



from Precision Health to One Health:  
**COVID-19 driven challenges and opportunities**  
Jie Huang, BMed MPH PhD





Article

# A Next Generation Sequencing-Based Protocol for Screening of Variants of Concern in Autism Spectrum Disorder

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<https://doi.org/10.1093/nar/gkab1245>

## PAGEANT: personal access to genome and analysis of natural traits

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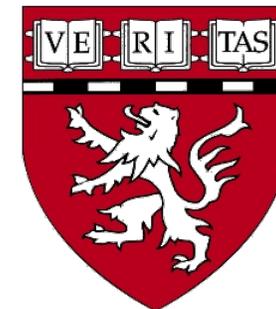


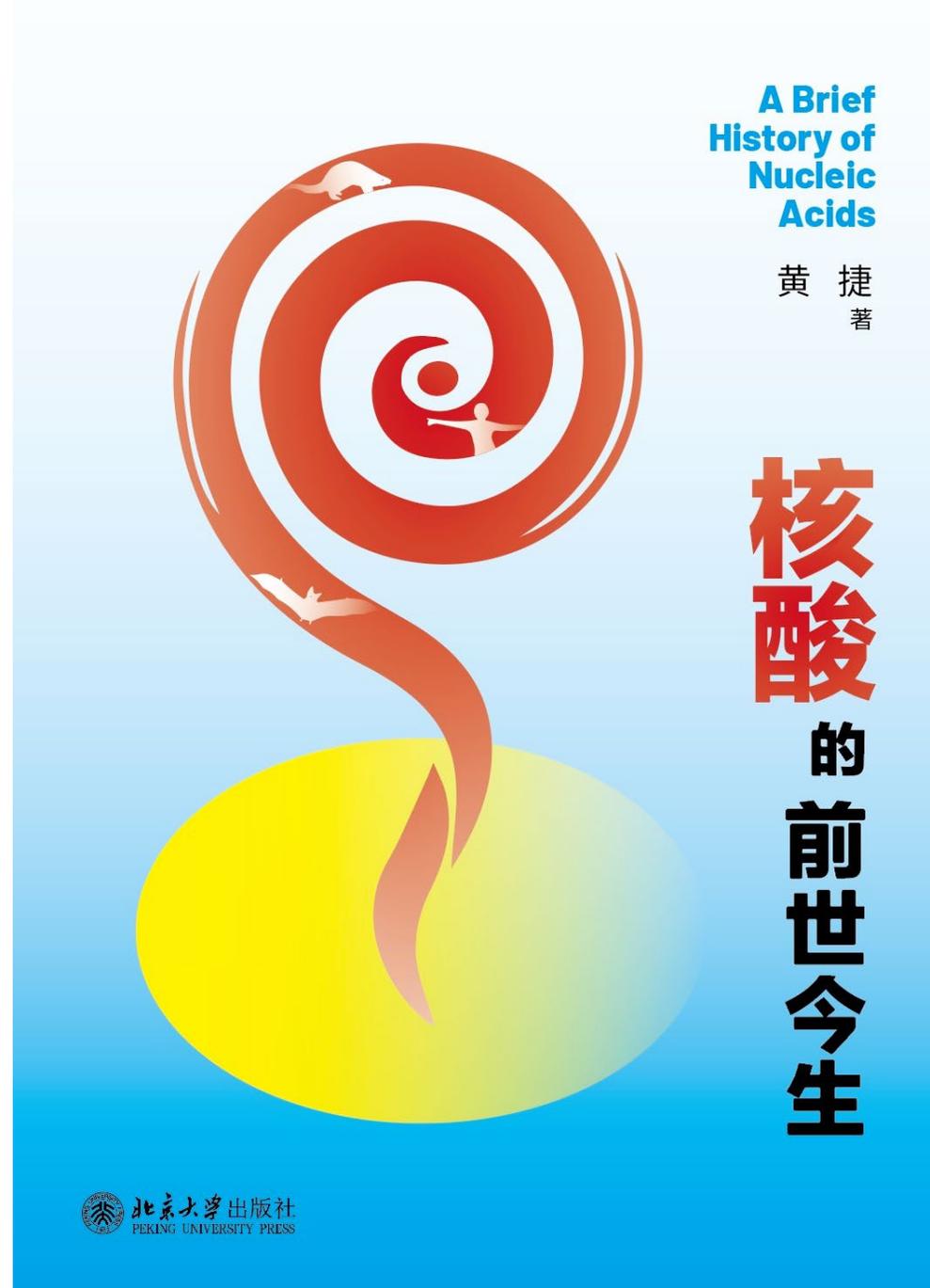
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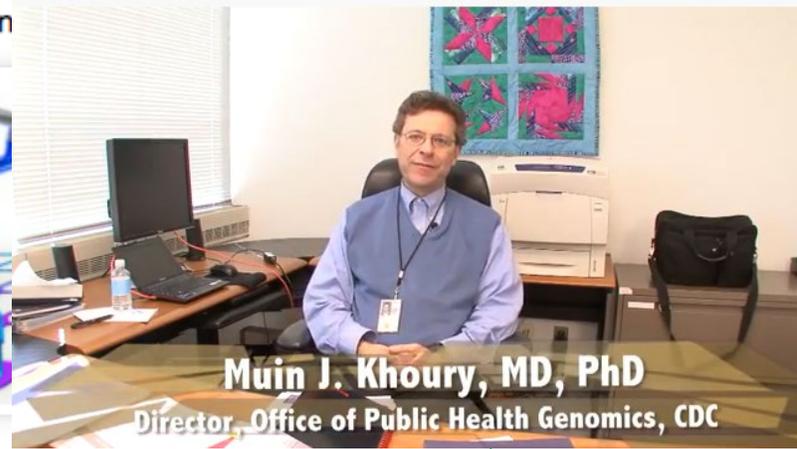
# 1<sup>st</sup> Sino-EU Permed Science & Technology Webinar: Perspectives in Personalised Medicine: genomics, rare diseases, devices

## The Shift From Personalized Medicine to Precision Medicine and Precision Public Health: Words Matter!

April 21, 2016 by Muin J Khoury, Director, Office of Public Health Genomics, Centers for Disease Control and Prevention

Advances in genomics and other 'omic' technologies have ushered in a new era variably called "personalized" or "precision" medicine, which takes into account individual genetic and other sources of variability in disease treatment and prevention.

In the past decade, we have seen a significant growth in interest and usage of the terms personalized and precision medicine. The terms precision, personalized, and individualized medicine have often been used interchangeably by many authors (including myself). The term P4 medicine has also been proposed (predictive, preventive, personalized and participatory medicine). By and large, the terms personalized medicine and precision medicine have had most currency. Recently, however, there has been a prominent shift from "personalized medicine" towards "precision medicine". This Google trends analysis shows an accelerated search for "precision medicine" in the past two years, perhaps propelled by the 2015 United States Precision Medicine Initiative (see figure below). Similarly, a PubMed query shows that in 2005, there was only one paper mentioning "precision medicine", compared to 74 papers mentioning "personalized medicine". In 2015, there were 1737 papers with "precision medicine" compared to 1529 papers mentioning "personalized medicine".



