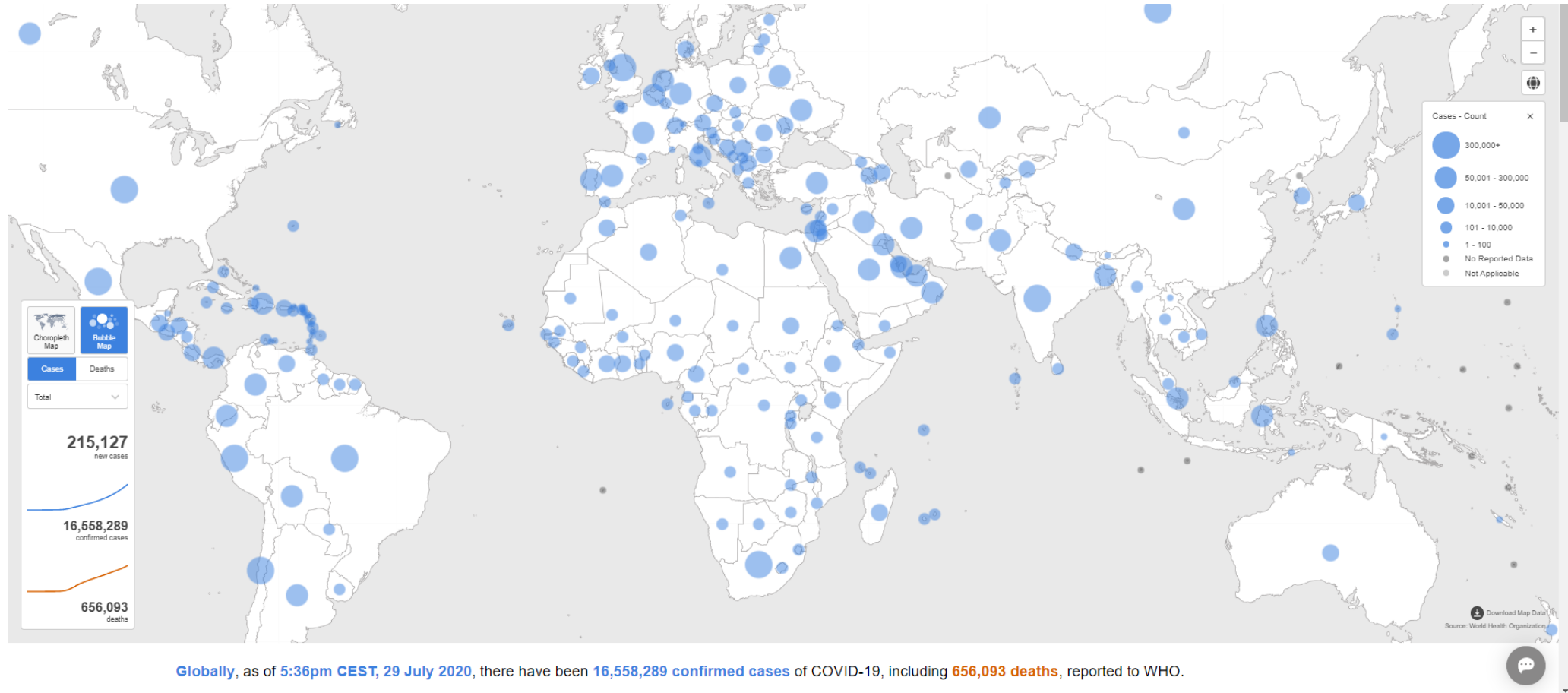
Source: European CDC – Situation Update Worldwide – Last updated 27 July, 10:38 (London time) OurWorldInData.org/coronavirus • CC BY



Source: European CDC – Situation Update Worldwide – Last updated 29 July, 10:14 (London time) OurWorldInData.org/coronavirus • CC BY

Source: <https://ourworldindata.org/grapher/daily-covid-cases-deaths/>

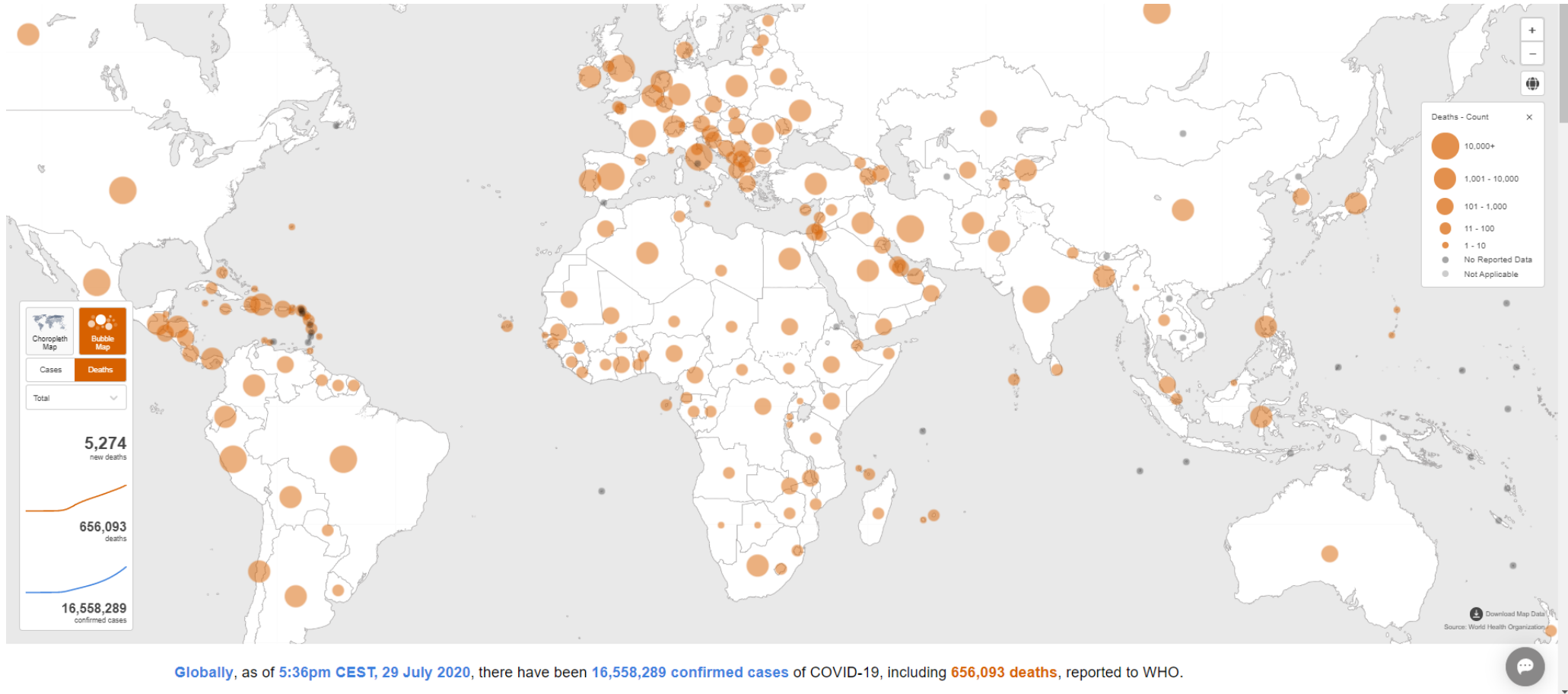
CURRENT STATUS OF COVID PANDEMIC



Globally, as of 5:36pm CEST, 29 July 2020, there have been 16,558,289 confirmed cases of COVID-19, including 656,093 deaths, reported to WHO.

Source: <https://covid19.who.int/>

CURRENT STATUS OF COVID PANDEMIC



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CURRENT STATUS OF COVID PANDEMIC



