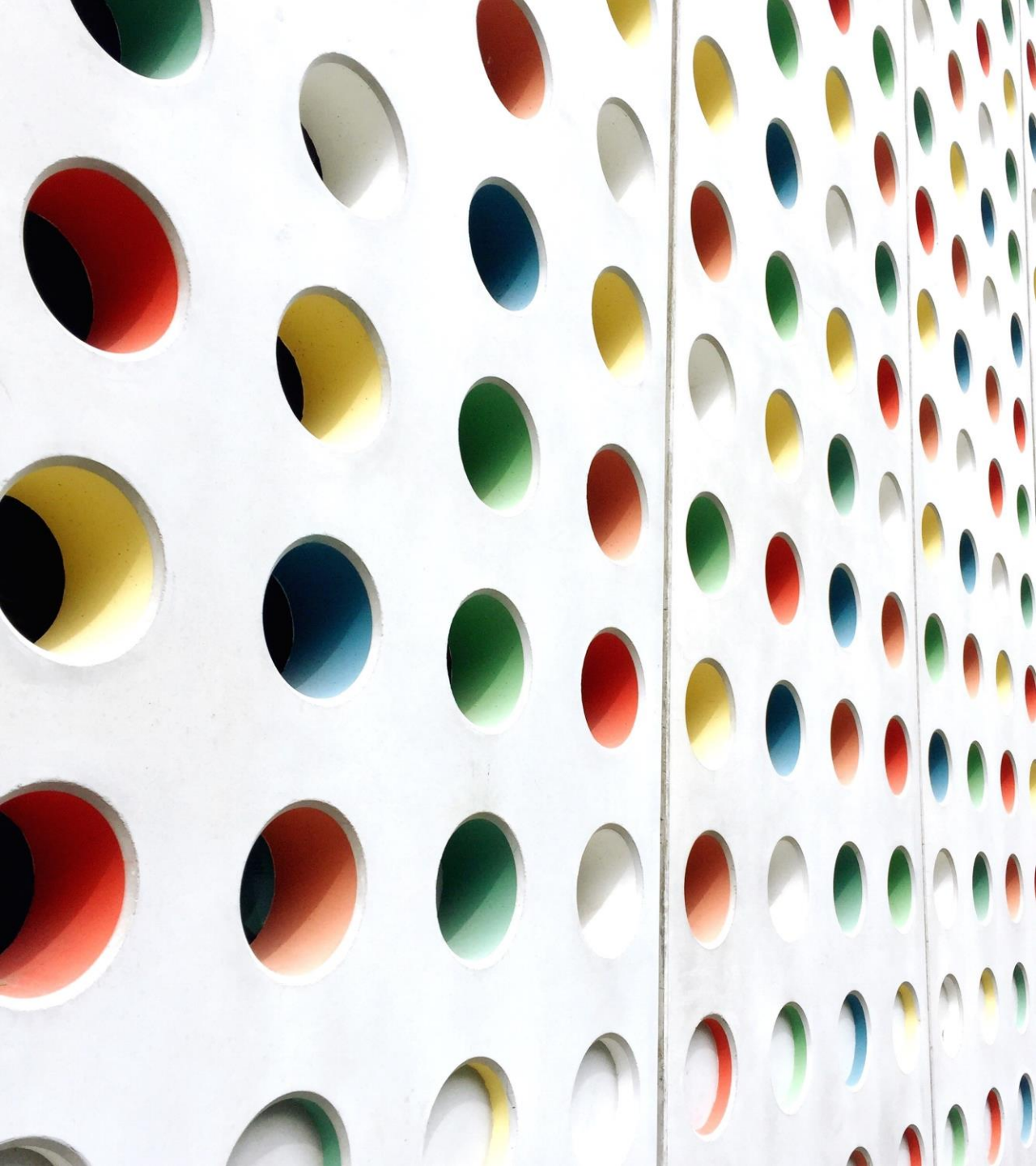




Digital technologies in the public-health response to COVID-19

NATURE MEDICINE- 2020

Introduction

Digital technologies are being harnessed to support the public-health response to COVID-19 worldwide, including **population surveillance, case identification, contact tracing and evaluation of interventions on the basis of mobility data and communication with the public.**

These rapid responses leverage billions of mobile phones, large online datasets, connected devices, relatively low-cost computing resources and advances in machine learning and natural language processing.

