Tracking COVID-19 in Real-time: Challenges Faced and Lessons Learned

Dr. Lauren Gardner

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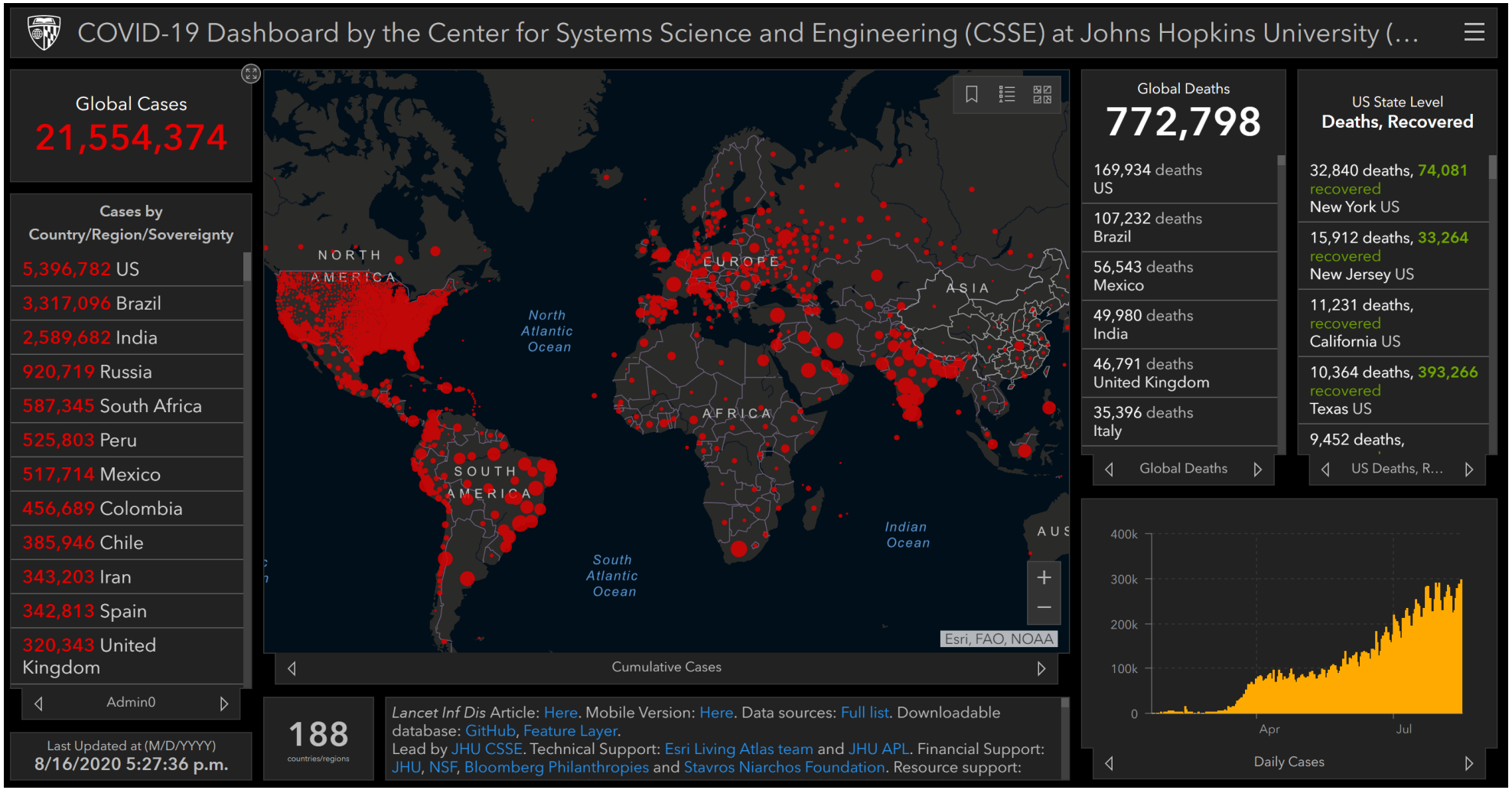
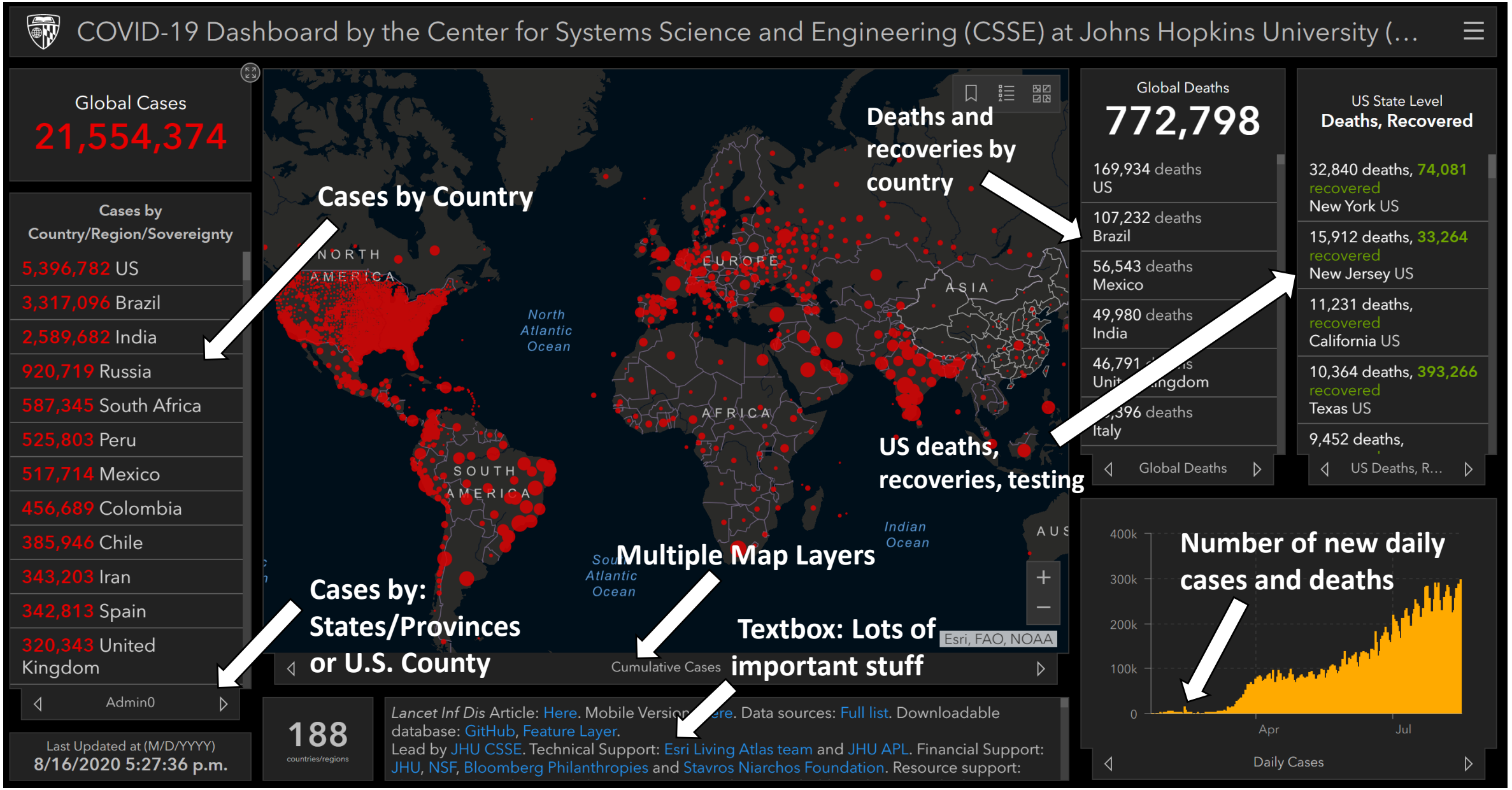
Visiting Scientist, CSIRO (Australia)