Covid-19 in numbers

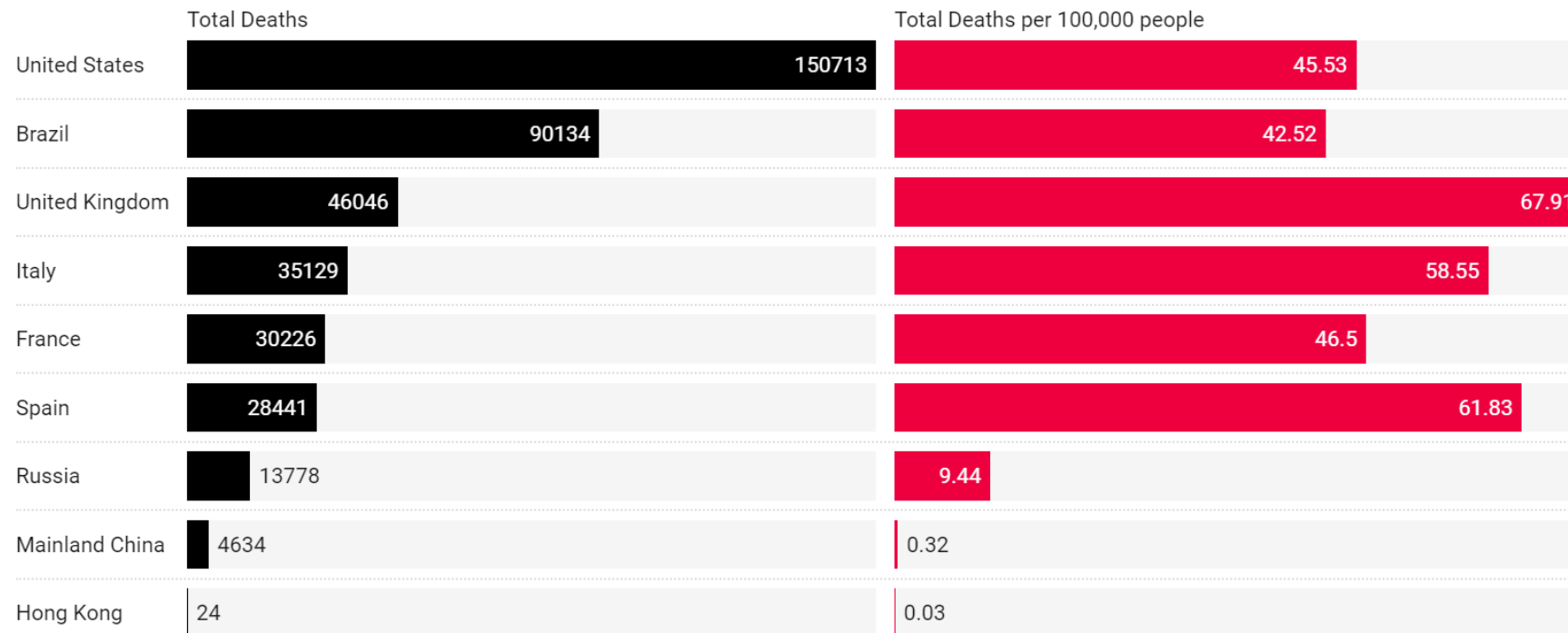


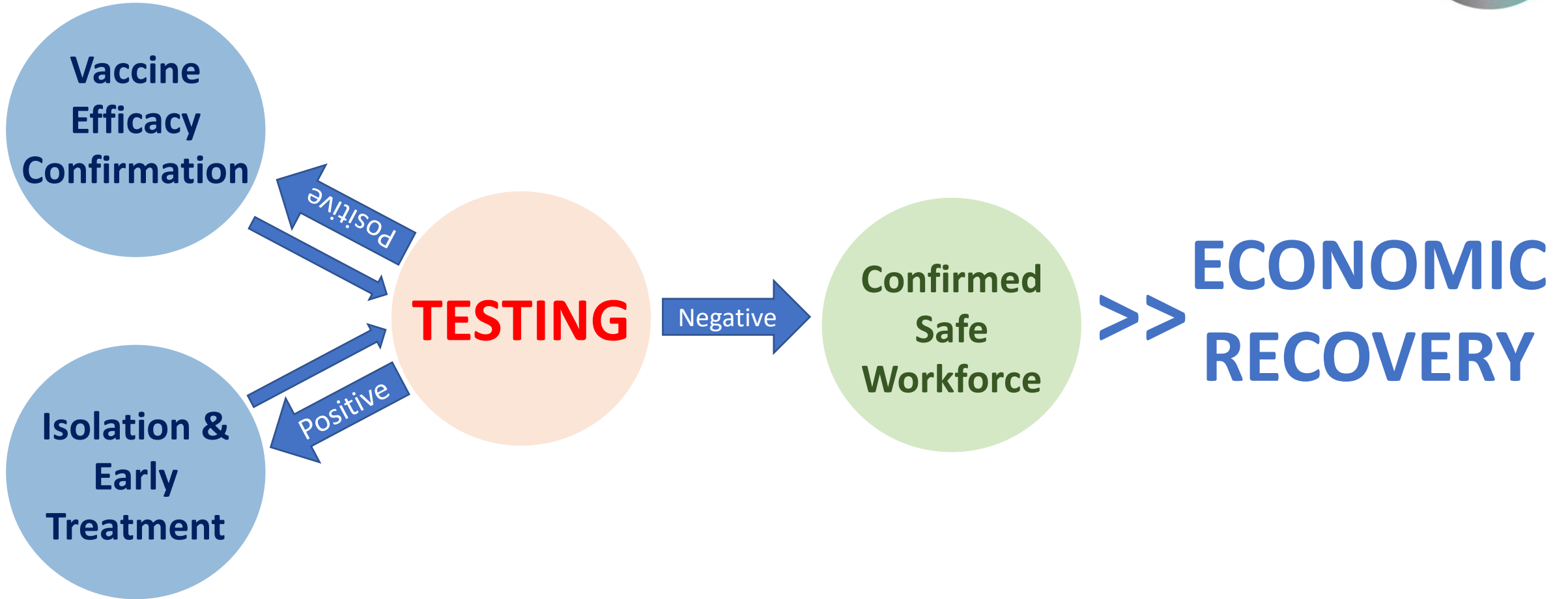
Chart: SCMP • Source: Johns Hopkins University, WHO and health authorities • [Get the data](#) • Created with [Datawrapper](#)

Last updated: 30 Jul, 5:12PM

Source: <https://www.scmp.com/coronavirus>



TESTING AND ECONOMIC RECOVERY



STRATEGY FOR CONTAINMENT & RECOVERY



Prevention

1. Containment – Isolation
2. Diagnosis
 - a) Fast & Accurate Screening
 - b) Diagnosis - Comprehensive
3. Vaccination (Efficacy & Time)

Treatment

Early Treatments

- Hydroxychloroquine
- Remdesivir
- Cocktail formula
- TCM etc.

Recovery – Diagnosis / Screening is First & Key

>> Isolation & Early Treatment

>> Vaccination needs diagnosis to confirm efficacy

>> To certify SARs-Cov-2 negativity to ensure workforce safety

STRATEGY THAT WORKS IN PANDEMIC



	Population	Testing Scheme	Tests (%)	Confirmed Cases (%)	Deaths	Death Rate	Avg Age
Lombardy	10.1 M	Significant Symptoms	607,863 (6.04%)	85,775 (0.85%)	15,600	18.2%	45.4
Veneto	4.9 M	Active Surveillance / Screening	536,798 (10.94%)	19,030 (0.39%)	1,800	9.5%	45.1
Indonesia	267.7 M	Significant Symptoms	50,000 (0.019%)	57,770 (0.0216%)	2,934	5.1%	30.5
Vietnam	95.8 M	High Screening Isolation	>200,000 (0.21%)	355 (0.00037%)	0	0%	30.9
New York	19.4 M	Close on 17-Mar	17-Mar	412,000 (2.17%)	32187	7.8%	34.2
California	39.5 M	Close on 25-Feb	25-Feb	389,000 (0.98%)	7697	2.0%	36.7
Hong Kong	7.5 M	Active Surveillance	Data not available	1,886 (0.025%)	12	0.6%	44.8
Korea	51.6 M	Full Surveillance	1,200,000 (2.33%)	13,771 (0.027%)	296	2.2%	40.8



SUMMARY OF OBSERVATION

1. The early screening to identify the virus that can enable effective isolation: Germany; Taiwan, Macau, Vietnam
2. Extensive Surveillance Screening Testing: Korea; Veneto; Vietnam and Hong Kong
3. Isolation: China; Taiwan, Vietnam and (California vs New York)
4. Personal Hygiene: Face covering and social distancing:
Asian Vs Western: Need Education & Self Discipline

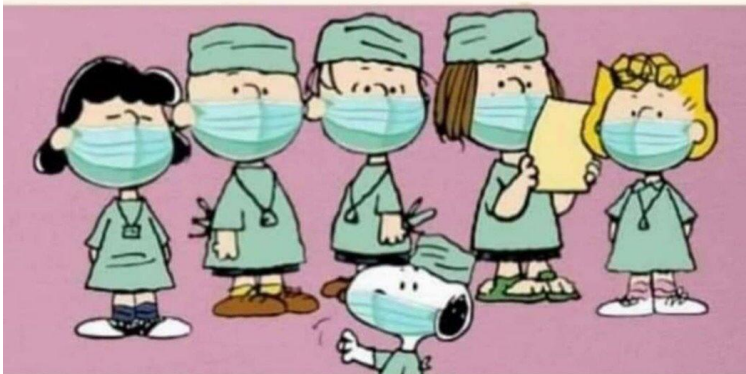
Test to identify COVID => Isolation & early treatment

Isolation and strict personal hygiene prevent spread

STRATEGY FOR CONTAINMENT & RECOVERY



A **MASK** is better
than a ventilator.
HOME is better than **ICU**.
PREVENTION is better
than treatment.
It's not curfew.
It's **CARE FOR U**.



Source: cannot find original citation

How Hard Will GDP Be Hit in 2020?

Projected change in GDP in 2020 compared to 2019 in a single-hit COVID-19 scenario*