This Review aims to capture the breadth of digital innovations for the public-health response to COVID-19 worldwide and their **limitations, and barriers to their implementation, including legal, ethical and privacy barriers, as well as organizational and workforce barriers.**

Digital epidemiological surveillance

Online data sources for early disease detection

machine learning

Survey apps and websites

Data extraction and visualization

Data dashboard

Online data sources for early disease detection

natural language processing and machine learning:

Web-based epidemic intelligence tools and online syndromic surveillance

Web-based epidemic intelligence tools

ProMED-mail

GPHIN (Global Public Health Intelligence Network)

HealthMap

EIOS (Epidemic Intelligence from Open Sources)

Based on social media or online search data

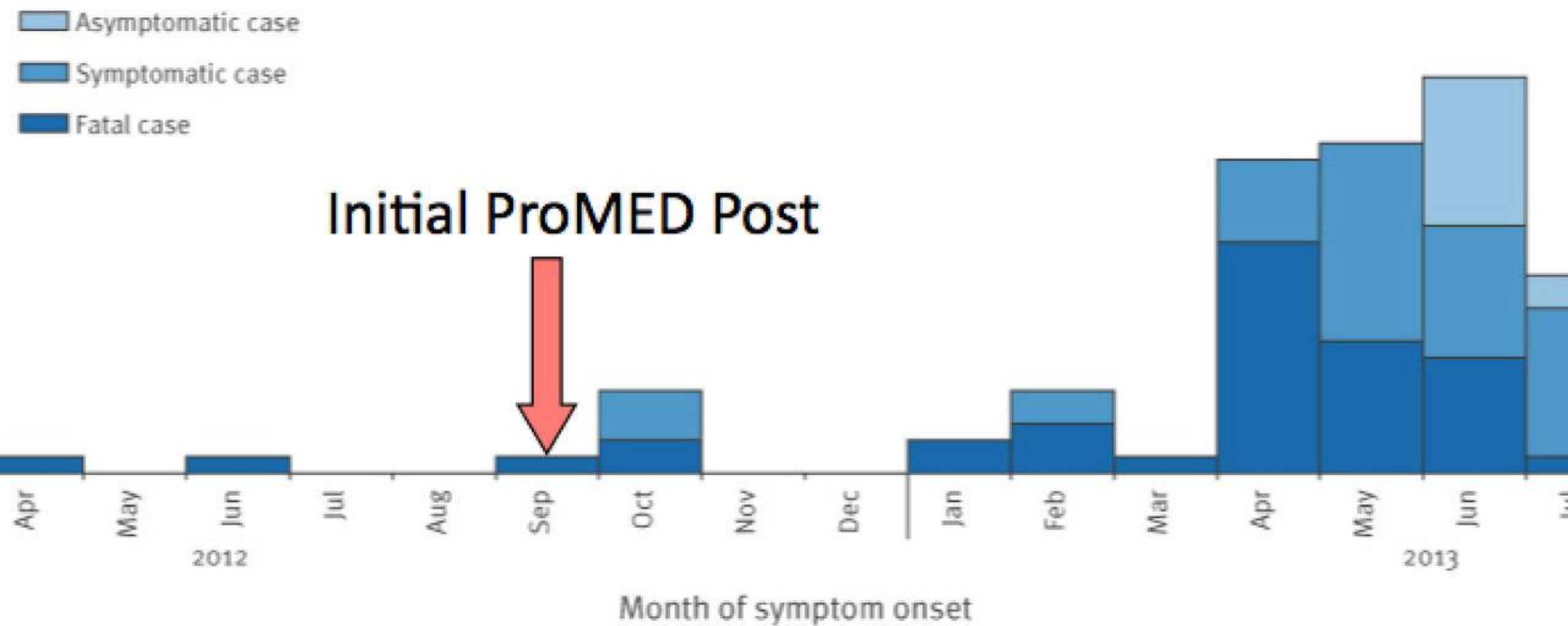
Baidu Index (Social media search indexes) in china

Survey apps and websites

Symptom reporting

e.g. COVID Near You in the USA, Canada and Mexico





st respiratory syndrome.