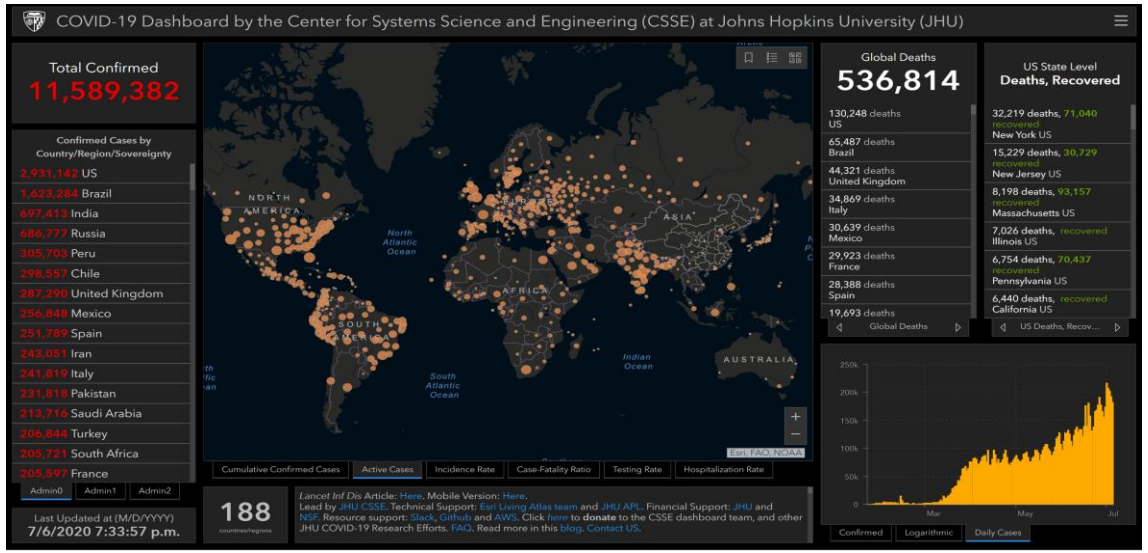


Global COVID-19 Cases, Deaths and Recoveries

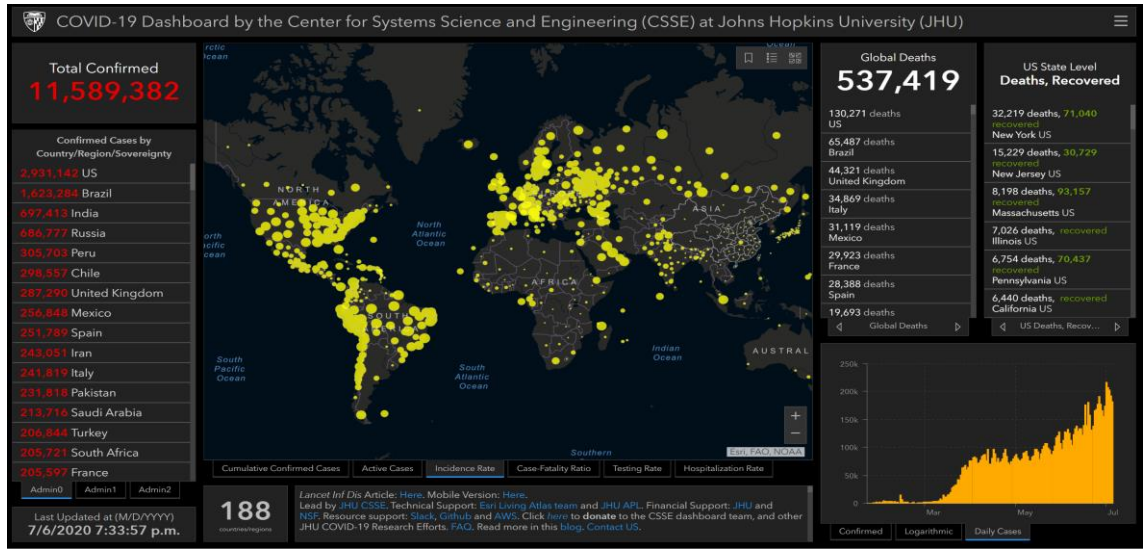


Additional Map Layers

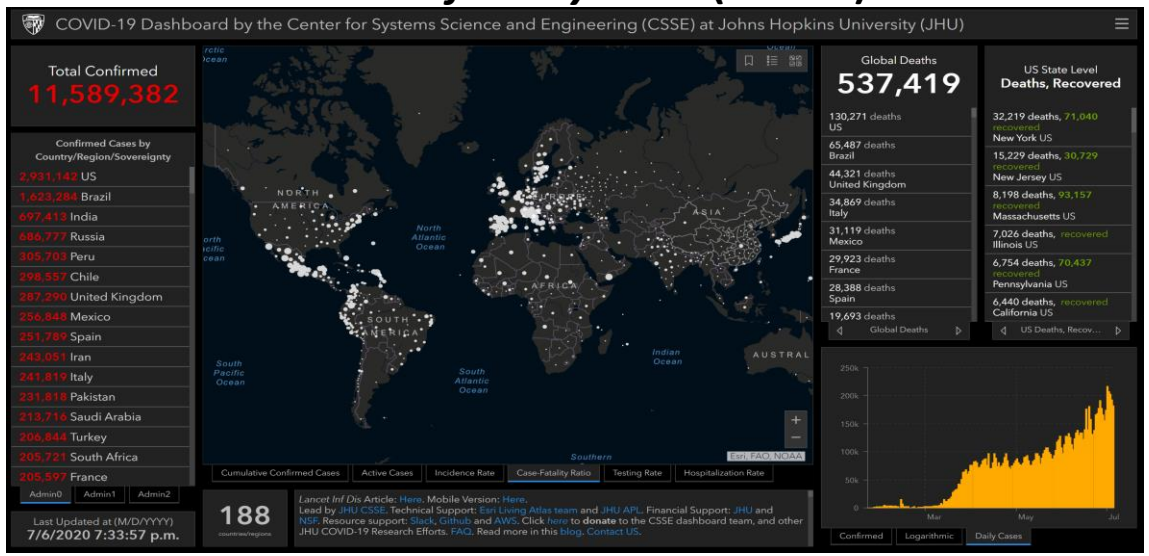
Active COVID-19 Cases (Global)



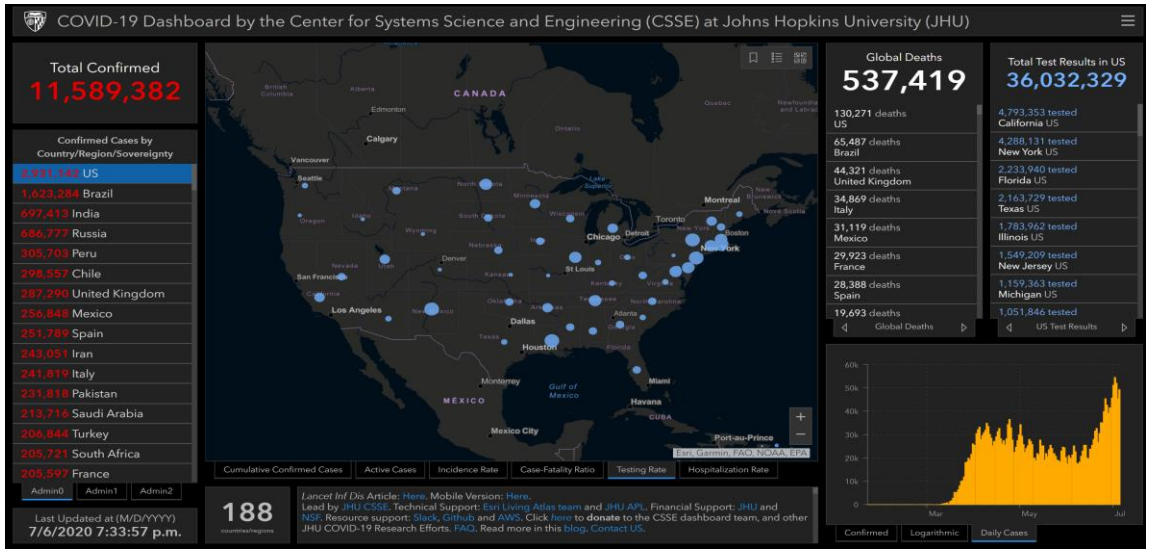
Case-incidence Rate (Global)



Case-fatality ratio (Global)