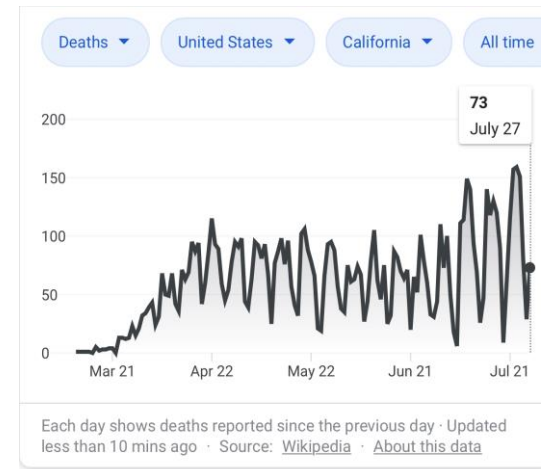
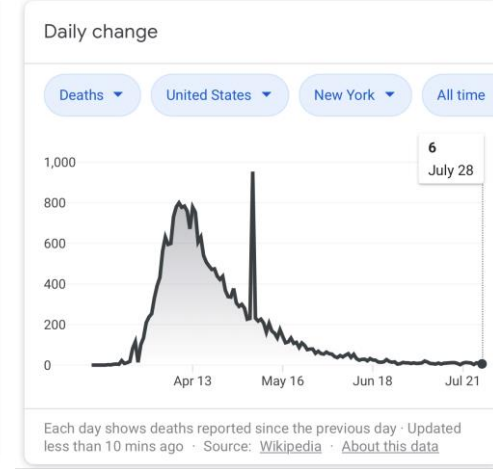
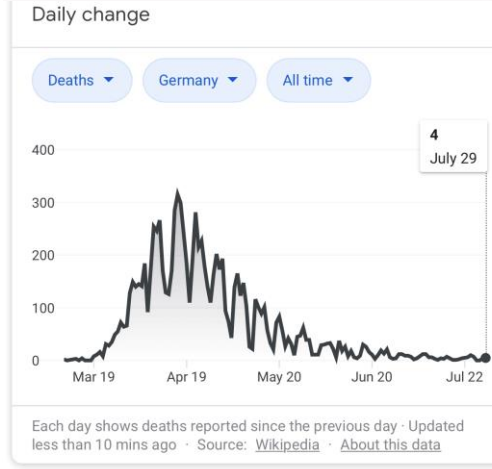
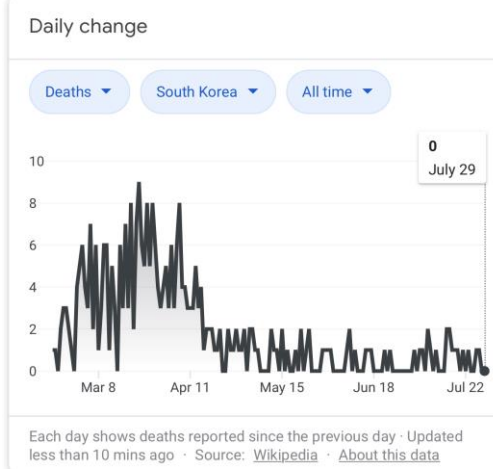
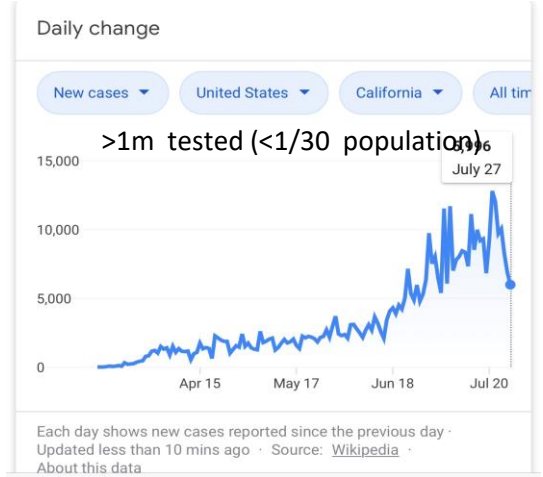
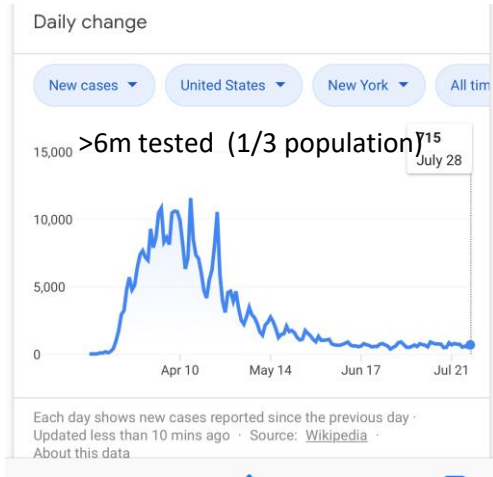
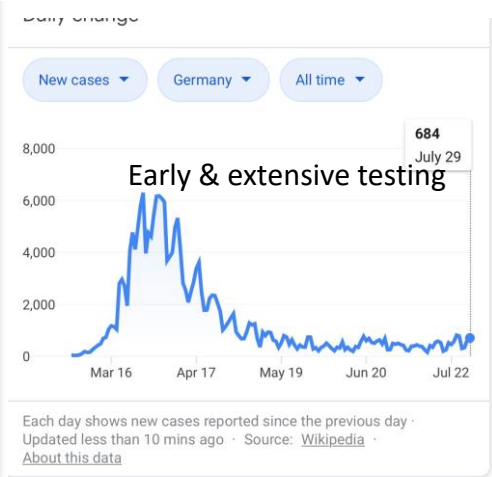
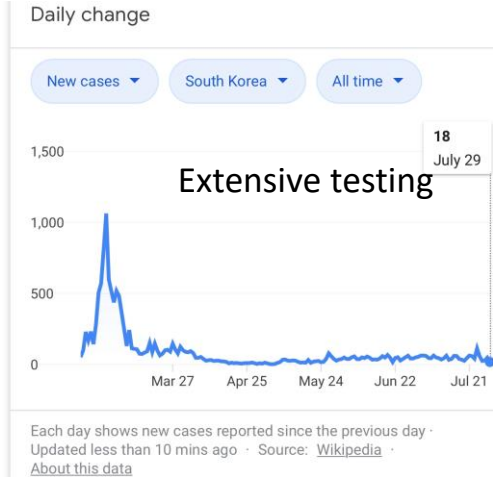
Selected countries.

* 'Single-hit' refers to a scenario where a second wave of infections does not occur before the end of 2020.

Source: OECD



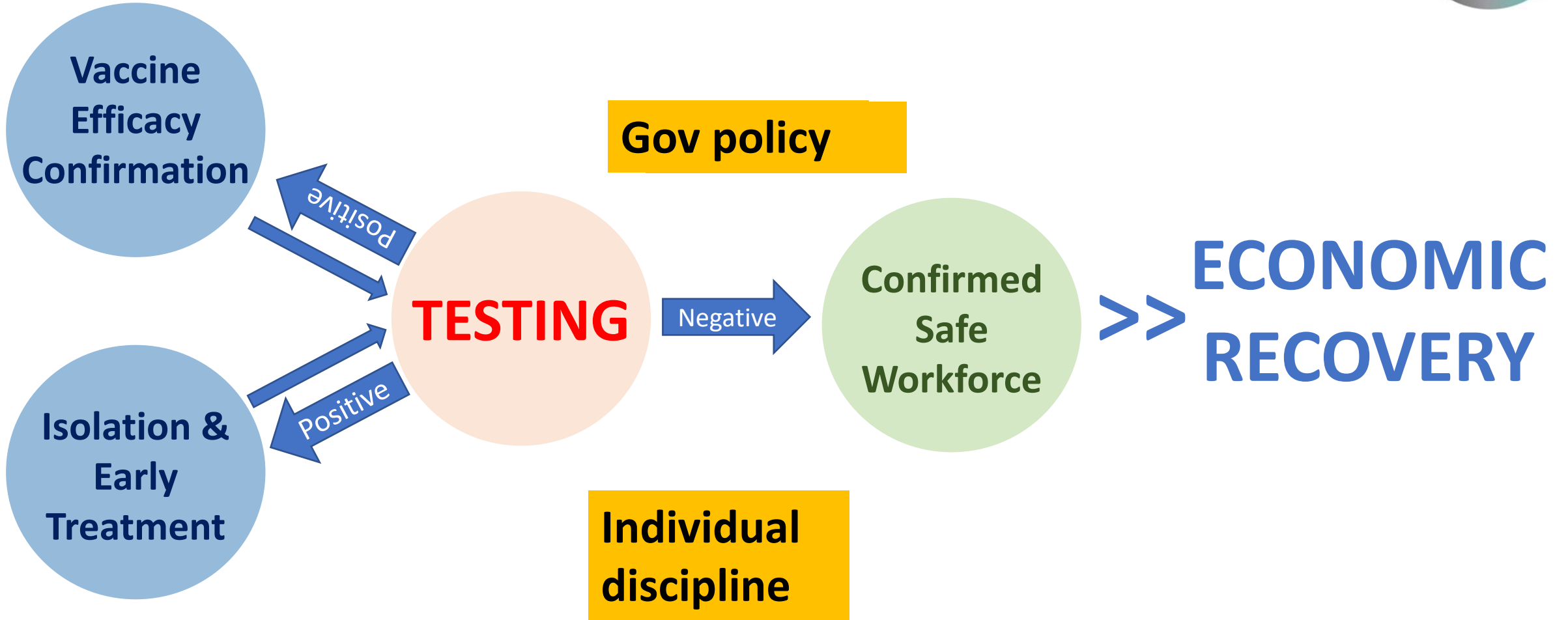
statista



data from Source: Wikipedia Template: COVID-19 pandemic data



TESTING AND ECONOMIC RECOVERY





Dr HY Poon, PhD Cambridge, UK

- Project Director at JTTC
- Assisting Prof Tam with project developments and fund raising
- A pharmacologist and pharmacist by training
- Previous experience in clinical trial, diagnostics, botanical pharmaceutical and clean energy project developments



“TEST, TEST, TEST”

Continuum of Medical Care

Most Diseases: **Prevention-Diagnosis-Treatment**

Infectious Diseases: Prevention-Diagnosis-
Treatment/**Prevention**



“TEST, TEST, TEST”

- **Testing** has been the WHO’s core strategy against the current COVID-19 pandemic.
- Current COVID-19 pandemic highlights the importance of diagnostic technologies in the fight against **novel** infectious diseases.
- Innovations in diagnostic technologies help quickly built the **first** line of defense in the fight against any outbreaks of infectious diseases, both known or unknown.



TESTING IS CRITICAL : AVAILABILITY

Timeline of COVID-19 test development

- Jan 10 Coronavirus genome released by Chinese scientists online.
- Jan 15 First known Covid-19 sufferer arrived on US soil.
- Jan 16 Scientists in Germany announced the development of the first diagnostic test for COVID-19
- Jan 27 First COVID-19 test approved in Korea
- Jan 20 US CDC confirmed the first positive case of COVID-19 in the US.
- Jan 24 CDC introduced to the world the new test kit for COVID-19.
- Feb 06 WHO shipped out 250,000 diagnostic tests (partly based on the German design) to 70 labs around the world.
- Feb 18 CDC warned laboratories across the country against the use of non-FDA approved testing kits.
- Feb 28 CDC unveiled new Covid-19 test kit and streamlined commercial testing development
- Feb 29 CDC announced the 1st death from COVID-19 in the US and barely 4,000 people had been tested nationwide.