To be sure, precision medicine and personalized medicine are highly related and genomics plays a big role in both. However, even highly personalized information may or may not lead to improved health outcomes. Moreover, precision medicine approaches may lead to non-personalized interventions that can be used population-wide.

# Precision Medicine Initiative



*“Doctors have always recognized that every patient is unique, and doctors have always tried to tailor their treatments as best they can to individuals. You can match a blood transfusion to a blood type — that was an important discovery. What if matching a cancer cure to our genetic code was just as easy, just as standard? What if figuring out the right dose of medicine was as simple as taking our temperature?”*

*- President Obama, January 30, 2015*

DISCOVERY



INNOVATION



ADVANCEMENT



# Million Veteran Program: A Partnership with Veterans



nature  
medicine

ARTICLES

<https://doi.org/10.1038/s41591-022-01891-3>

Check for updates

## Large-scale genome-wide association study of coronary artery disease in genetically diverse populations

Catherine Tcheandjieu <sup>1,2,3,4,88</sup> ✉, Xiang Zhu <sup>1,5,6,7,88</sup>, Austin T. Hilliard <sup>1,88</sup>, Shoa L. Clarke <sup>1,2,88</sup>, Valerio Napolioni <sup>8,9</sup>, Shining Ma<sup>5</sup>, Kyung Min Lee<sup>10</sup>, Huaying Fang<sup>11</sup>, Fei Chen<sup>12</sup>, Yingchang Lu<sup>13</sup>, Noah L. Tsao<sup>14</sup>, Sridharan Raghavan<sup>15,16</sup>, Satoshi Koyama<sup>17</sup>, Bryan R. Gorman <sup>18,19</sup>, Marijana Vujkovic <sup>20,21</sup>, Derek Klarin <sup>1,18,22,23,24,25</sup>, Michael G. Levin <sup>20,21</sup>, Nasa Sinnott-Armstrong <sup>1,11</sup>, Genevieve L. Wojcik <sup>26</sup>, Mary E. Plomondon<sup>27,28</sup>, Thomas M. Maddox<sup>29,30</sup>, Stephen W. Waldo<sup>27,28,31</sup>, Alexander G. Bick <sup>32</sup>, Saiju Pyarajan<sup>18,33</sup>, Jie Huang <sup>18,34,35</sup>, Rebecca Song<sup>18</sup>, Yuk-Lam Ho <sup>18</sup>, Steven Buyske <sup>36</sup>, Charles Kooperberg <sup>37</sup>, Jeffrey Haessler<sup>37</sup>, Ruth J. F. Loos <sup>38</sup>, Ron Do <sup>38,39</sup>, Marie Verbanck<sup>38,39,40</sup>, Kumardeep Chaudhary <sup>38,39</sup>, Kari E. North <sup>41</sup>, Christy L. Avery <sup>41</sup>, Mariaelisa Graff<sup>41</sup>, Christopher A. Haiman<sup>12</sup>, Loïc Le Marchand<sup>42</sup>, Lynne R. Wilkens<sup>42</sup>, Joshua C. Bis <sup>43</sup>,



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# The world has changed: from the beginning of the presidential term



# Precision Public Health

NEWS FEATURE | 04 January 2022 | Correction [11 January 2022](#)

## Is precision public health the future — or a contradiction?

Some public-health researchers are embracing data and technology to target small groups with precise health interventions. Others fear that these tactics could fail millions.

[Carrie Arnold](#)

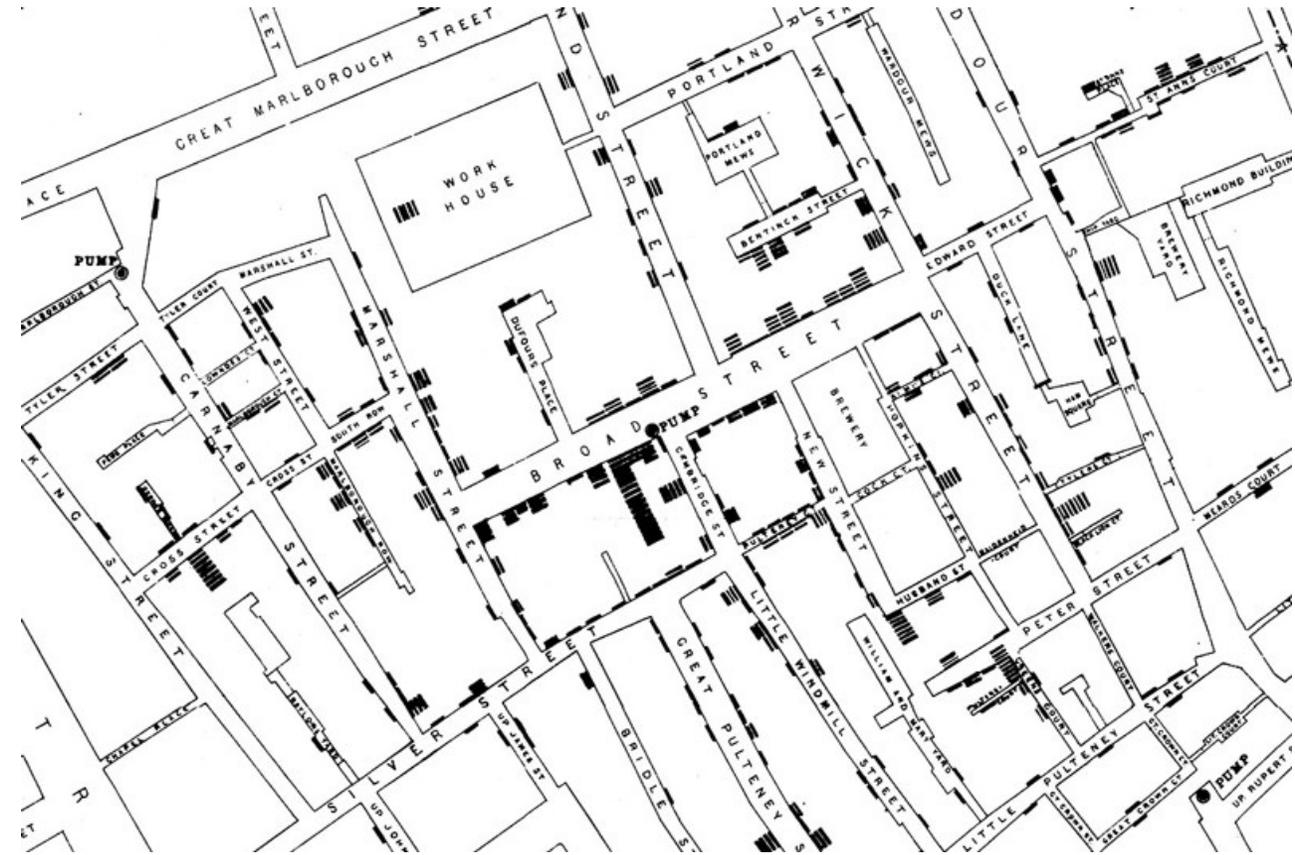


- This sophisticated approach relied on detailed data from hospitals and laboratories, and **showed that the virus wasn't affecting all New Yorkers equally**. That knowledge helped Greene's team at the New York City Department of Health and Mental Hygiene **to distribute testing resources and protective gear such as masks and gloves to the right places**.
- It was a different approach from New York City's typical pandemic response plan, **which advised largely blanket policies such as lockdowns and mass testing**. "Instead of just parking a testing van somewhere in an affected zip code, we can park it at an intersection in the middle of the cluster," Greene says.
- The tech-centric, targeted approach used by Greene and other epidemiologists to address COVID-19 is part of a burgeoning field known as precision public health. **The concept is a modernization of the 150-year-old field of epidemiology**, similar to how precision medicine has transformed health care, says Muin Khoury.