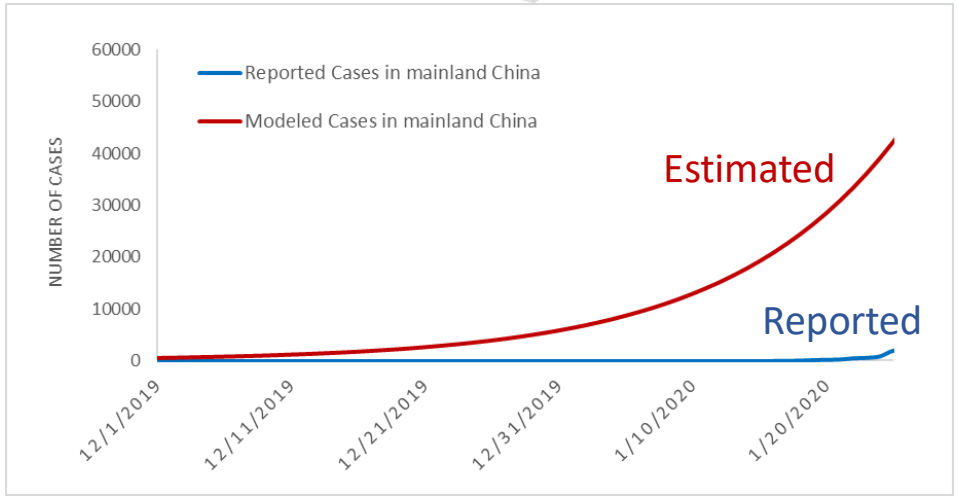


U.S. Testing Data from *COVID Tracking Project*

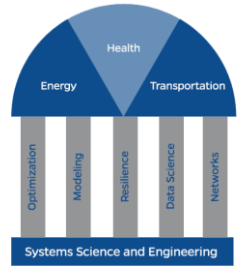


The Genesis of the Dashboard

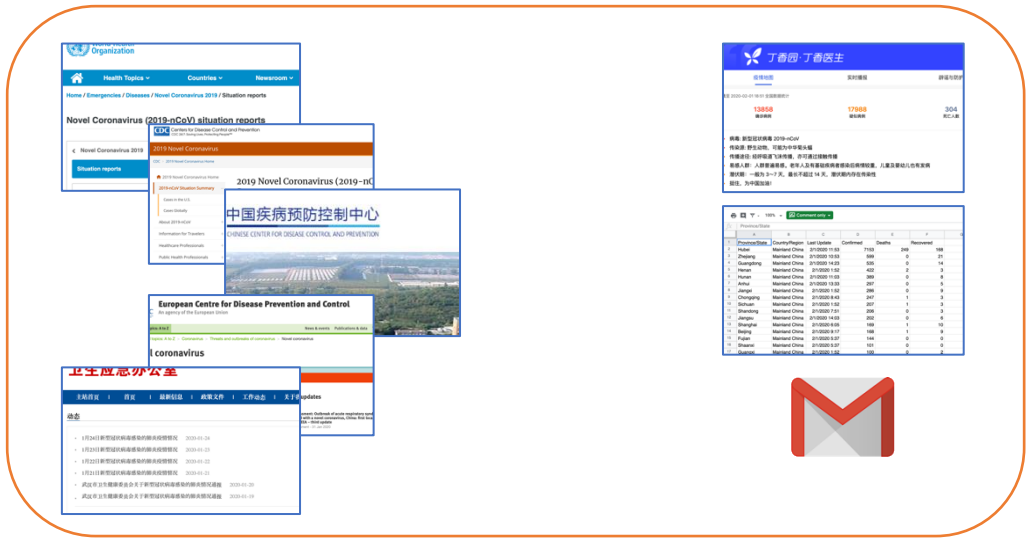
(January) Modeling the International Spread of COVID-19



A recognized need for high quality, open, real-time data for outbreak modeling and decision making



Stage 1 Architecture (January)



"Authoritative" Data Sources

Crowd Sourced Data

Manual Data Curation

Manual Dashboard Push

Fully manual process – did not scale
Limited Data Sharing

Data Sharing, Licensing and Terms of Use

CSSE COVID-19 GitHub

README.md

COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University

This is the data repository for the 2019 Novel Coronavirus Visual Dashboard operated by the Johns Hopkins Univer Center for Systems Science and Engineering (JHU CSSE). Also, Supported by ESRI Living Atlas Team and the Johns Hopkins University Applied Physics Lab (JHU APL).

Visual Dashboard (desktop):
https://www.arcgis.com/apps/opsdashboard/index.html

Visual Dashboard (mobile):
http://www.arcgis.com/apps/opsdashboard/index.html#

Lancet Article:
An interactive web-based dashboard to track COVID-19 in real time

Provided by Johns Hopkins University Center for Systems Science and Engineering (JHU CSSE):
https://systems.jhu.edu/

Data Sources:

ArcGIS: Feature Service

ArcGIS Pricing Map Scene Help

ncov_cases

Current situation for the noval coronavirus starting from Wuhan, China

Feature Layer by CSSE_GISandData

Created: 25 Jan 2020 Updated: 17 Aug 2020 View Count: 988,516,603

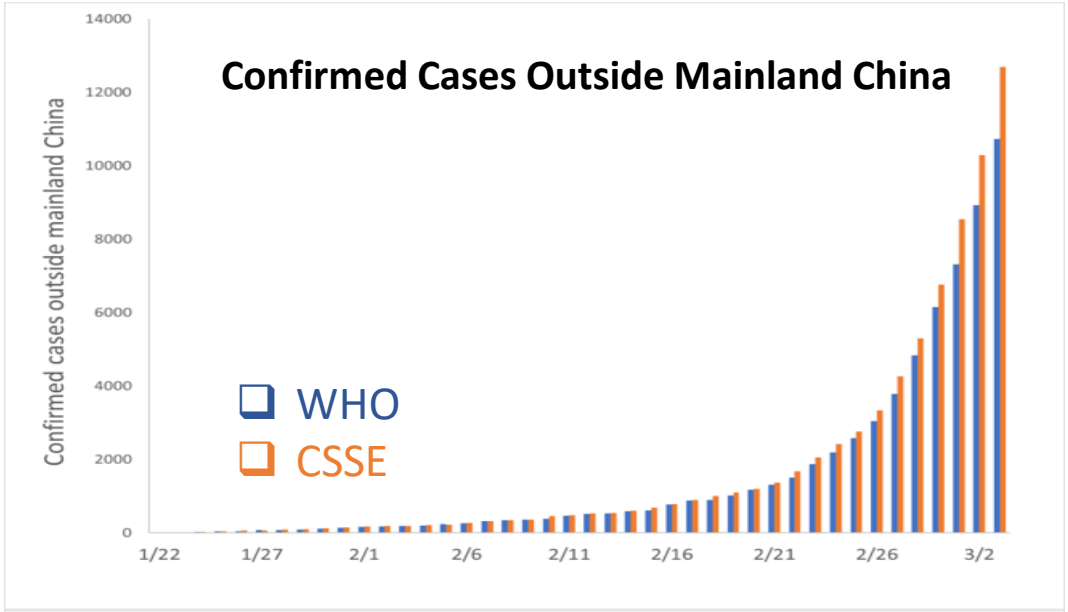
ot available.