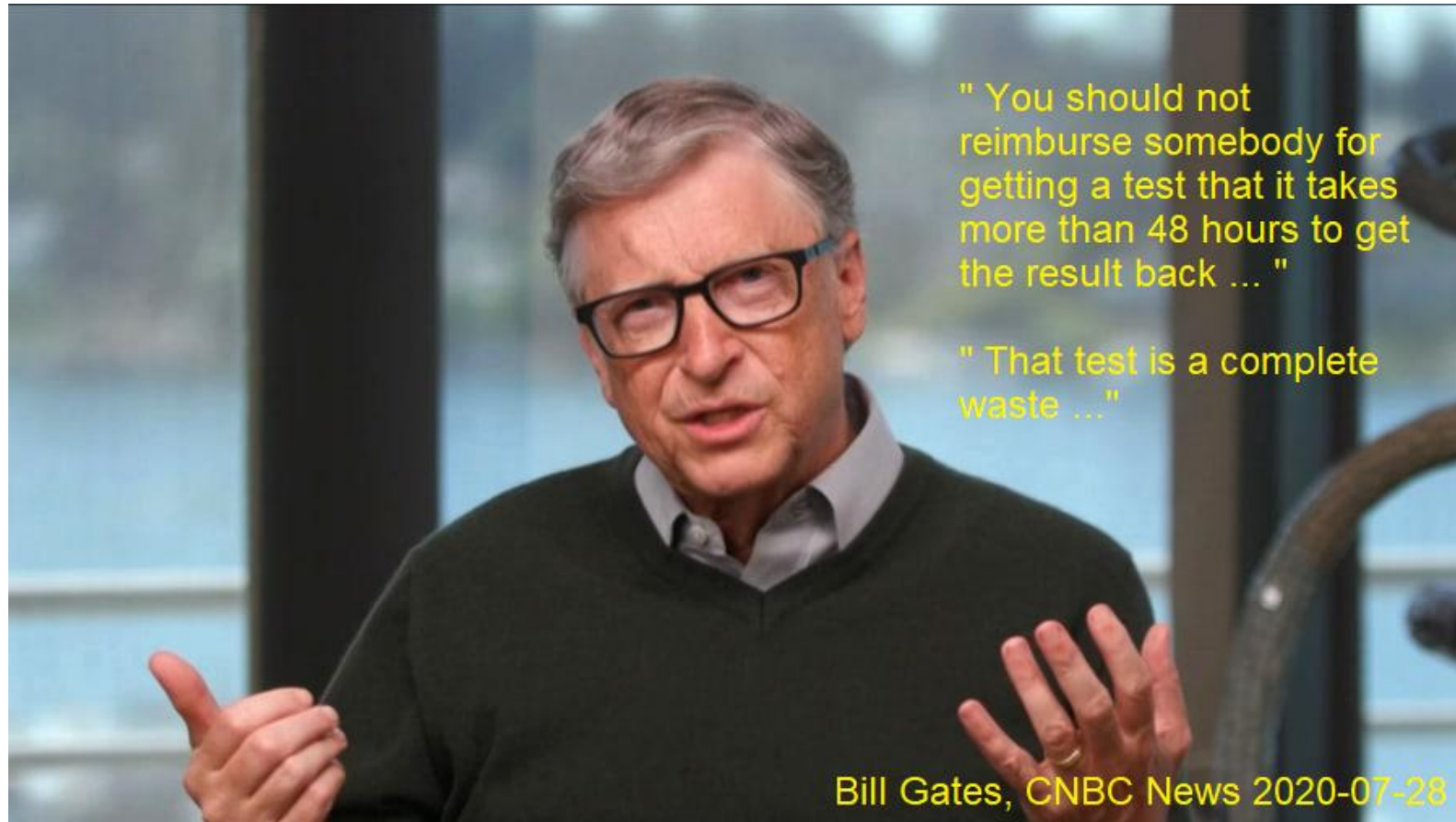
TESTING IS CRITICAL : **AVAILABILITY**

Outcome:

- **Irreversible damage** has been done to the effort to contain the spread of COVID-19 in the month when US CDC and FDA were struggling to come up with a functional test for COVID-19.
- As of July 30, **4,568,375** confirmed cases and **153,848** deaths have registered in the US.
- If the current trend remains unchecked, soon a 100,000 daily new cases have been projected.

<https://www.worldometers.info/coronavirus>

TESTING IS CRITICAL : **SPEED**



The turnaround time for Covid-19 tests can take several days to a **week** or longer for many patients in the US.



TESTING IS CRITICAL : **SPEED**

- **Speed** is most critical for effective contact tracing.
- A delay of **3 days** or more between symptom onset and testing will not sufficiently reduce onward transmission of the virus.
- Long turnaround time means extended period of disease spread and delayed medical intervention



TESTING IS CRITICAL : **SPEED**

- **Pooled testing** increase COVID-19 screening without added resources.
- Samples from multiple individuals are tested **together** and a negative result would clear all pooled samples.
- If positive, each member of the pool is then tested individually.



TESTING & SEQUENCING

- By sequencing the virus from **EVERY** person infected in **Iceland**, researchers get to find out how the infection was caught, the way it spreads, and how it mutates as it spreads.
- This '**molecular epidemiology**' can reveal the geographic origin of the virus in every single case.



TESTING & SEQUENCING

Insights into **how** COVID-19 spreads

- Parents commonly infected their children but rarely the other way round.
- Research done by HKU has also found that viral genetic sequences in some cases emerging in the current wave were different from those in the previous months, suggesting the current infections came from imported cases.

EMERGING COVID-19 DIAGNOSTICS



Artificial Intelligence

- AI-powered diagnosis system developed by **Alibaba** claims to detect new COVID-19 cases (up to **96% accurate**) using computerized **tomography scans** to complete the recognition process within **20 seconds**.

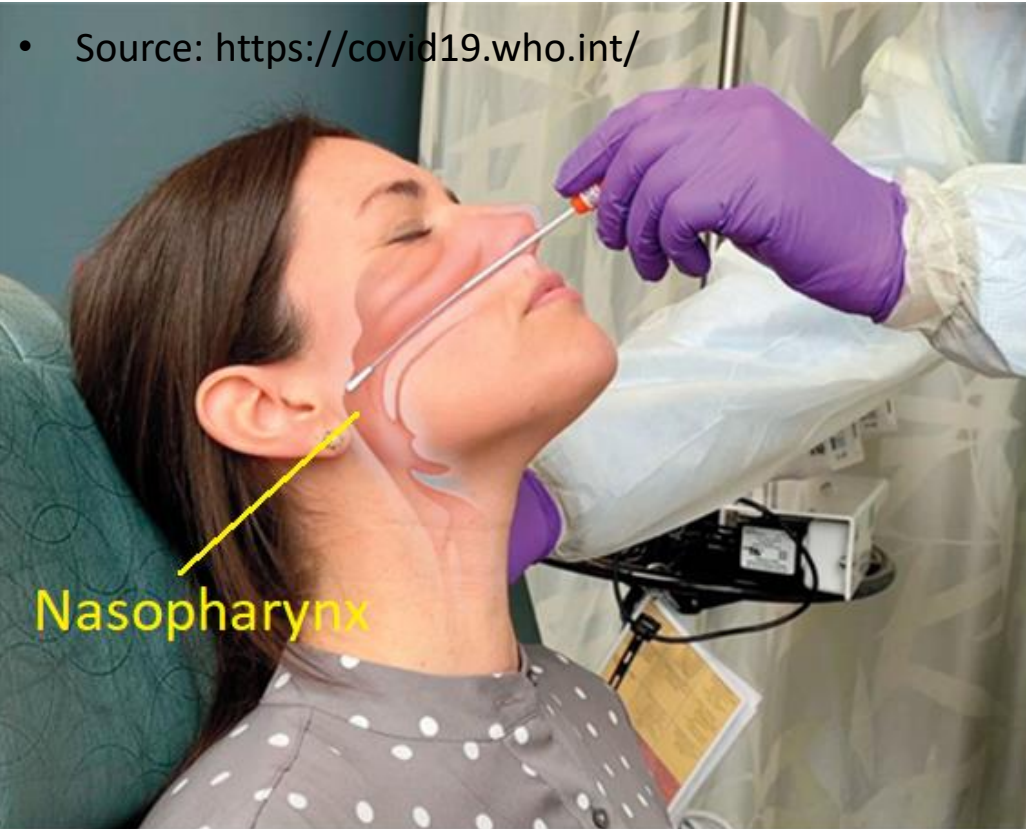
EMERGING COVID-19 DIAGNOSTICS



Big Data & AI

- **BlueDot** in Toronto uses a platform built around big data, AI and machine learning to track and **predict the outbreak** and spread of infectious diseases by gathering data globally 24/7. BlueDot had spotted what would come to be known as COVID-19, **nine days** before WHO released an official alert about the emergence of a novel coronavirus.

EMERGING COVID-19 DIAGNOSTICS



Manual collection of nasopharyngeal specimens with the swab technique

Source: <https://brainnavi.com/nasalswabrobot/>

EMERGING COVID-19 DIAGNOSTICS



Robotics (Brain Navi, Taiwan)

- Nasal swab is to insert into the nasopharyngeal cavity a swab and rotating it several times to collect sample for to test for coronavirus
- **Automatic** sample collection by robots minimizes the risk of exposing healthcare providers to infection
- The robot uses **facial recognition** to determine precise nostril position before swab insertion

EMERGING COVID-19 DIAGNOSTICS



4

Facial Recognition of the patient

EMERGING COVID-19 DIAGNOSTICS



Mircofluidics & Lab-On-Chip

- **Sanwa Biotech's** microfluidic, disposable **Lab-On-Chip (LOC) platform** comprises of an array-based LED-induced fluorescence immunoassay device, a single-use biochip, and the biomarker array for the diseases being diagnosed.
- The system, **fully automated** and **portable**, is able to diagnose a range of respiratory diseases, including COVID-19 antigen, within **15 minutes**, and with an accuracy of between **90 to 100 %**.



EMERGING COVID-19 DIAGNOSTICS



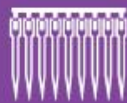
PHASiFY™ VIRAL SAMPLE COLLECTION

The PHASiFY™ VIRAL Sample Collection Kit safely collects patient sample for transport and testing by inactivating the virus upon collection.



PHASiFY™ VIRAL RNA EXTRACTION

The PHASiFY™ VIRAL RNA Extraction Kit concentrates viral RNA from the collected patient sample to make them easier to detect.



PHASiFY™ VIRAL RNA EXTRACTION (AUTOMATED)

The PHASiFY™ VIRAL RNA Extraction Kit (Automated) enables streamlined, fully automated workflow.