Apple COVID-19

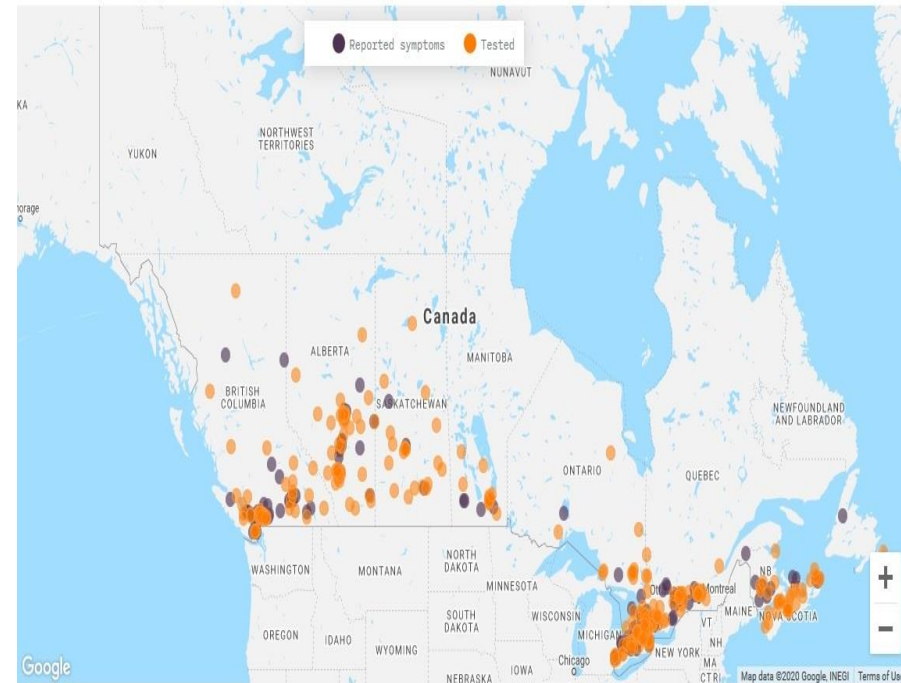
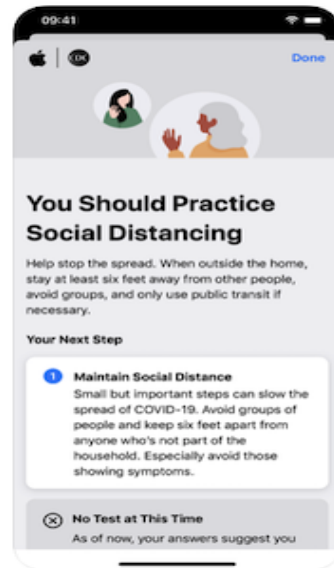
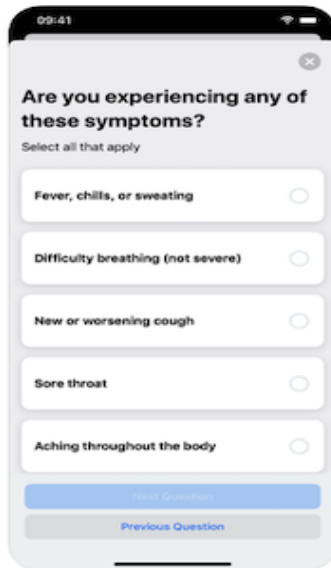
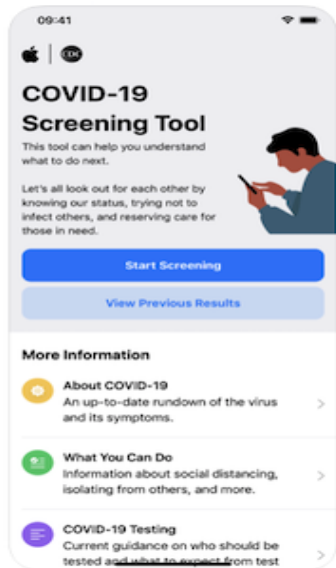
Apple