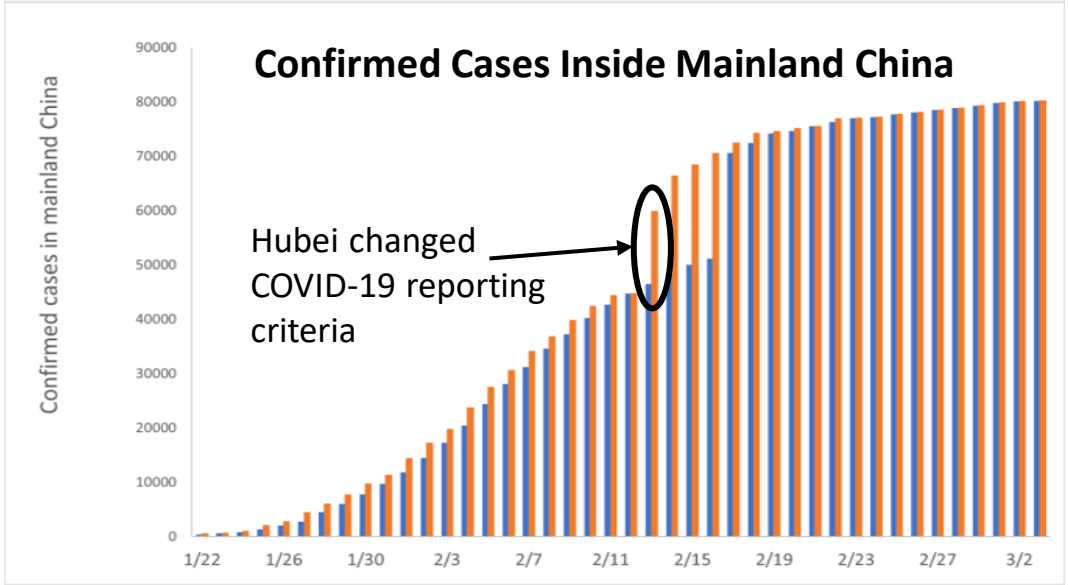
Deaths
Point Layer

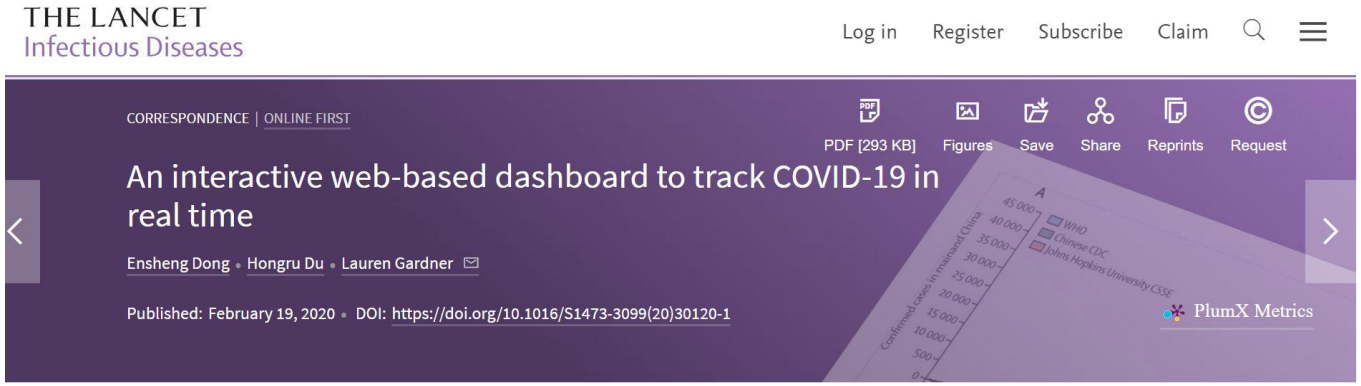
Cases
Point Layer

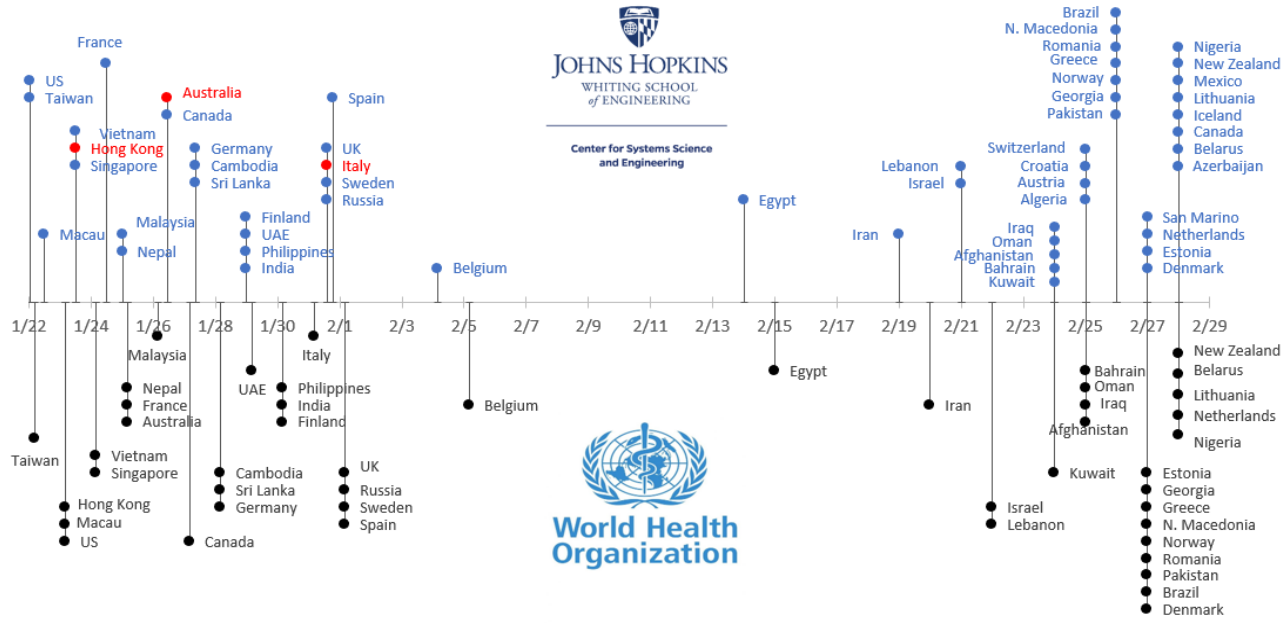
Cases_country
Point Layer

Reference: Dong, Du, Gardner. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Inf Dis*. 20(5):533-534









*Thailand, S.Korea and Japan not shown, as reported before dashboard start date

Week 1

LEGGO

Coronavirus, ecco la mappa che mostra in tempo reale la diffusione dell'epidemia

Newsweek

HEALTH

China Coronavirus Outbreak Updates Can Now Be Tracked Live Online with This Dashboard

BY KASHMIRA GANDER ON 1/28/20 AT 5:14 AM EST

CTV NEWS

cases: 10,248 | Recovered: 125,215 | Deceased: 9,223 | Total: 144,686

p: Tracking the spread of the deadly coronavirus

CNN health

This map tracks the coronavirus in real time

By Scottie Andrew, CNN

Updated 8:56 PM ET, Wed January 29, 2020

keeps climbing.

What you need to know about coronavirus

Xinjiang government confirms huge birth rate drop but denies forced sterilization of women

Millions of acres are in flames in South America. Here's why

Why this Irish town is supporting Joe Biden

(CNN) — The number of novel coronavirus cases is changing quickly. A real-time shows us just *how* quickly.

The map from Johns Hopkins University's Center for Systems Science and Engine coronavirus cases across the world.