PHASiFY™ DeCOVID RT-qPCR

The PHASiFY™ DeCOVID SARS-CoV-2 PCR Detection Kit enables qualitative detection of nucleic acids from SARS-CoV-2. RT-qPCR tests are administered via a nasal or throat swab.

EMERGING COVID-19 DIAGNOSTICS



INDICAID[®] SALIVA ANTIGEN TESTS

Supported by the RADx program organized by the US National Institute of Health, the **INDICAID[®] Saliva Antigen Rapid Test** is the optimal, highly sensitive SARS-CoV-2 rapid antigen test, seamlessly integrating the PHASIFY™ sample preparation technology to boost the sensitivity of LFA detection without the need of equipment, power and training. *This test can be done anywhere, anytime, by anyone - a great convenience.*



INDICAID[®] BLOOD IgM / IgG RAPID TESTS

The **INDICAID[®] COVID-19 IgM/IgG Rapid Test** offers high sensitivity COVID-19 testing with results in only 10 minutes. Soon to be available using oral fluids and serum as sample inputs.



INDICAID[®] MASS TESTING SERVICE

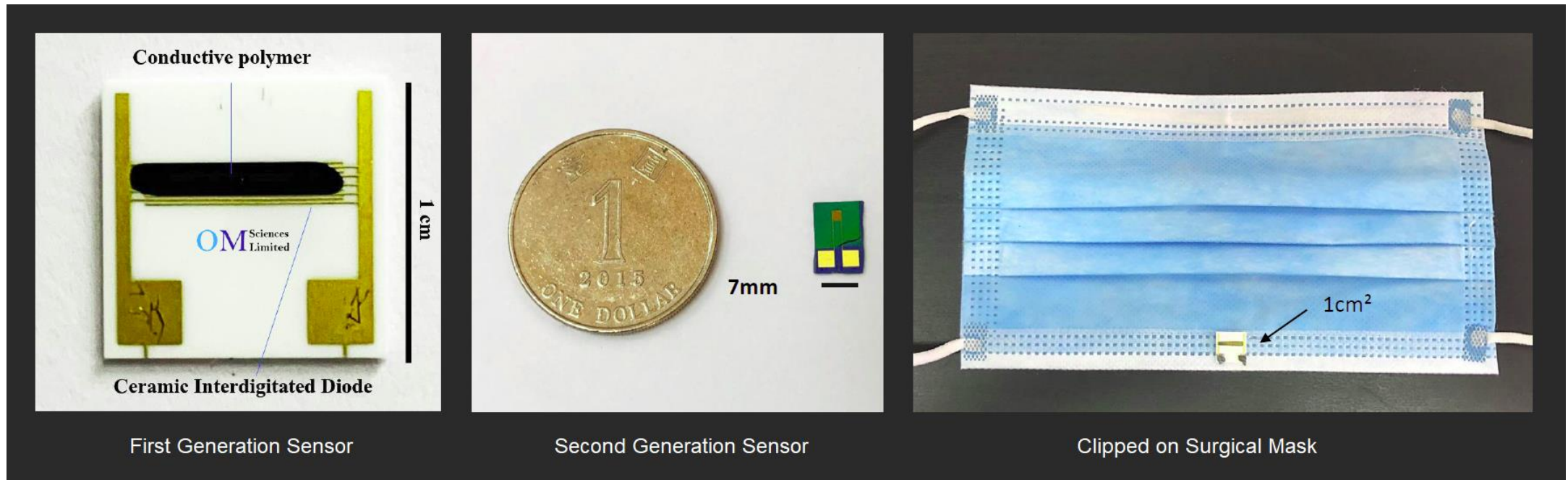
Operated by professional medical staff, the **INDICAID[®] COVID-19 Antibody Mass Testing Service** tests for COVID-19 antibodies with fingerstick blood, with results available after 10 minutes. A same-day professional report is generated by medical lab technicians, and a complimentary PCR test will be offered if the result is positive.

Source: Phase Scientific International (PSI)

EMERGING COVID-19 DIAGNOSTICS

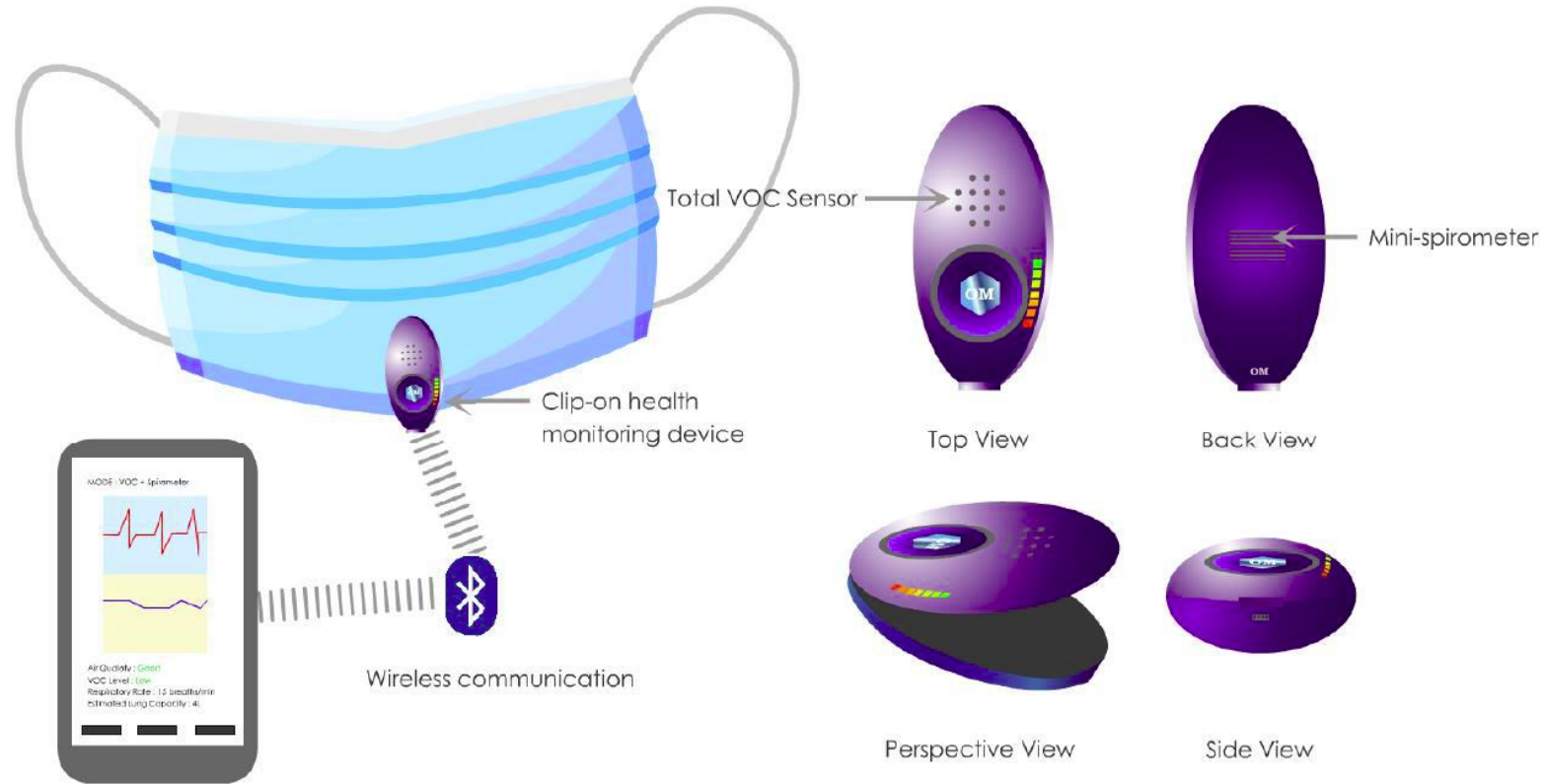


OM SCIENCES – PORTABLE SPIROMETER ON MASK



Source: OM Science



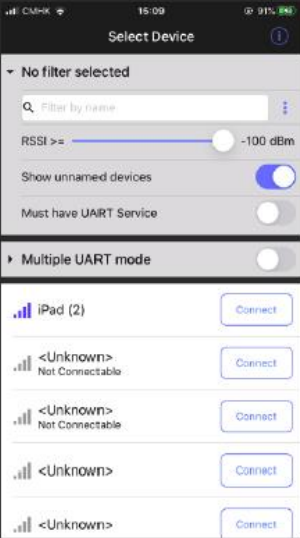
EMERGING COVID-19 DIAGNOSTICS



Concept art of OM Spirometer or VOC sensor

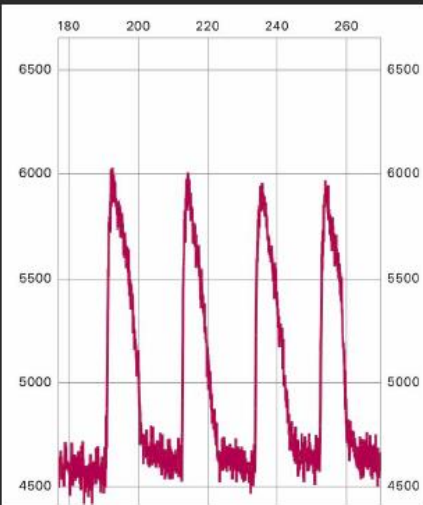
Source: from OM Science

EMERGING COVID-19 DIAGNOSTICS

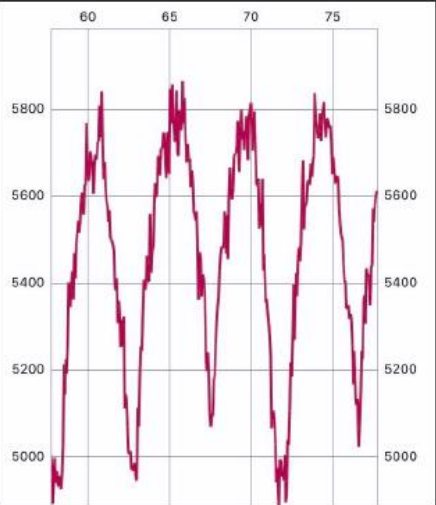


1. Connect the sensor with the app using Bluetooth

2. Put the sensor under the mask then breath normally



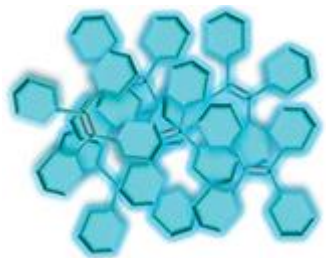
Forced vital capacity (FVC)