## Think local

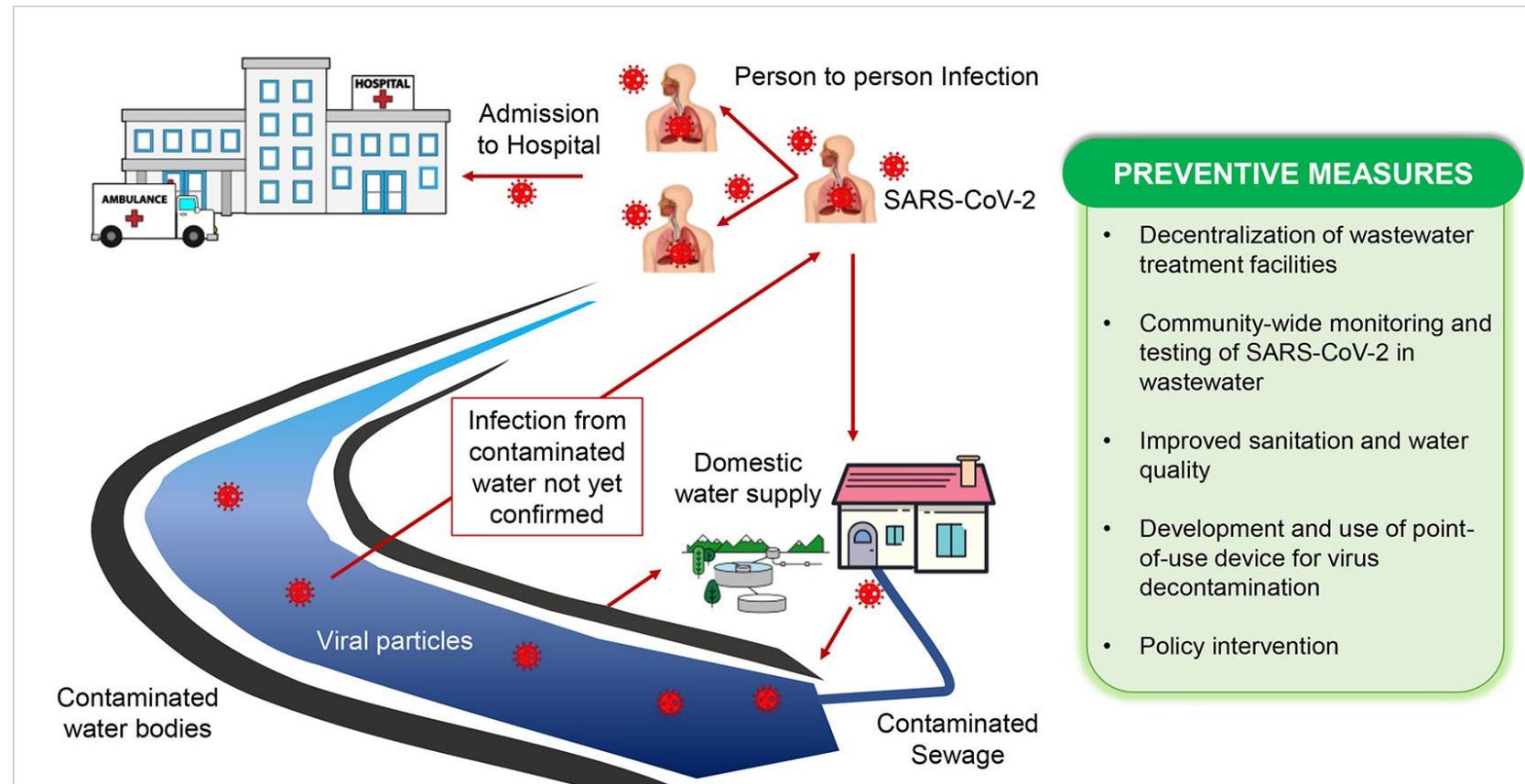
For John Quackenbush, a biostatistician at the Harvard School of Public Health in Boston, the push for precision public health has existed since the birth of epidemiology. In the 1850s, citizens of London stared down a different outbreak: cholera. The disease killed millions of people in the nineteenth century. In 1854, a string of cases appeared in Soho, in central London. Physician John Snow worked just a few streets away. Snow went from door to door and began to plot cholera cases on a map.

**He found that people who got their water from a pump on Broad Street were much more likely to develop cholera.**



The concept of precision public health is not new — but the phrase is recent. **Khoury** coined it in a [March 2015 blog post](#) as he watched the genomics revolution take hold in medicine. He wanted to see that same energy spill over into public health. To some extent, it already had. In 1996, the CDC launched [PulseNet](#), which used DNA fingerprinting of bacteria that caused food poisoning to detect large, diffuse outbreaks across county and state lines.

# Rethink the water pump & staying true to our original aspiration and founding mission



## PREVENTIVE MEASURES

- Decentralization of wastewater treatment facilities
- Community-wide monitoring and testing of SARS-CoV-2 in wastewater
- Improved sanitation and water quality
- Development and use of point-of-use device for virus decontamination
- Policy intervention

2020. Science of The Total Environment. Snowballing transmission of COVID-19 (SARS-CoV-2) through wastewater: Any sustainable preventive measures to curtail the scourge in low-income countries?

Article | [Open Access](#) | [Published: 07 July 2022](#)

# Wastewater sequencing reveals early cryptic SARS-CoV-2 variant transmission

Seattle, USA

[bdnelson@nasw.org](mailto:bdnelson@nasw.org)

Cite this as: *BMJ* 2022;378:o1869

<http://dx.doi.org/10.1136/bmj.o1869>

Published: 29 July 2022

# What poo tells us: wastewater surveillance comes of age amid covid, monkeypox, and polio

Sewage surveillance is going through a rebirth as covid, monkeypox, and now polio bring new urgency to virus detection. **Bryn Nelson** reports

SCIENCE | CORONAVIRUS COVERAGE



## One of the best tools for predicting COVID-19 outbreaks? Sewage.

The pandemic brought renewed attention to the value of wastewater monitoring for tracking pathogens and mitigating disease.