FAST COMPANY

al-time China virus map lets you he outbreak live as it ns

PBS NEWS HOUR

Menu

Shenyang

Beijing

NORTH KOREA

Pyongyang

SOUTH KOREA

Seoul

Osaka

CHINA

Shanghai

Chengdu

Chongqing

Taipei

Hong Kong

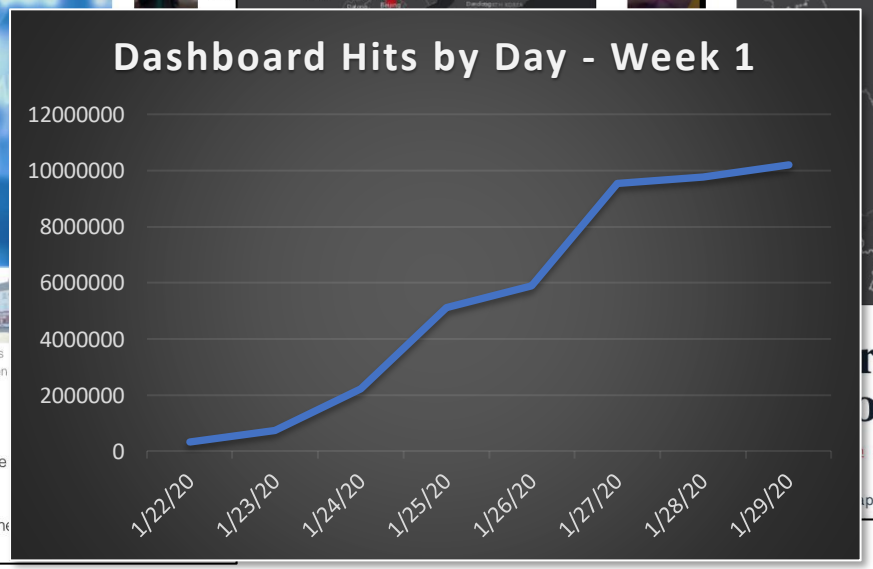
Hanoi

LAOS

rack the spread of novel oronavirus with this map

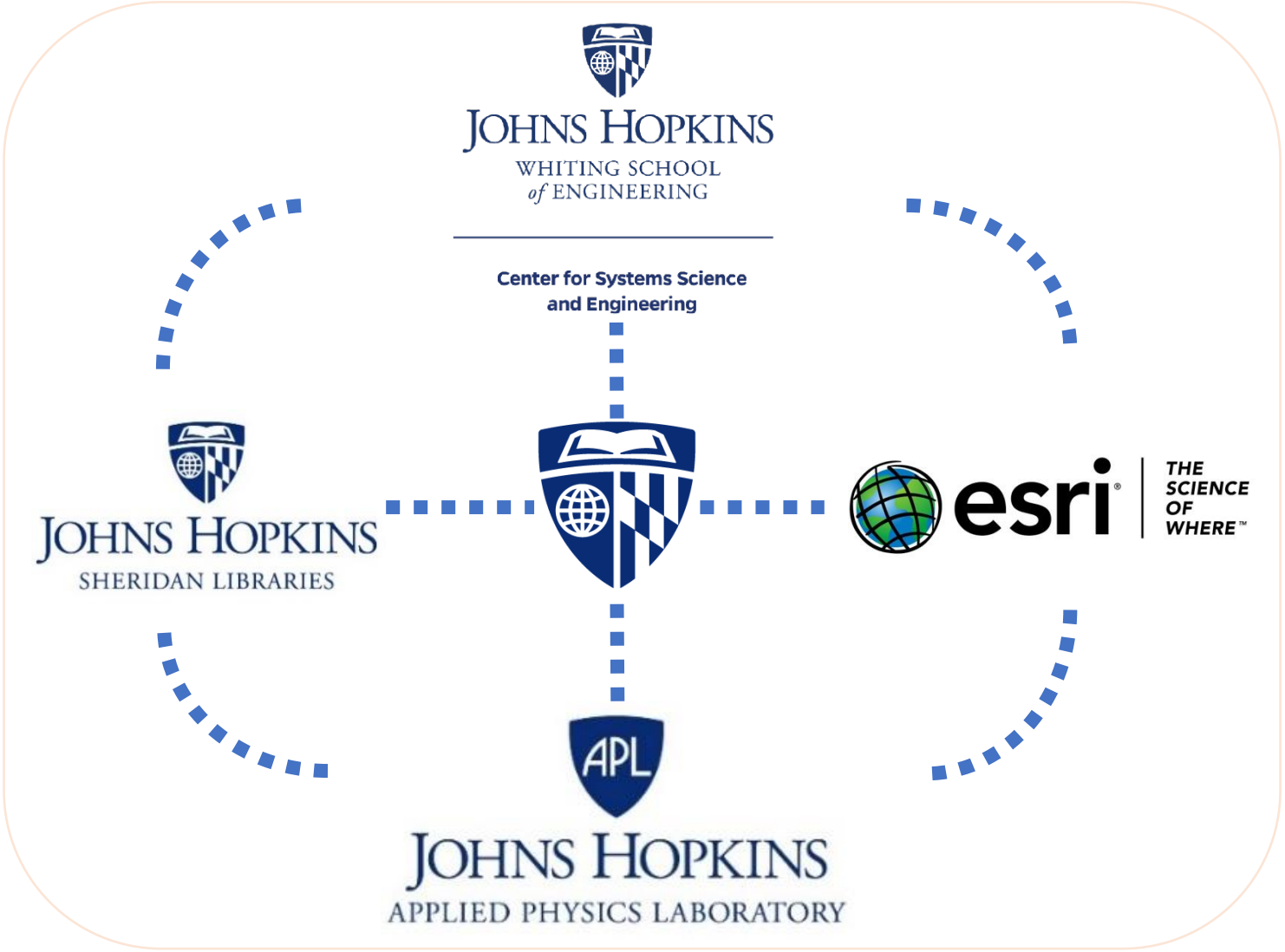
Jan 22, 2020 6:37 PM EDT

p created by U.S. researchers is tracking in real-time a virus in China



The Dashboard was rapidly picked up by US and international press

The Dashboard Team Grows



Stage 2 Architecture (Beginning February …)