Normal breathing

3. Exhale and inhale data will be transferred to smartphone

Source: from OM Science



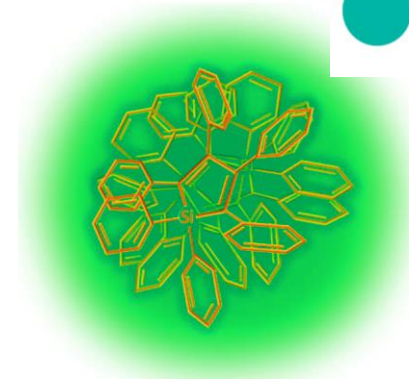
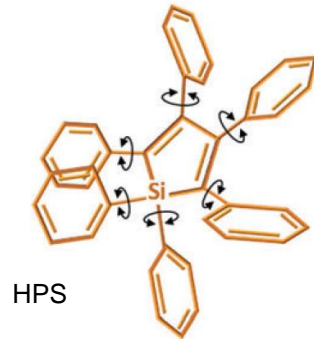
Aggregation-Induced Emission



The Hong Kong **U**niversity of
Science and **T**echnology



Aggregation-Induced Emission (AIE) Molecules – A New Generation of Fluorescent Probe



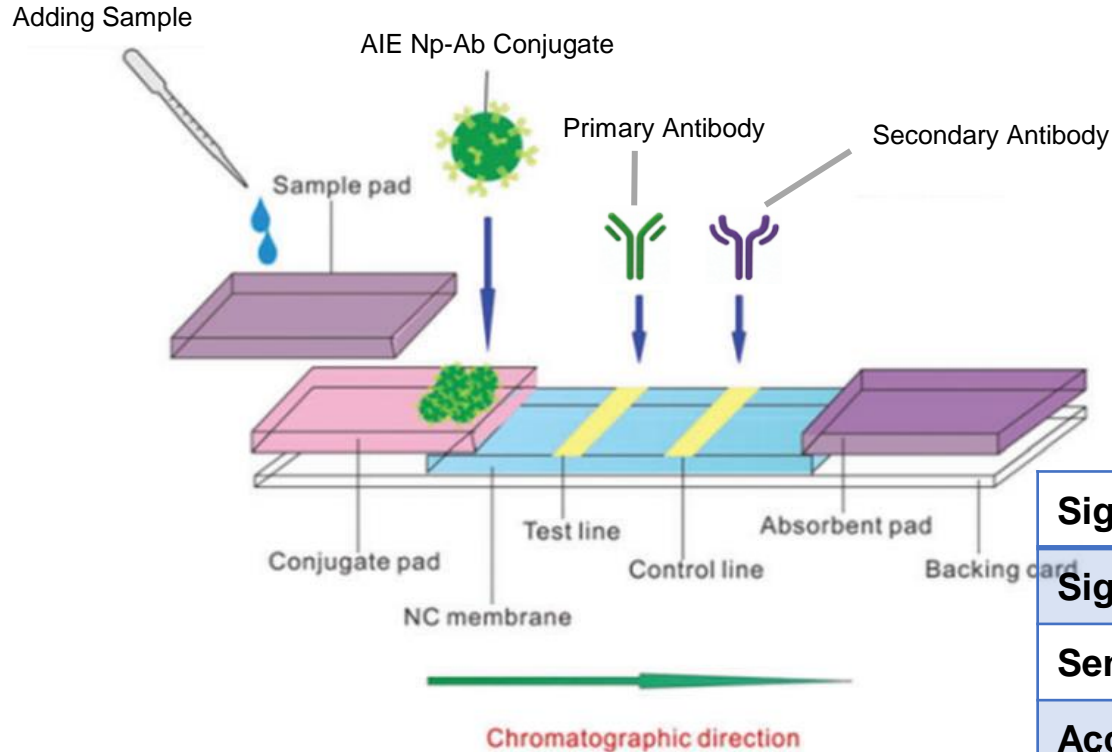
Non-Emissive in Solution under Light Irradiation
Emission is quenched by intramolecular rotation

AIE molecules in good solvents

Highly Emissive in Aggregates under Light Irradiation
Restriction of intramolecular rotation
AIE molecules in poor solvents or
solid state or polymer matrix

	FITC (traditional fluorophores)	AIE fluorophores
Photostability	Susceptible	Resistant
Luminescence Quantum Yield	Low	High
Quenching in High Concentration	Yes	No
Background Signal	High due to small stokes shift	Low due to large Stokes shift
Nanoparticle Form	Inferior due to concentration quenching	Perfect

Lateral Flow Immunoassay for nCovid-19 Detection



Signal Label for LFA	Colloidal Gold	AIE-Np
Signal Output	Colour	Luminescence
Sensitivity	Low	Very High
Accuracy	Low	High
Detection Range	Narrow	Wide
Read-out Mode	+ / --	Digital



IP RIGHTS VS NATIONAL EMERGENCY

- **Private** Property Right vs Public Good
- **Compulsory licensing** (TRIPS, WTO) offers governments to get round patent protection to ensure that generic versions of patented **innovations** be made available at **affordable** prices.
- **AbbVie** has relinquished global patent rights of potential COVID-19 treatment of **Kaletra**. **Gilead Sciences** has a similar arrangement for its **remdesivir**.
- **Royalty** rates set variably at certain % of generic prices by governments, e.g. 0 – 6% Japan, 0 – 4% Canada.



TESTING AND ECONOMIC RECOVERY

- Diagnostic testing may offer the faltering economies a lifeline – **Immunity** Passport
- Conduct blood testing to identify people who have recovered from COVID-19 and may have COVID-19 antibodies in the body to build up a “safe” workforce.

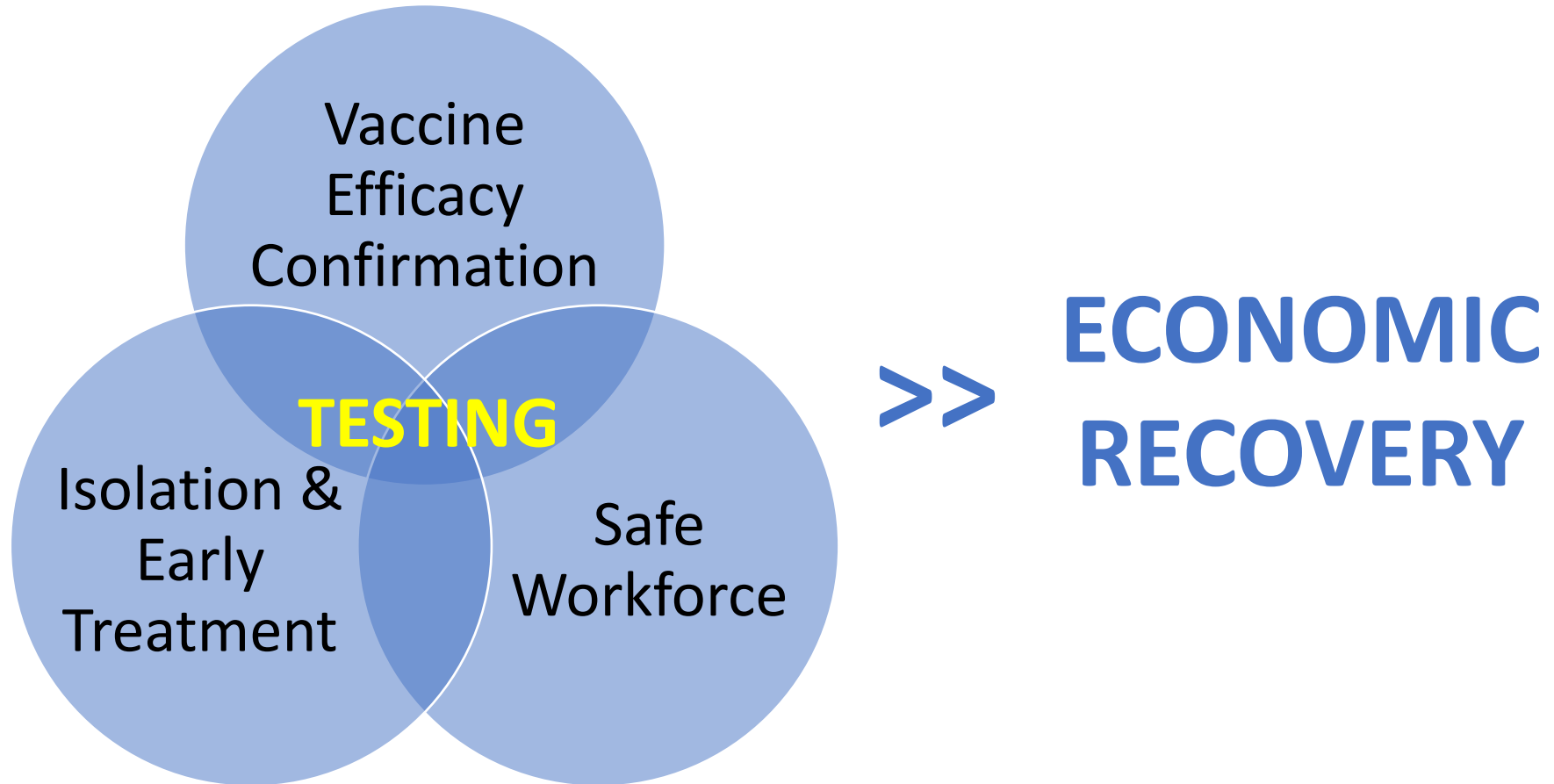


TESTING AND ECONOMIC RECOVERY

Hurdles to overcome:

- There is currently no conclusive **scientific** evidence supporting the notion that patients recovered from COVID-19 have sufficient antibodies to be immune from a re-infection as in the case of lifelong immunity in people recovered from chicken pox or polio.
- **Ethical** issues – Immunity passport system may establish a new divide in society, i.e. the immuno-privileged and the immuno-deprived and lead to even more socio-economic issues.