#1 in Health & Fitness

★★★★★ 4.4, 1.5K Ratings

Free

iPhone Screenshots



For the past 2 weeks in Canada

The data below shows

- 716 people on this site have reported COVID-19 symptoms
- 542 people on this site have reported taking a COVID-19 test

Continue to practice social distancing. This data represents submitted COVID-19 related symptom reports to this site, not confirmed cases in your area.

388615 people have reported on this site in Canada

COVID-19 activity in the Canada

(Since start of outbreak)

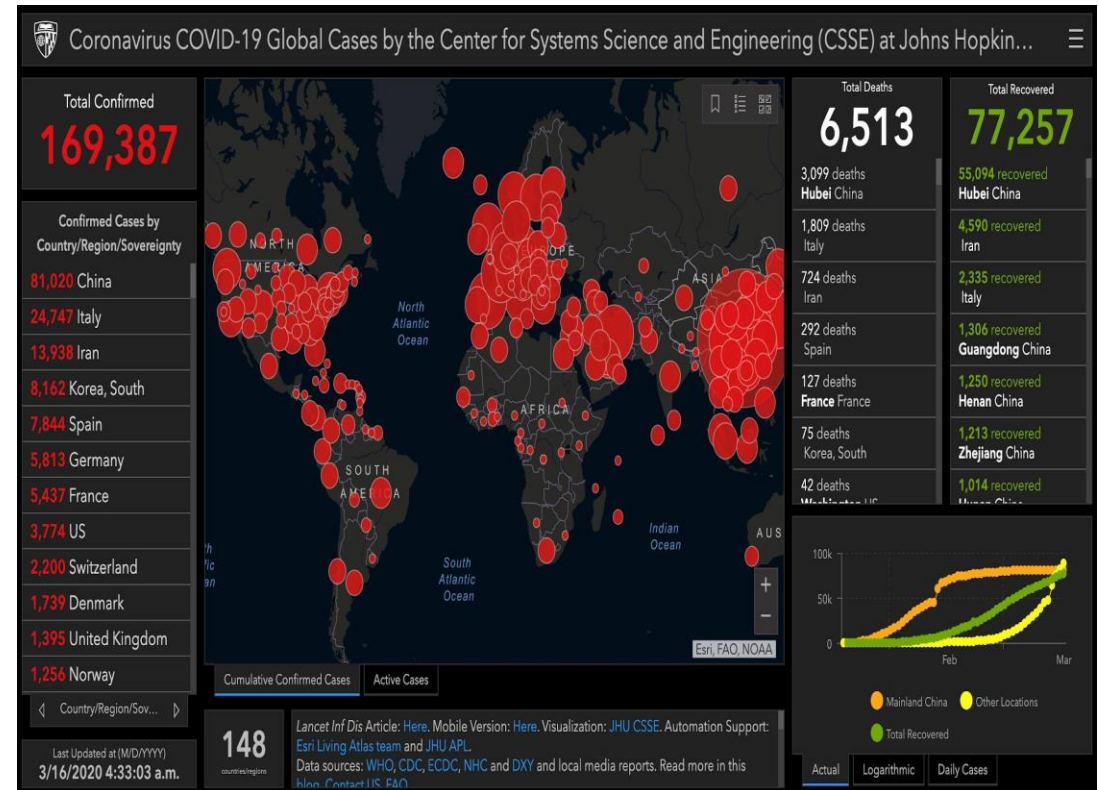
28289 confirmed cases [Data source](#)

1088 deaths [Data source](#)

Data-visualization tools for decision support

Data dashboards are being used extensively in the pandemic, collating real-time public-health data, including confirmed cases, deaths and testing figures, to keep the public informed and support policymakers in refining interventions.