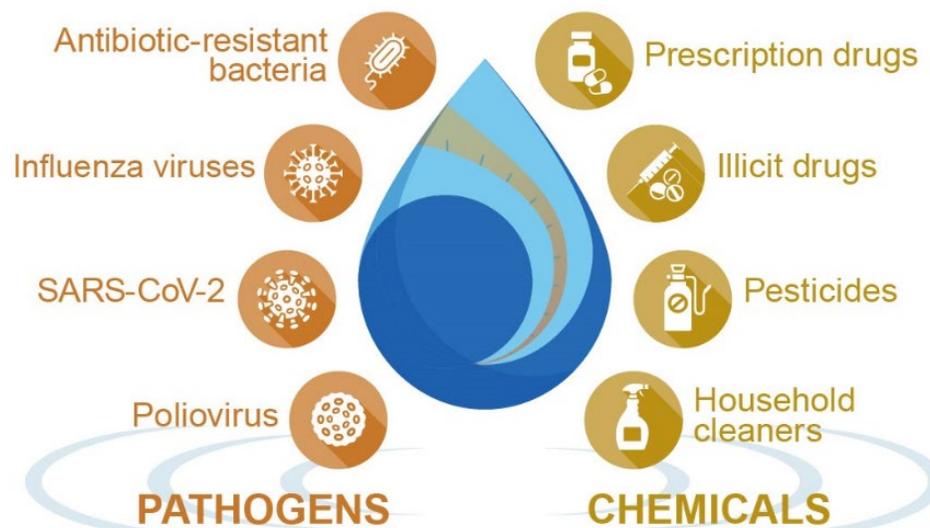
BY PRIYANKA RUNWAL



PUBLISHED JULY 1, 2022 • 11 MIN READ

Article | [Published: 18 July 2022](#)

# Viral variant-resolved wastewater surveillance of SARS-CoV-2 at national scale



Sources: GAO analysis of World Bank information (data); Alexandra GL/Blankstock/stock.adobe.com (images). | GAO-22-105841

Figure 1. Uses of wastewater testing.

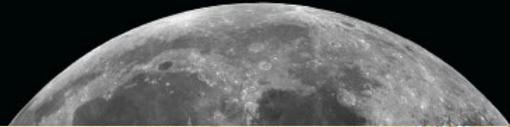
## in US

- Wastewater surveillance can be an efficient way to detect community-level disease outbreaks and other health threats. It has the potential to identify a COVID-19 outbreak 1 to 2 weeks sooner than clinical testing and allow for a more rapid public health response.
- As of February 2022, health departments in 43 jurisdictions, representing about 16 percent of the U.S. population, were using funds distributed by CDC to support wastewater surveillance efforts. Nearly 80 percent of the U.S. population is served by municipal sewer systems that could be monitored through such programs.

# We choose to go to the Moon.

We choose to go to the Moon in this decade  
and do the other things,  
not because they are easy, but because they are hard,  
because that goal will serve to organize and measure  
the best of our energies and skills,  
because that challenge is one that we are willing to accept,  
one we are unwilling to postpone,  
and one which we intend to win.

JFK, 1962

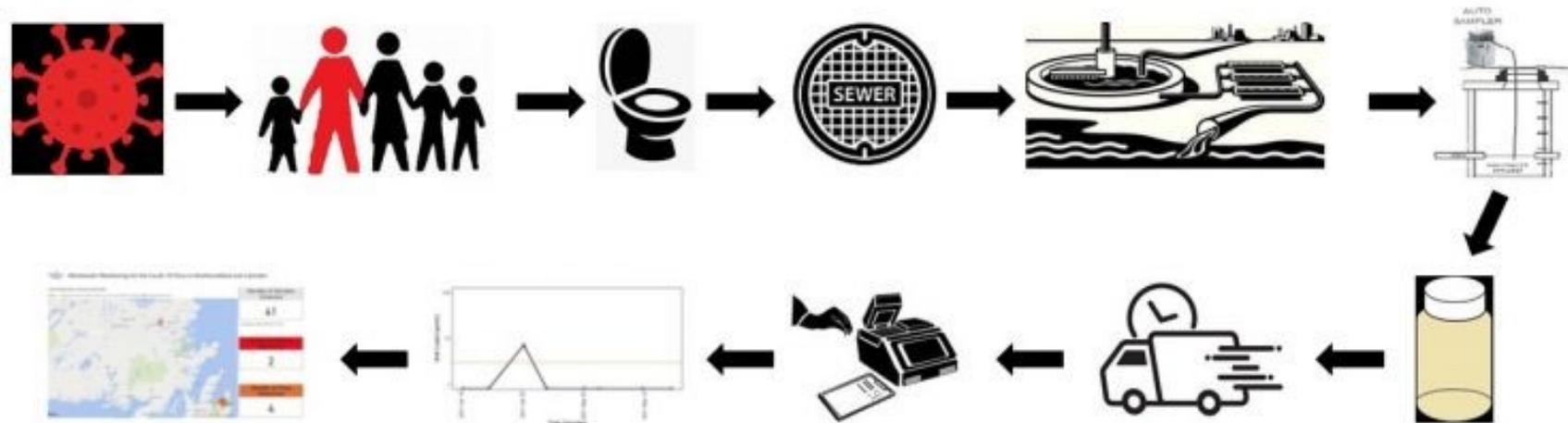
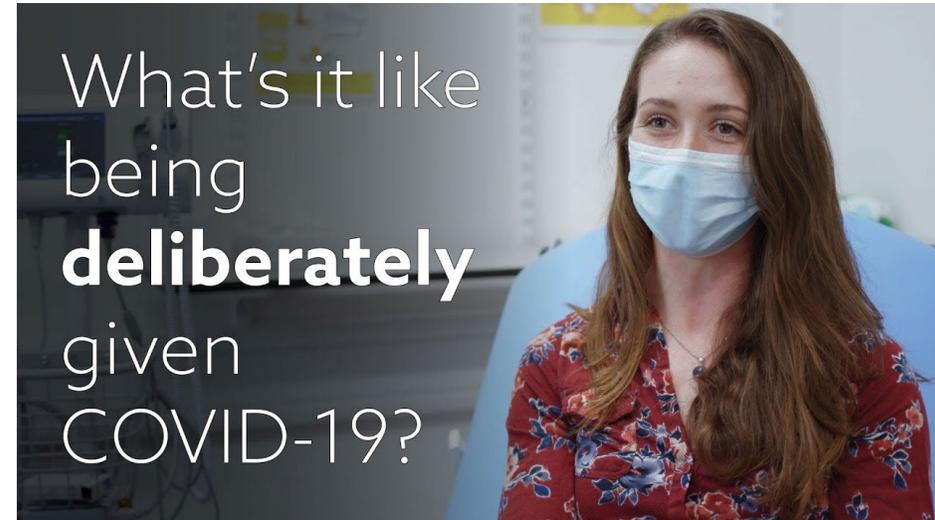
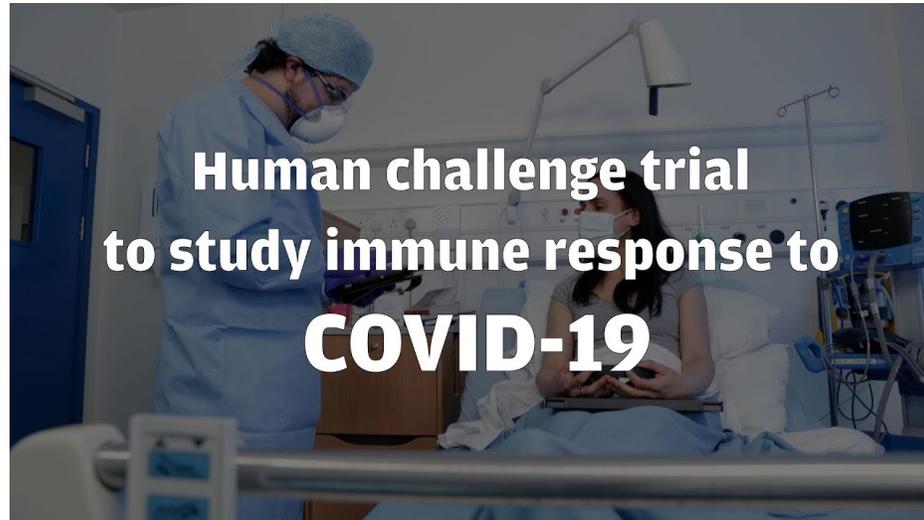