TESTING AND ECONOMIC RECOVERY





Thank You



POSITIVE TEST RATES OF US STATES

How each state's current testing measures up

New York Times 2020-07-27

Average daily testing and hospitalizations in the last two weeks

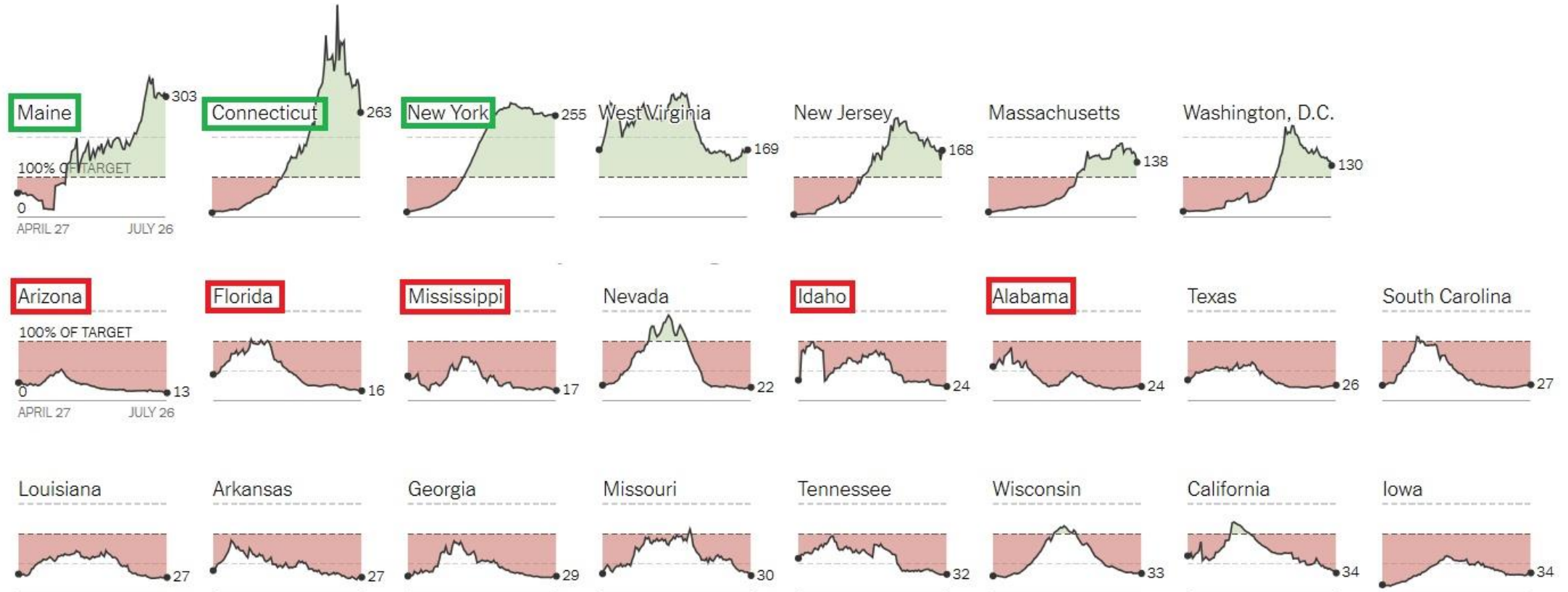
	DAILY TESTS PER 100,000	PERCENTAGE OF TESTING TARGET	Target	▲ POSITIVE TEST RATE	HOSPITALIZED PER 100,000
United States	242	38		8%	18
New York	329	255		1%	4
Connecticut	248	263		1%	2
Maine	176	303		1%	1
Vermont	160	344		1%	3
Arizona	168	13		23%	43
Florida	270	16		19%	42
Alabama	201	24		19%	30
Mississippi	211	17		18%	38
Idaho	164	24		18%	11



POSITIVITY & TESTING LEVEL

Rate of testing compared to target

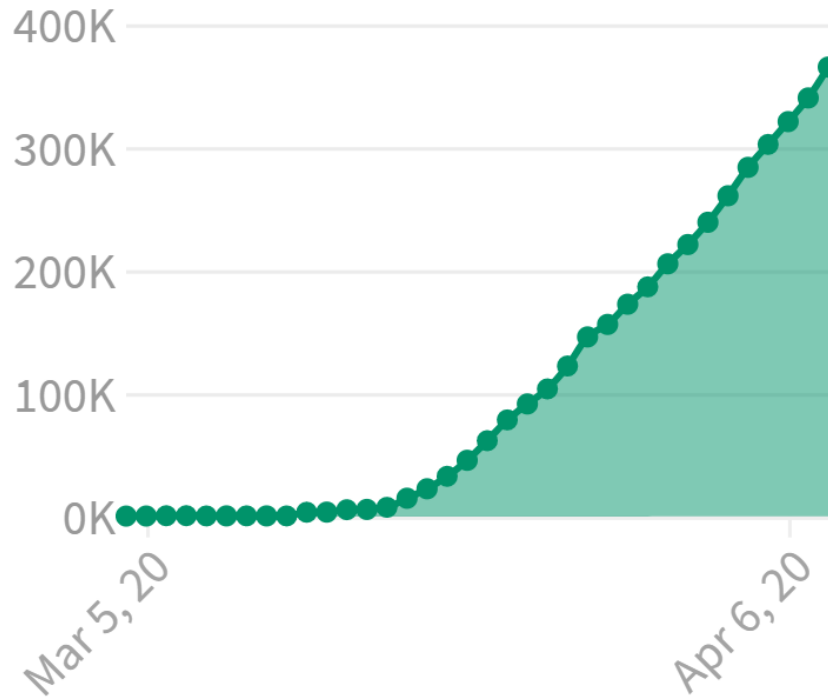
States are ordered by current testing levels (or shortfall)



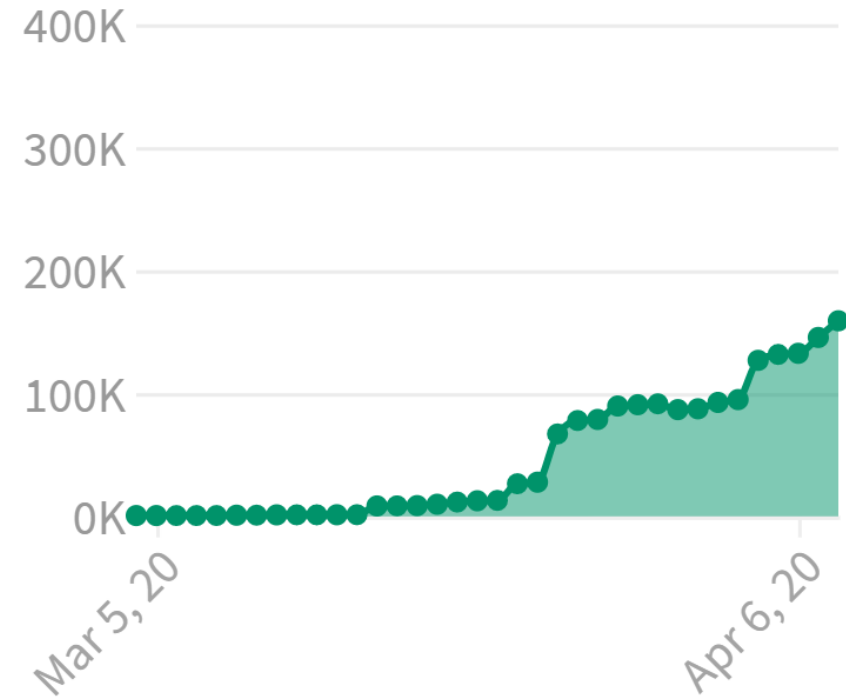


CALIFORNIA VS NEW YORK – TESTING

New York



California

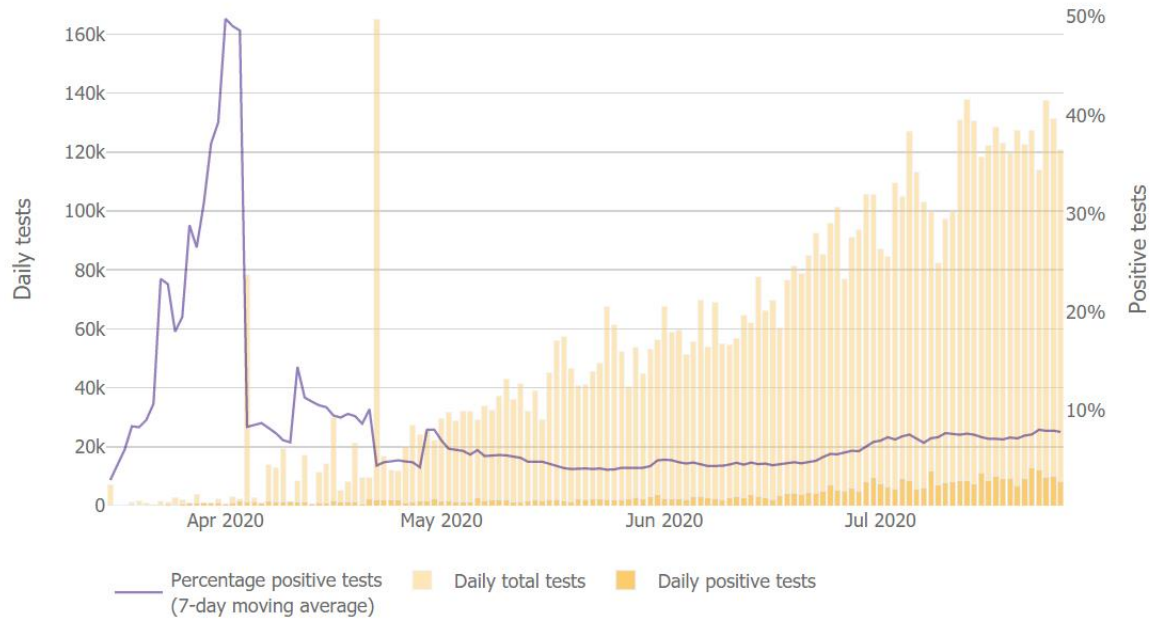


<https://www.businessinsider.com/state-coronavirus-testing-compared-timeline-2020-4>