COVID-19 dashboards typically focus on time-series charts and geographic maps, ranging from region-level statistics to case-level coordinate data



Rapid case identification

Connected diagnostic device

Sensors including wearables

Machine learning

Connected diagnostic device

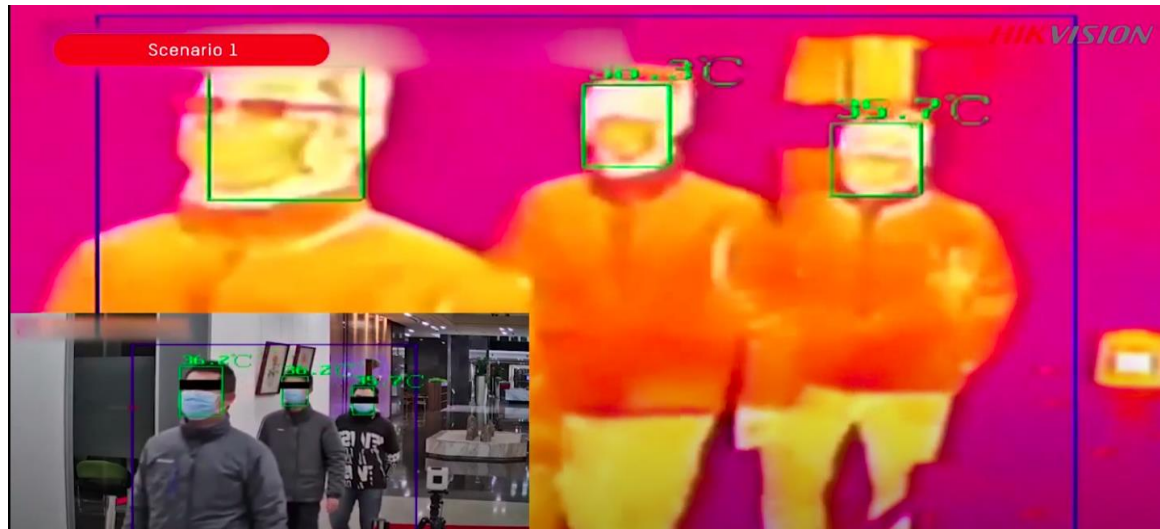
Digital technologies can supplement clinical and laboratory notification, **through the automation and acceleration of reporting to public-health databases**

Case identification by online symptom reporting, now offers advice on isolation and referrals to further healthcare services, such as **video assessments** and **testing**

this approach is suitable for symptomatic people, widespread testing of people and populations, as well as contact tracing, has a crucial role in case identification, as an estimated 80% of COVID-19 cases are mild or asymptomatic.