Global Sitreps

National Reporting

State & Local Reporting

“Authoritative” Data Sources

Crowd Sourced Data

~25

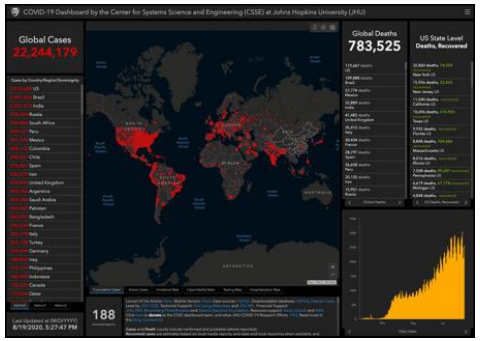
Collection

GitHub

GIS & Web Services

Optimized JHU Infrastructure

aws



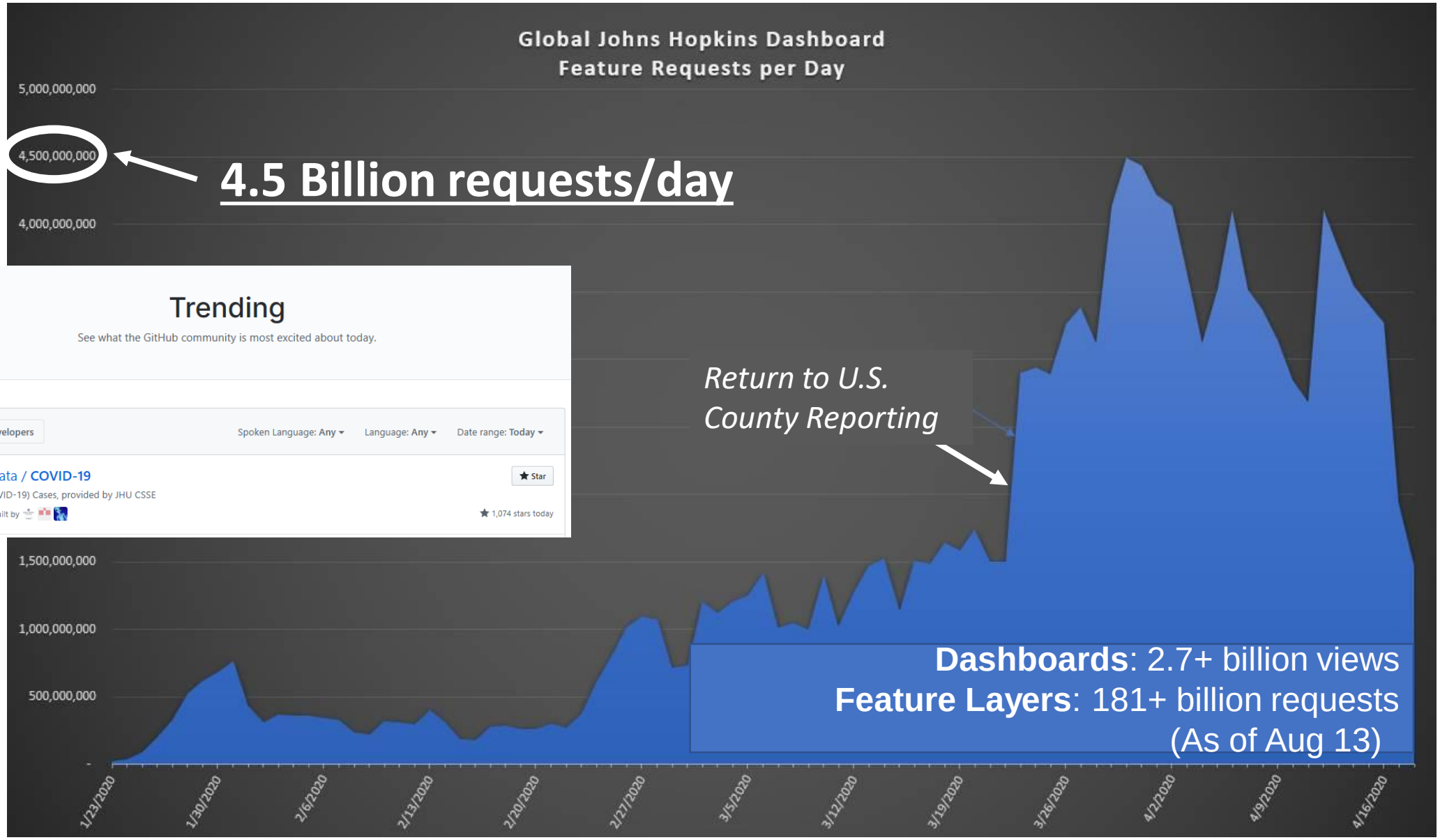
CNN

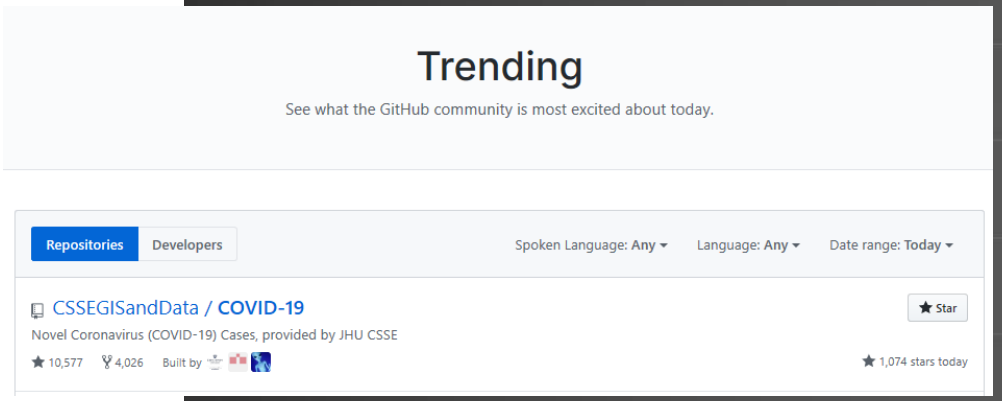
npr

Public Consumers

Automated + Manual Data Collection – Manual Error Recovery

JHU CSSE COVID-19 Dashboard Viewership





JHU CSSE COVID-19 Dashboard Users

Department of Health and Human Services Secretary's Operations Center at ASPR

JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

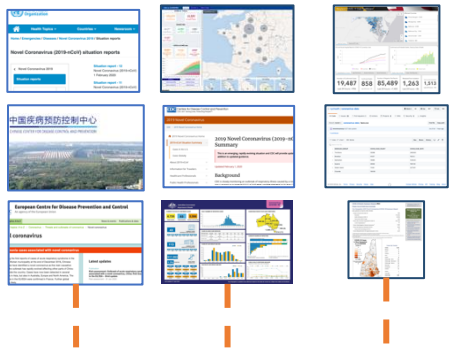
Center for Systems Science
and Engineering

Led to Expanding Demands

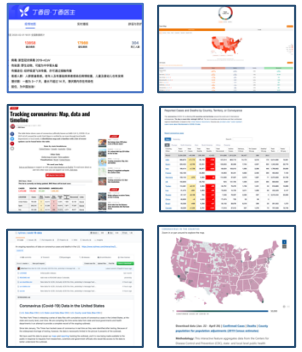
Department of Health and Human Services Secretary's Operations Center at ASPR

Johns Hopkins Whiting School of Engineering | Center for Systems Science and Engineering

Stage 3 Architecture



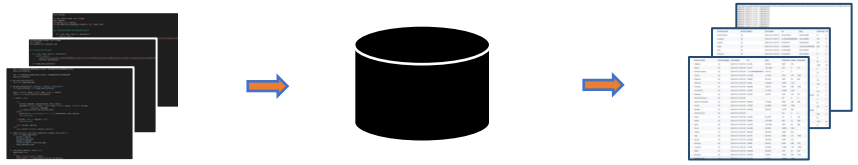
Global Sitreps | National Reporting | State & Local Reporting



Crowd Sourced Data

(400+) "Authoritative" Data Sources

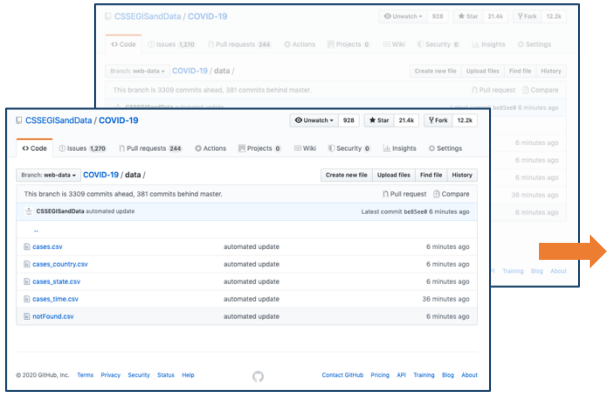
Expanded Data Sourcing



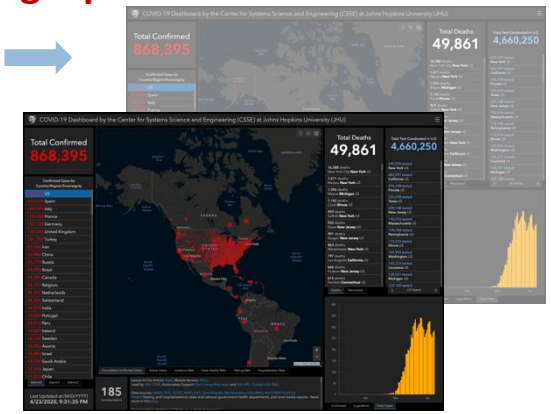
Collection | **Curation/Fusion** | Production