# Challenges

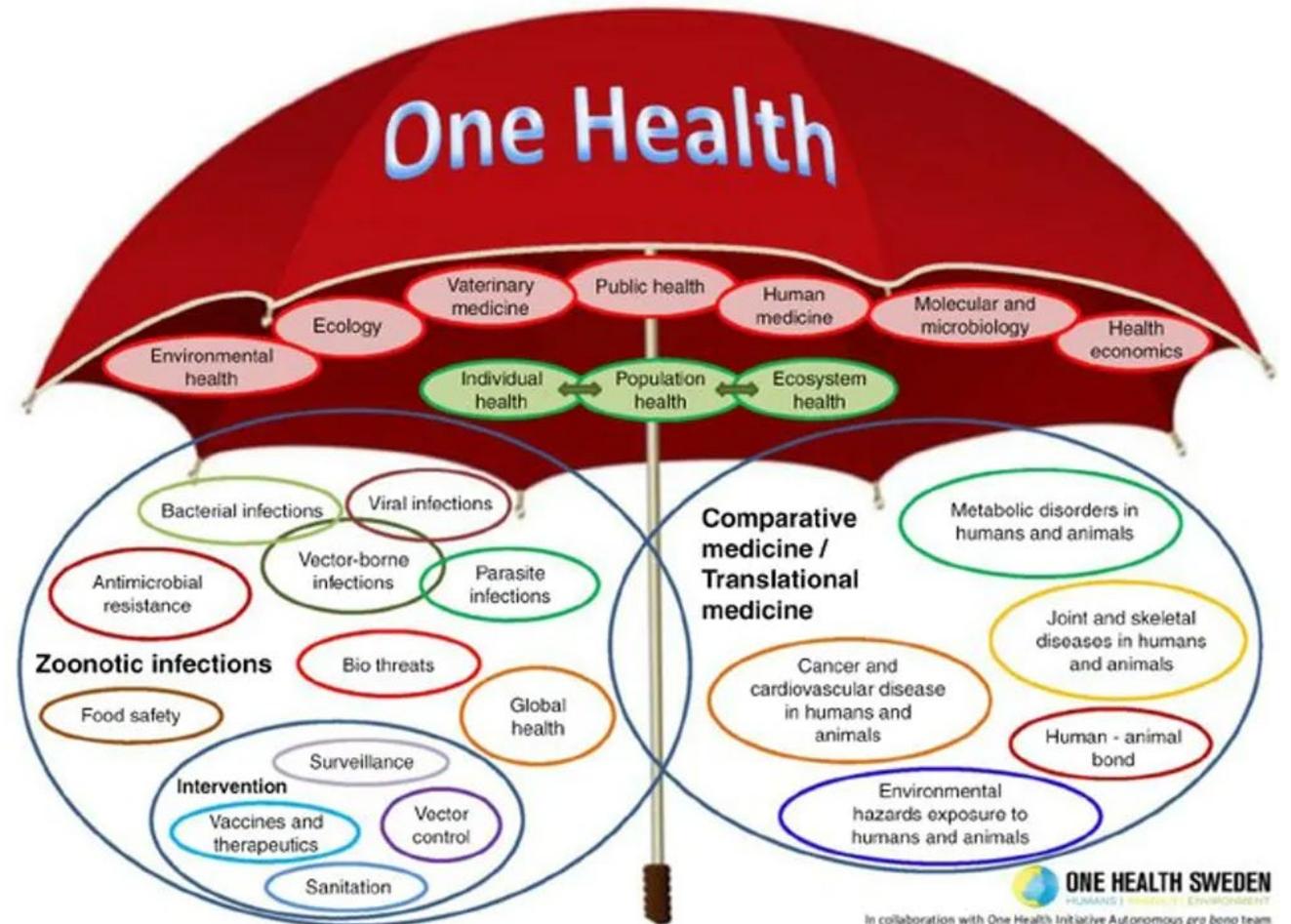
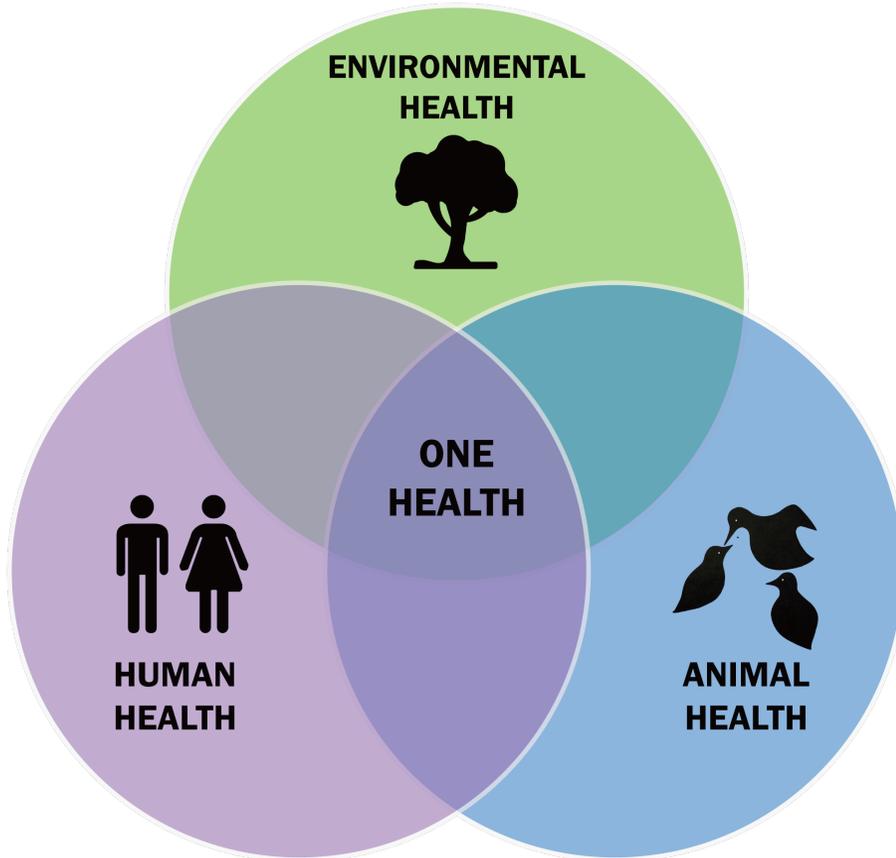
- **Coordination and standardization.** Methods for sample collection, analysis, and data sharing are not currently standardized, making it difficult to compare sites and focus mitigation efforts.
- **Sample integrity.** Contaminants such as animal waste can compromise sample quality, and the origin of detected pathogens and chemicals may not always be clear.
- **Privacy.** Using wastewater data could pose privacy concerns when linked with identifiable data, especially in small communities. Wastewater contains not only a pathogen's genetic data, but also human genetic data that could potentially be misused. Additionally, communities may be stigmatized if wastewater surveillance data indicate pathogen spread or illicit drug use.