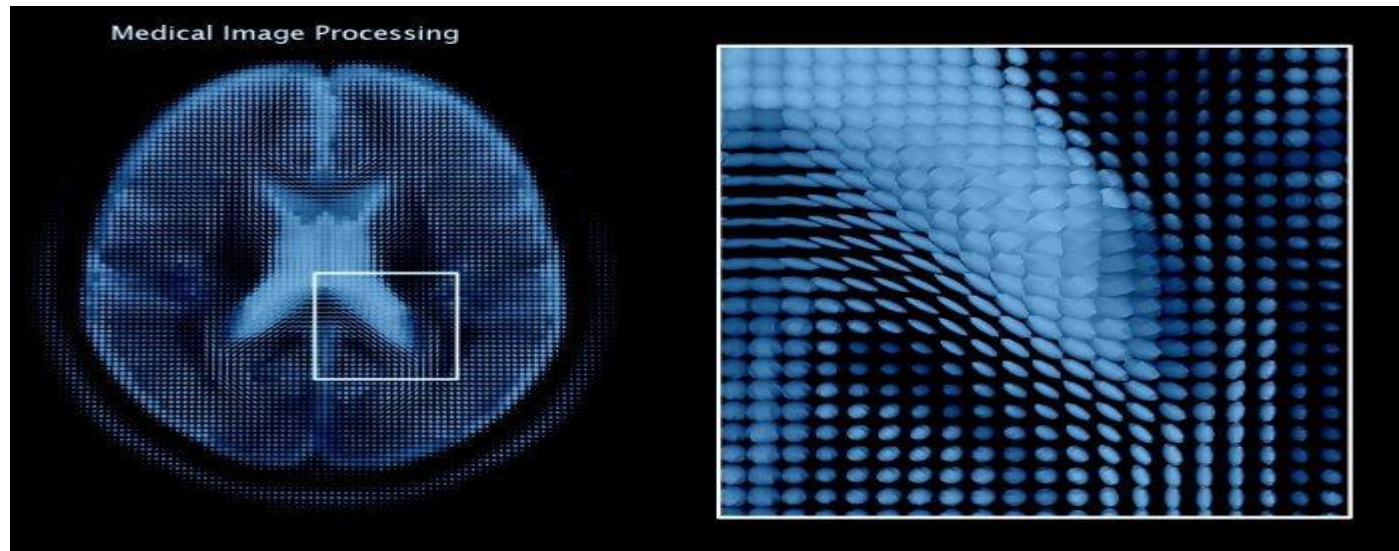
Sensors including wearables

Sensors, including **thermal imaging cameras** and **infrared sensors**, are being deployed to identify potential cases on the basis of febrile symptoms (for example, at airports)



Machine learning

Machine-learning algorithms are also being developed for case identification by automated differentiation of COVID-19 from community-acquired pneumonia through the use of hospital chest scans by **computerized tomography** and **Medical image analysis**



Interruption of
community
transmission

**Smartphone app, low-power Bluetooth
technology**

Mobile-phone-location data

Smartphone app, low-power Bluetooth technology

Digital contact tracing

Digital contact tracing automates tracing on high scale and speed

It reduces reliance on human recall, particularly in densely populated areas with mobile populations.

In the COVID-19 pandemic, digital contact-tracing apps have been developed for use in several countries; these apps rely on approaches and technologies not previously tried on this scale and are controversial in terms of privacy.

More-recent voluntary contact-tracing apps have been launched in collaboration with governments; these collect location data by **global positioning system (GPS)** or **cellular networks**, proximity data collected by **Bluetooth**.

Evaluating interventions through the use of mobility data.

Aggregated location data collected by smartphones via GPS, cellular network and Wi-Fi can monitor real-time population flows, identify potential transmission hotspots and **give insight into the effectiveness of public-health interventions such as travel restrictions on actual human behavior.**

Daily aggregated origin-destination data from Baidu, are being used to evaluate the effect of travel restrictions and quarantine measures on COVID-19 transmission in China.

Analysis of the location data of **Italian smartphone** users estimated a reduction of 50% in the total trips between Italian provinces in the week after the announcement of lockdown on 12 March 2020 .

Apple and google has similarly released a dataset with daily figures for mobility and assumed method of transport

Public communication:
informing populations

Social-media platforms

Online search engine

Chat-bot

Online data and **social media** have had an ongoing, important role in public communication.

Public-health organizations and technology companies are stepping up efforts to mitigate the spread of misinformation and to prioritize trusted news sites

for example, Google's SOS alert intervention prioritizes the WHO and other trusted sources at the top of search results.

Chat-bots are also providing information to reduce the burden on non-emergency health-advice call centers, and clinical practice is being transformed by the rapid adoption of remote health-service delivery, including telemedicine, especially in primary care.

Digital communication platforms are also supporting adherence to social-distancing measures. **Video conferencing** is allowing people to **work and attend classes from home.**

Key challenges persist, including the rise of potentially **harmful misinformation** and **digital inequalities**

Clinical care

Tele-conferencing

Telemedicine

Future directions

Implementation

Workforce and organizational barriers

Data sharing and data quality

Evidence of effectiveness and regulation

Legal, ethical and privacy concerns

Inequalities and the digital divide

*Thank
you*