Automated Open Data Product Generation

Parallel Testing Pipeline



Open Data Sharing



Automated Updates

Automation for Detection & Correction

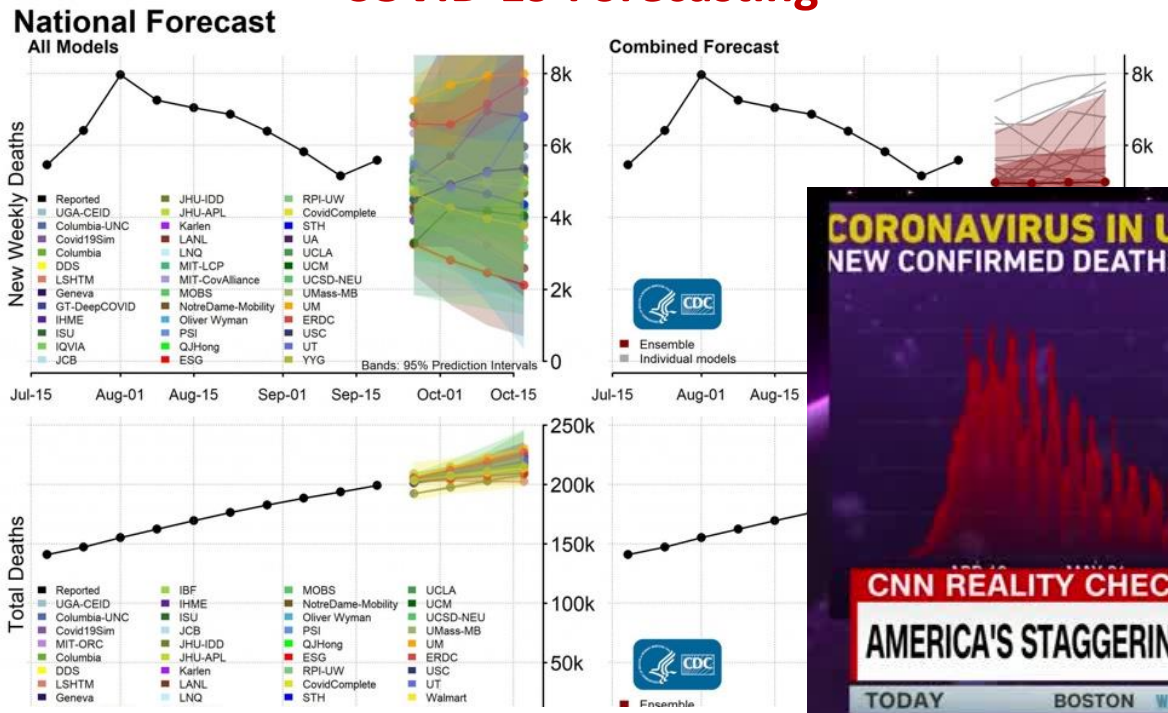
Manual recovery where necessary

Anomaly Detection and Error Correction

Automated process scales –
but introduces complexity

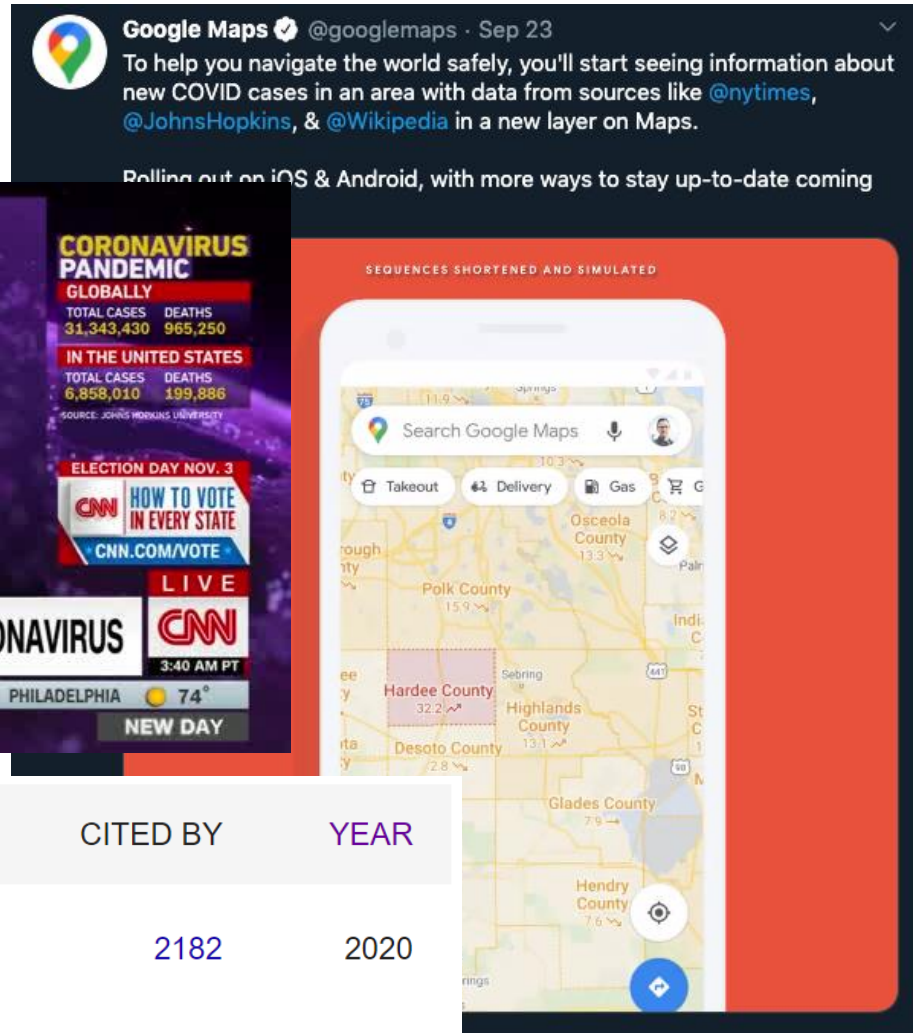
JHU CSSE COVID-19 Dashboard Data Uses Today

Driving Public Health Policy: CDC COVID-19 Forecasting



Mainstream Media

Helping inform the decision making of people everyday.

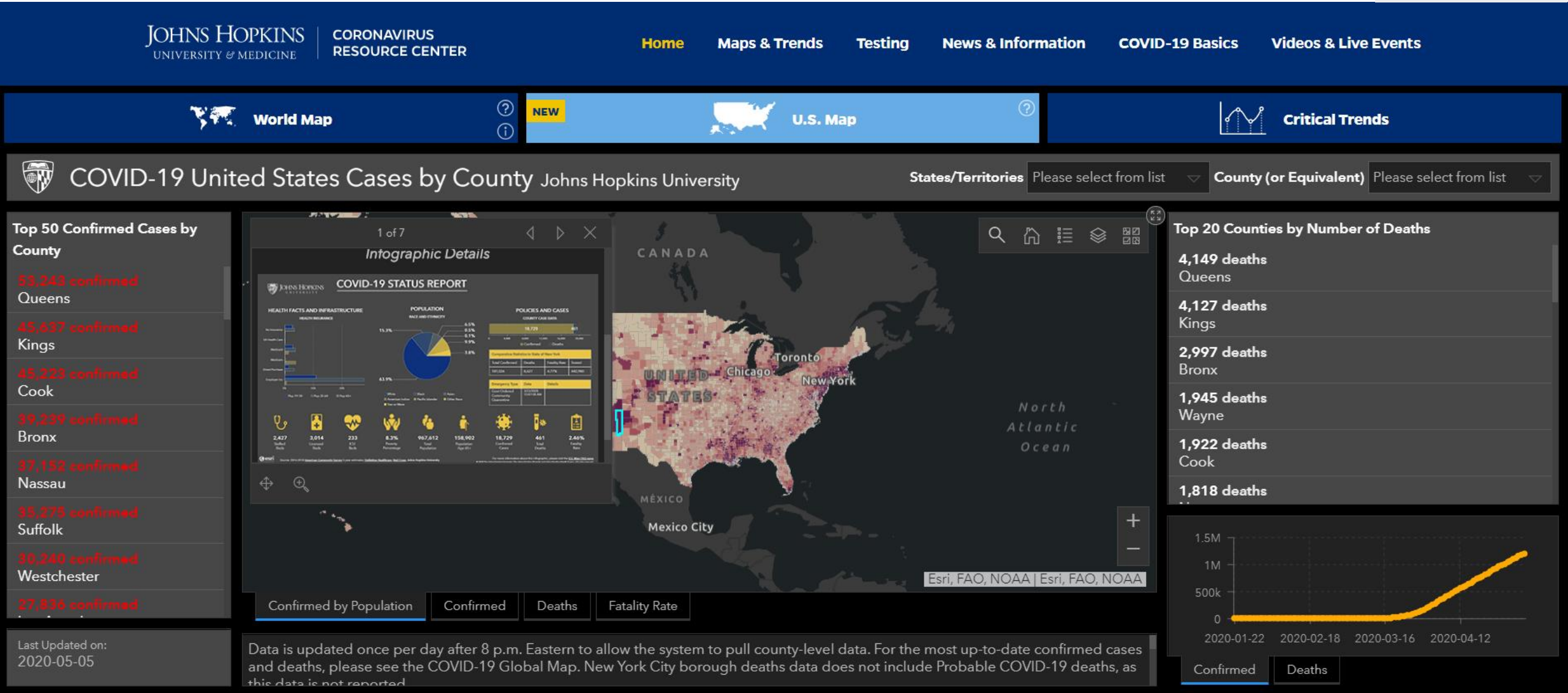


Supporting modeling and response efforts

TITLE	CITED BY	YEAR
An interactive web-based dashboard to track COVID-19 in real time E Dong, H Du, L Gardner The Lancet infectious diseases 20 (5), 533-534	2182	2020