# Human challenge → Environment challenge



# This is One Health! Easier said than done



# Two pandemics in China, One Health in Chinese

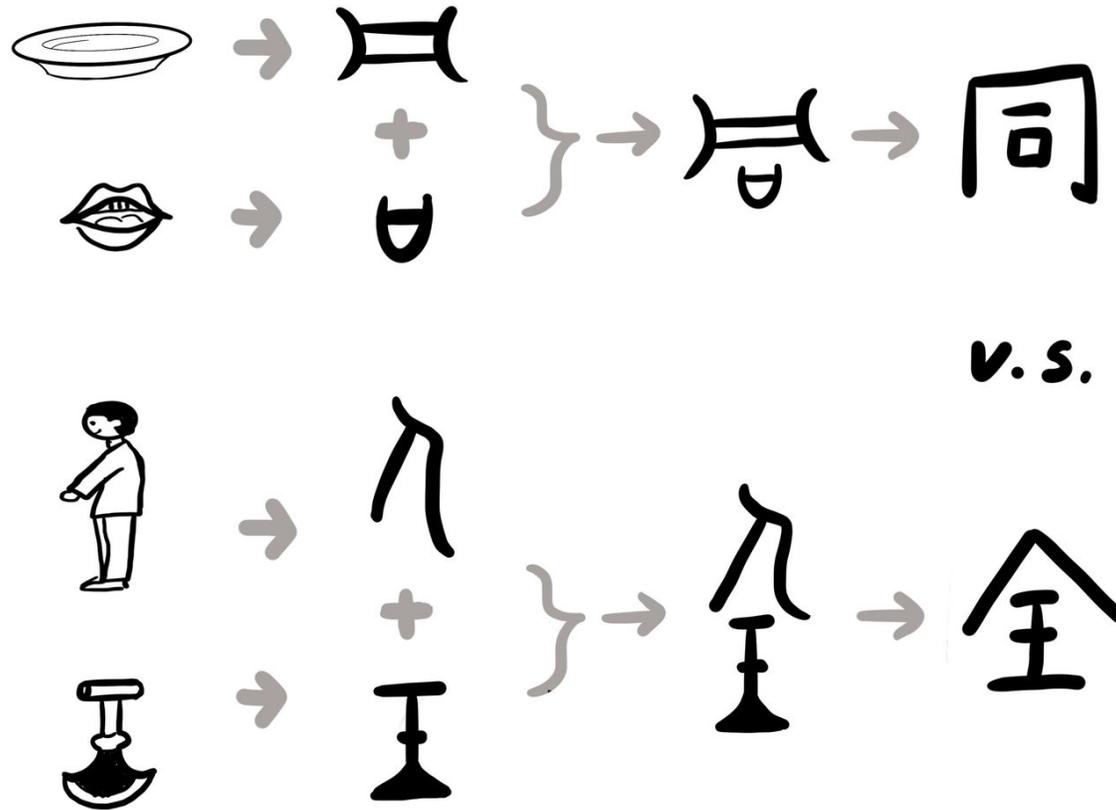
Jie Huang ,<sup>1,2,3</sup> Gary R McLean,<sup>4,5</sup> Frederick C Dubee,<sup>6</sup> Zhijie Zheng<sup>2,3</sup>

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# Two pandemics in China, One Health in Chinese

Jie Huang ,<sup>1,2,3</sup> Gary R McLean,<sup>4,5</sup> Frederick C Dubee,<sup>6</sup> Zhijie Zheng<sup>2,3</sup>

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- ▶ The term 'One Health' was coined in 2003 to describe the interdependence of healthy ecosystems, animals and people, soon after the emergence of SARS broke out. The philosophy of One Health is now widely accepted by the international community, due to the COVID-19 pandemic, which was first reported in China, but its origin is far from certain.
- ▶ China has suffered two major pandemics during the 21st century. The 'One Health' philosophy and principals are dearly needed in China; therefore, it is critical to ensure a correct Chinese translation so that its holistic meaning could be fully grasped, and actions could be orchestrated across the globe.
- ▶ In China, two completely different Chinese characters are used as the translation of 'One' in One Health. Both sides have distinguished scholars from the field, and have reasonable arguments.
- ▶ The opportunities to contribute to Health at the 'World' scale, on the 'International' stage and with 'Global' spirit certainly sound inspirational especially for the young generations. But we argue that the acronym WIG (world, international, global) paints a more realistic picture of what is needed to be done. Under a wig in health salons, there is a hairless problem to be fixed. Under a wig in justice courts, there is a fairness problem to be tackled.

# The World Needs a **Pandamic solution** for a **Pandemic problem**

- **pan** could be interpreted in the literal meaning of a cooking pan, or in the sense of Darwin's pangenesis theory and the emerging concept of pan-genome invoking all of nature;
- **da** refers to data applications widely used and dearly needed to prevent and fight pandemics in the most meaningful sense;
- **mic** means microbiology and in particular various omics technologies.
- Therefore, pandamic stresses the deep fusion of bio-technology (wet) and info-technology (dry).