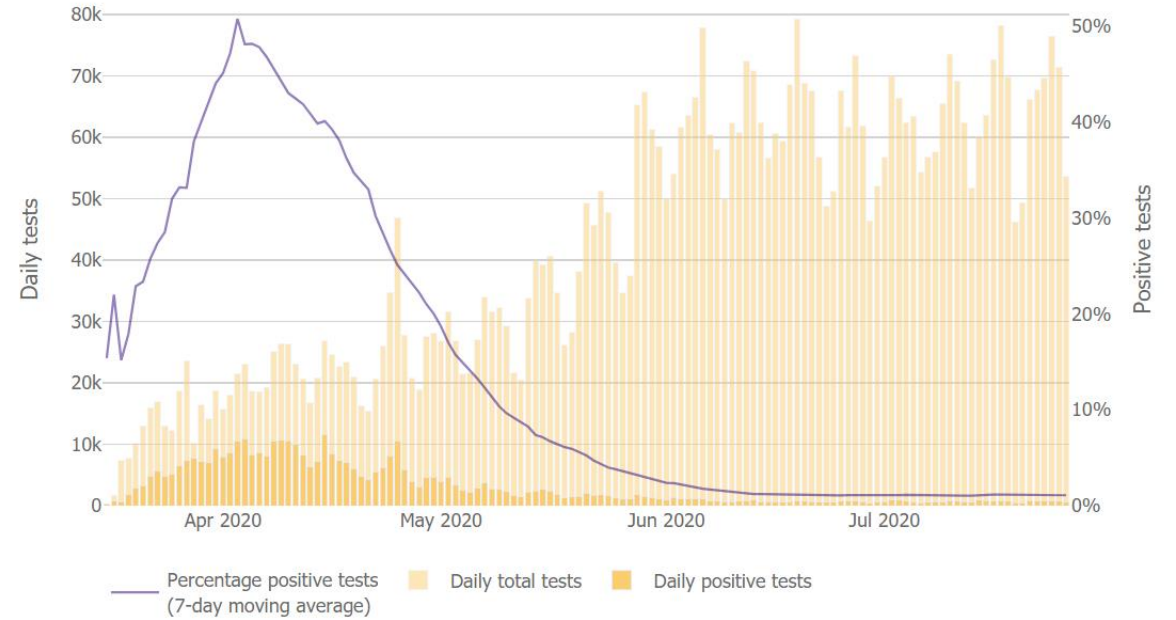
CALIFORNIA VS NEW YORK – POSITIVITY



California ▼



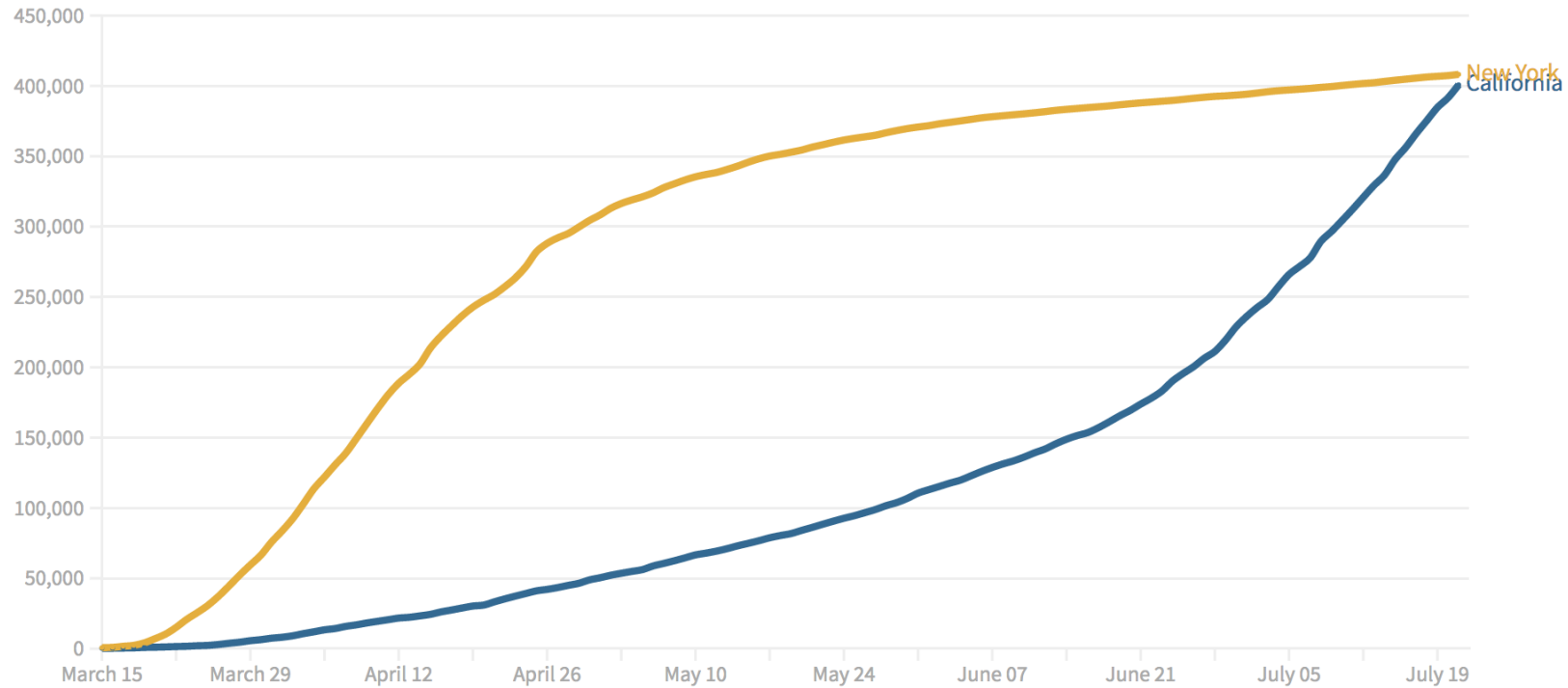
New York ▼





CALIFORNIA VS NEW YORK – CASES

Cumulative COVID-19 Cases for California vs New York
California is about to surpass New York in total cases.



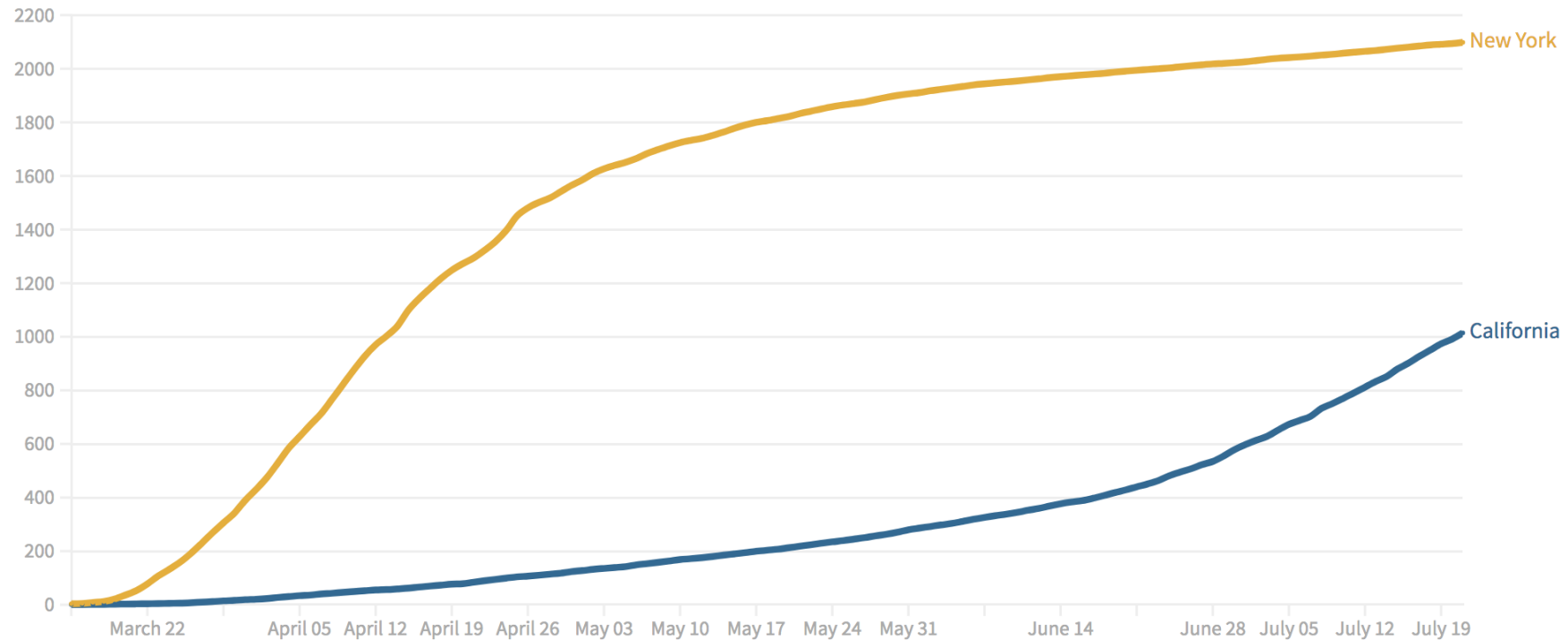
Source: [COVID Tracking Project](#)



CALIFORNIA VS NEW YORK – TESTS

Per Capita Cumulative COVID-19 Cases for California vs New York

New York's rate is currently double that of California, even with cases rapidly rising.



Source: [COVID Tracking Project](#) • Per capita is calculated per 100,000 people.