JHU Coronavirus Resource Center – U.S. Map

CENTERS FOR Civic Impact



JHU Coronavirus Resource Center

JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

CENTERS FOR Civic Impact

JOHNS HOPKINS WHITING SCHOOL of ENGINEERING

Center for Systems Science and Engineering

JOHNS HOPKINS UNIVERSITY & MEDICINE | CORONAVIRUS RESOURCE CENTER

Home | Tracking | Testing | Tracing | By Region | News & Resources | About

Global Confirmed
20,950,402

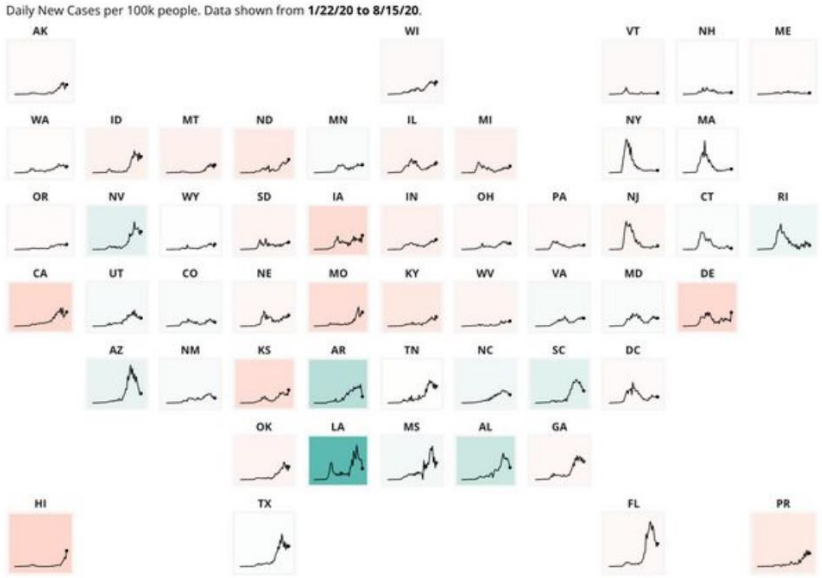
Global Deaths
760,213

U.S. Confirmed
5,254,878

U.S. Deaths
167,253

Global Map >

U.S. Map >



NEW CASES OF COVID-19 IN US STATES

Have states flattened the curve?

See if new cases are rising or declining as states reopen.

NEW

BY REGION

See the latest data in your region

Explore stats and trends specific to your country or U.S. state

Country or state... >

TESTING TRENDS TOOL

Track trends in COVID-19 cases and tests

NEW

STATE TIMELINE

Impact of opening and closing decisions by state

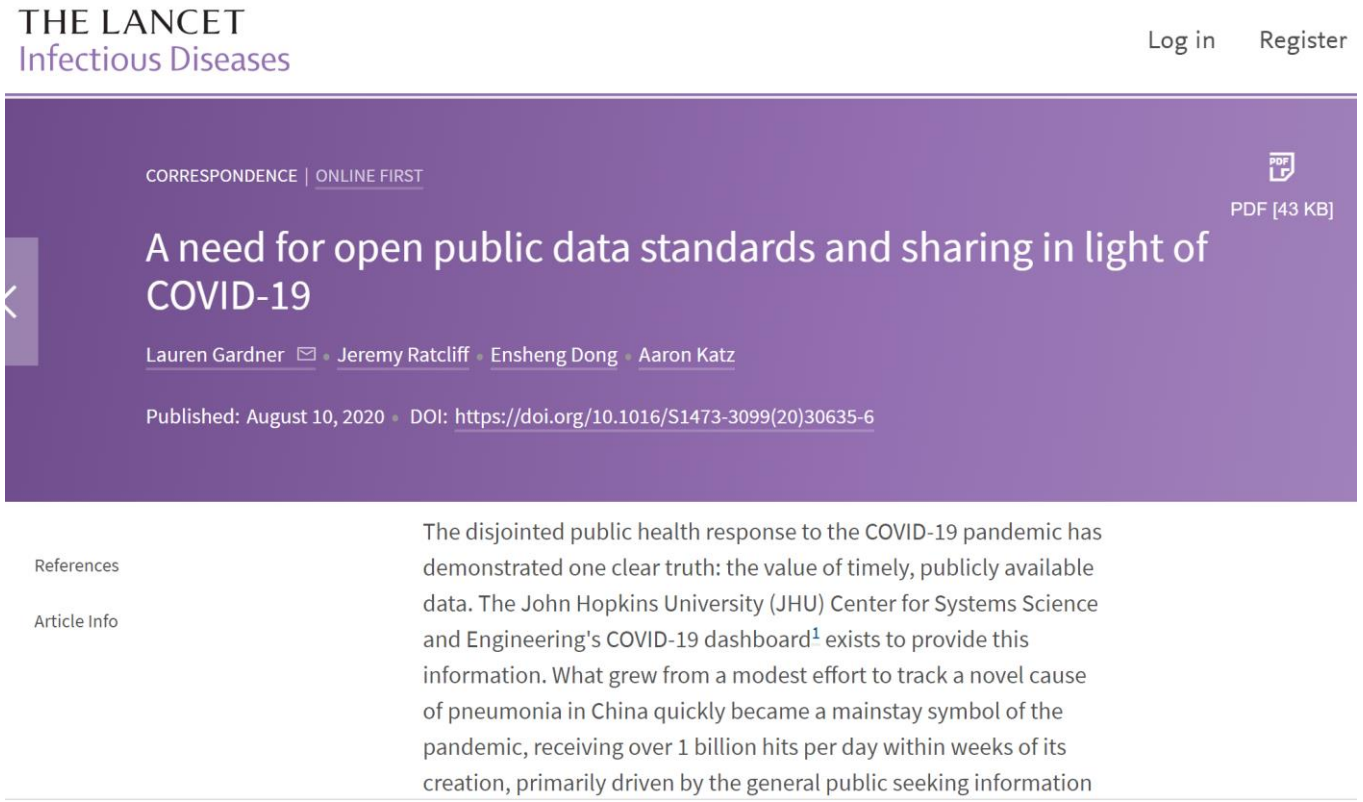
A look at how social distancing measures may have influenced trends in COVID-19 cases and deaths

Why this is hard (Hint: Standards Matter)

- **Instability and inconsistencies in reporting** (retrospective reporting, data structure and mechanisms, machine readability)
  - Our solution: Anomaly detection system
- **Discrepancies in reported numbers among authoritative sources** (TX, UK, France)
  - Our solution: Fusion Logic
- Variability in **frequency and time-of-day reporting** across locations
  - Our Solution: 0400 GMT was the least bad chalk line
- **Ambiguity in parameter definitions** (probable vs. confirmed; reported vs onset time; diagnostic vs antibody, recoveries, etc.)
  - Our Solution: Report consistent across locations, and according to latest CDC guidelines.

Simultaneously addressing both source instability globally and operating near a zero error rate requires extensive engineering and effort

Open Data Principles and the need for a better system



THE LANCET
Infectious Diseases

Log in Register

CORRESPONDENCE | ONLINE FIRST

PDF [43 KB]

A need for open public data standards and sharing in light of COVID-19

Lauren Gardner • Jeremy Ratcliff • Ensheng Dong • Aaron Katz

Published: August 10, 2020 • DOI: https://doi.org/10.1016/S1473-3099(20)30635-6

References

Article Info

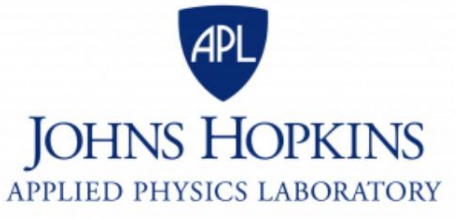
The disjointed public health response to the COVID-19 pandemic has demonstrated one clear truth: the value of timely, publicly available data. The John Hopkins University (JHU) Center for Systems Science and Engineering's COVID-19 dashboard[1] exists to provide this information. What grew from a modest effort to track a novel cause of pneumonia in China quickly became a mainstay symbol of the pandemic, receiving over 1 billion hits per day within weeks of its creation, primarily driven by the general public seeking information

"Moving forward, it is imperative that a **standardized reporting system** for systematically collecting, visualizing, and sharing high-quality data **on emerging infectious and notifiable diseases in real-time** is established. The data should be made available **at a spatial and temporal scale that is granular enough to prove useful** for planning and modelling purposes. Additionally, a critical component of the proposed system is the **democratization of data**; all collected information (observing necessary privacy standards) should be **made publicly available immediately upon release, in machine-readable formats, and based on open data standards**."

Such an established system will both help us make sound and timely decisions when faced with the next potential outbreak, and can help us establish the public trust necessary to combat health related disinformation

Acknowledgements: The Dashboard Team

Acknowledgements: Funding and Resource Support



Thank You.