# The world needs a pan-da-mic solution for a pandemic problem

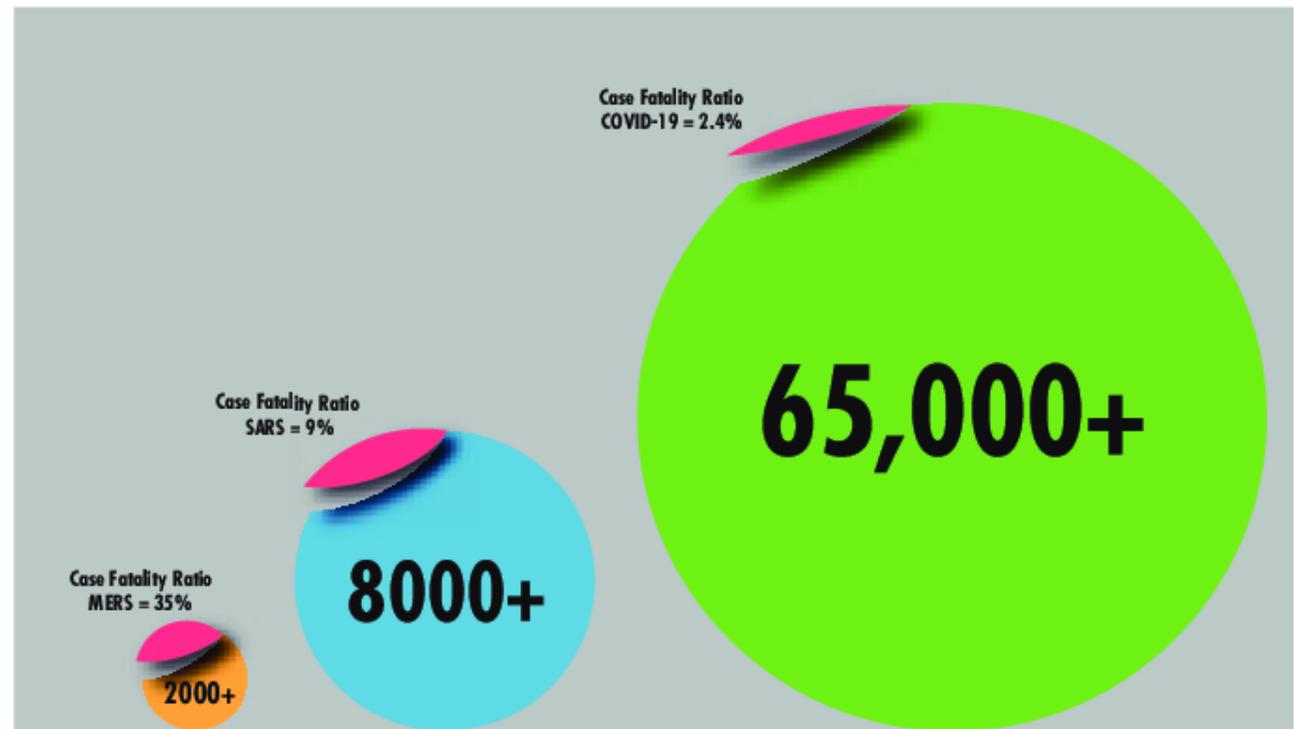
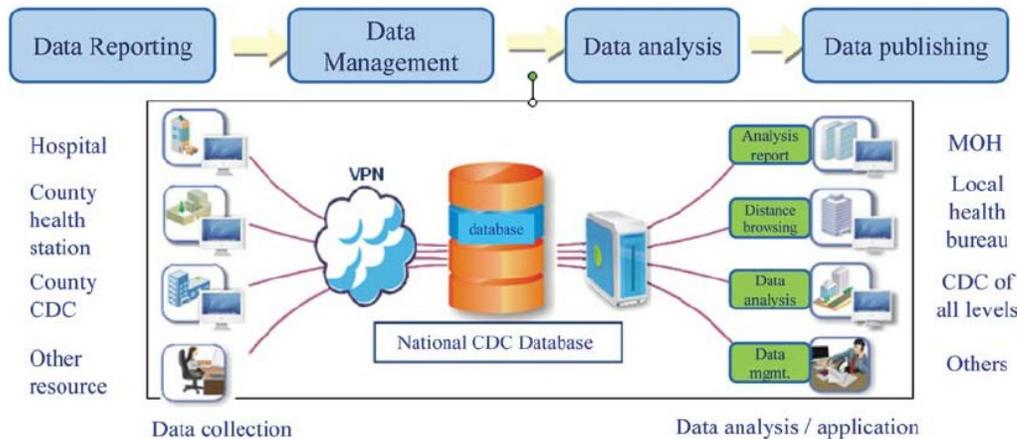
Two decades ago, the term “infodemic” was coined **AQ1** right after severe acute respiratory syndrome (SARS) emerged [1]. The World Health Organization (WHO) defined infodemic as “*too much information including false or misleading information in digital and physical environments during a disease outbreak*”. Compared to the scale of current COVID-19 pandemic and related information volume, what the world had two decades ago were rather modest figures.

While fully realizing the negative impact of misinformation and disinformation during an epidemic, we argue that most epidemic related information was generated not due to bad intention, but due to haste, confusion and lack of reliable information. This is especially true for COVID-19, with the emergence of a novel virus and uncertainties surrounding variants and vaccines. With a lack of timely scientific evidence, it is reasonable and even recommended for global citizens to foster debates and voice skepticism on certain matters. As we see through the past 2.5 years of COVID-19 pandemic, there was some degree of infodemic during the first year. But, as time goes on while citizens had wider access and matured judgement, quality information has grown.

Therefore, we propose to avoid simply and pejoratively labeling infodemic as over-abundance of false or detrimental information. Instead, we now propose a 3D view of an infodemic: (1) genuine information *of* the epidemic, (2) false information *by* the epidemic, and (3) intelligent information *for* the epidemic. The 1st dimension refers to the narrow scope of objective information concerning the epidemic itself that usually has limited circulation within government agencies and public health authorities. The 2nd dimension refers to misinformation and disinformation that are by-products of the epidemic, usually resulting from non-professionals. The 3rd dimension refers to (big) data technologies and applications for fighting a pandemic.

# Look back → 2003

- Completed the “human genome project”
- Coined “Infodemic”
- Coined “One Health”
- Built “direct reporting system”



MERS COV

SARS

COVID-19

Total Number of Cases COVID-19 = 67,091

The SARS, MERS and novel coronavirus(COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned?

Citations — 1,324

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February 2020 · [International Journal of Epidemiology](#)

# CELEBRATING

On this day...

14 April 2003



## The Human Genome Project was completed

Of the 2.9 billion letters of DNA code that were read, the Wellcome Sanger Institute contributed more than 0.8 billion - 30%.

<https://www.science.org> > content > article > toxic-cocktail...

### 'A toxic cocktail:' Panel delivers harsh verdict on the ... - Science

Their report, COVID-19: Make it the Last **Pandemic**, concludes that the world has **failed** to take **pandemic** threats seriously and build structures that can respond ...

<https://www.bbc.com> > news > world-57085505

### Covid: Serious failures in WHO and global response, report finds

May 12, 2021 — Covid: Serious **failures** in WHO and global response, report finds ... The Covid-19 **pandemic** was preventable, an independent review panel has said.

<https://www.nature.com> > news

### How the world failed to curb COVID - Nature

MIT Technology Review

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#### ARTIFICIAL INTELLIGENCE

## Hundreds of AI tools have been built to catch covid. None of them helped.

Some have been used in hospitals, despite not being properly tested. But the pandemic could help make medical AI better.

By Will Douglas Heaven

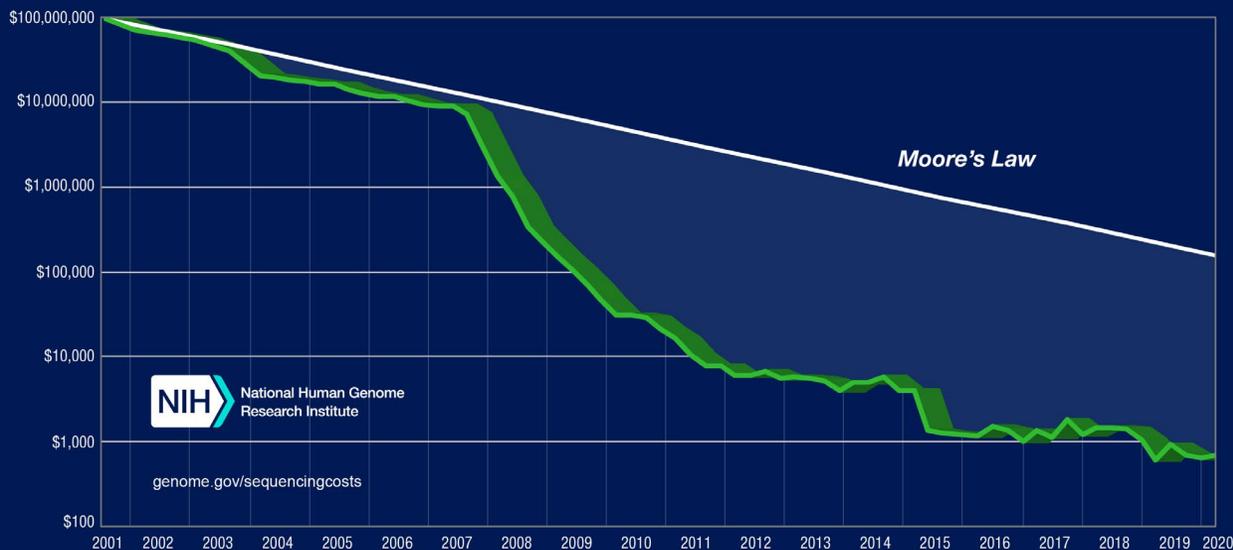
July 30, 2021

<https://www.nytimes.com> > 2022/08/18 > briefing > monk...

### America's Pandemic Failures - The New York Times

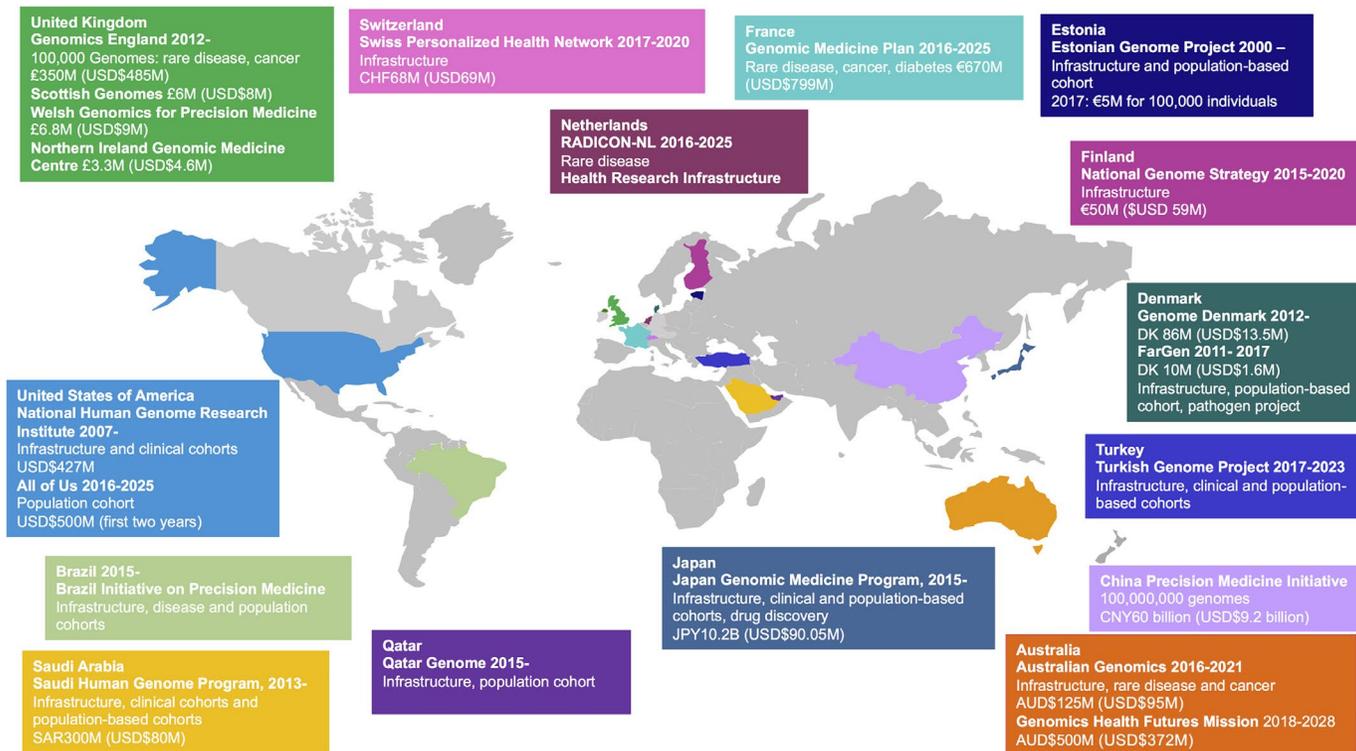
Aug 18, 2022 — The C.D.C. acknowledged it had botched its Covid response. It is part of a broader set of **failures**.

Cost per Human Genome

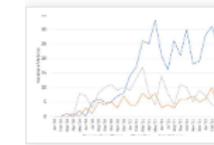


# Look forward

## 1<sup>st</sup> Sino-EU Permed Science & Technology Webinar: Perspectives in Personalised Medicine: genomics, rare diseases, devices



## Precision Health Innovations in the Pandemic Era



Two recent articles, one in Nature Medicine and another in Nature Biotechnology, highlight areas of health innovation that have been accelerated by the COVID-19 pandemic. This blog post focuses on two precision health applications of technology—(1) genomics and (2) wearable devices and smartphone apps—that are likely to have a lasting impact beyond the pandemic. Increased [Read More >](#)

July 8, 2022 by Danielle Rasooly, Emily Drzymalla, and Muin J. Khoury, Office of Genomics and Precision Public Health, Centers for Disease Control and Prevention Atlanta, Georgia

## Applications of Digital Tools for Precision Public Health in the COVID-19 Era: Where Are We?



Two recent systematic scoping reviews explore the use and limitations of digital tools in public health surveillance and their applications to the pandemic response. Digital health tools offer increasing potential for substantial benefits to medicine and public health. In clinical practice, digital applications include personal wearable devices, devices within the body, and sensors that can [Read More >](#)

March 29, 2021 by Muin J. Khoury, W. David Dotson, Scott Bowen, Office of Genomics and Precision Public Health, Centers for Disease Control and Prevention, Atlanta, Georgia

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[genomics, precision public health](#)

[COVID-19, public health](#)

**Figure 1** Map of Currently Active Government-Funded National Genomic-Medicine Initiatives



# Thank You!

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