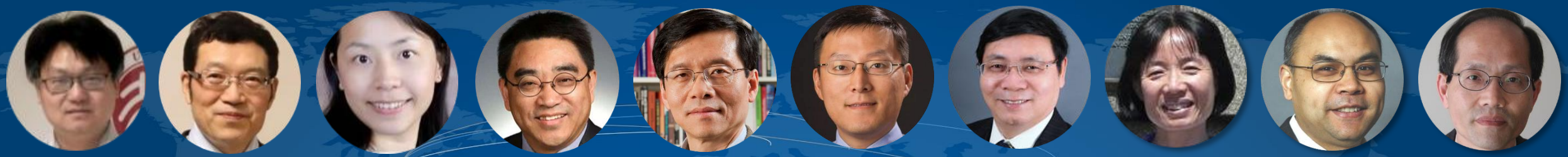

新冠疫情数据分析系列公益讲座(10) COVID-19 Data Analysis Webinars

“中美日防疫模式与疫情影响分析”论坛

主讲人：沈体雁，薛进军、苏延芳、戴晓晨

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总结人：龚健雅

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支持单位：泰康公共卫生及流行病防治基金

北京时间 2020年7月3日上午9-10:30

Introduction of COVID-19 Projections by the Institute of Health Metrics and Evaluation (IHME)

Presenters:

Dr. Xiaochen Dai, University of Washington

Dr. Yanfang Su, University of Washington

Discussant:

Dr. Xi Chen, Yale University

Objectives

- To provide brief introduction of COVID-19 projections by the Institute of Health Metrics and Evaluation (IHME)

Background

- Institute for Health Metrics and Evaluation (IHME)
  - independent population health research center at UW medicine
  - Vision: produce high-quality information on population health, its determinants, and the performance of health systems.
  - Global Burden of Disease (GBD)
- COVID-19 pandemic & impact
  - Started in Wuhan in December 2019 and soon became a global pandemic.
  - According to JHU, 10.7m confirmed infections and about 520k deaths.
  - Huge economic impact as well
- Purpose of the projections
  - Track the pandemic globally and prepare the governments and local hospitals for the impact of the pandemic
- What are our projections?
  - number of deaths, number of infections, hospital & ICU bed utilization & shortage
  - Human mobility, testing, mask use and Rn etc..
- The scope of our prediction
  - Duration: Feb 4th to Oct 1st, 2020
  - Locations: Most countries in the world

Data

- Deaths, Infections, Testing
  - JHU Coronavirus Resource Center, June 20 https://github.com/CSSEGISandData/COVID-19/tree/master/csse_covid_19_data
  - Government/ city departments' websites
  - newspapers (e.g. NY times)

- Hospital beds, ICU beds, Ventilators
  - American Hospital Association (AHA)
  - State department of health
  - Collaborators around the world

Data (cont.)

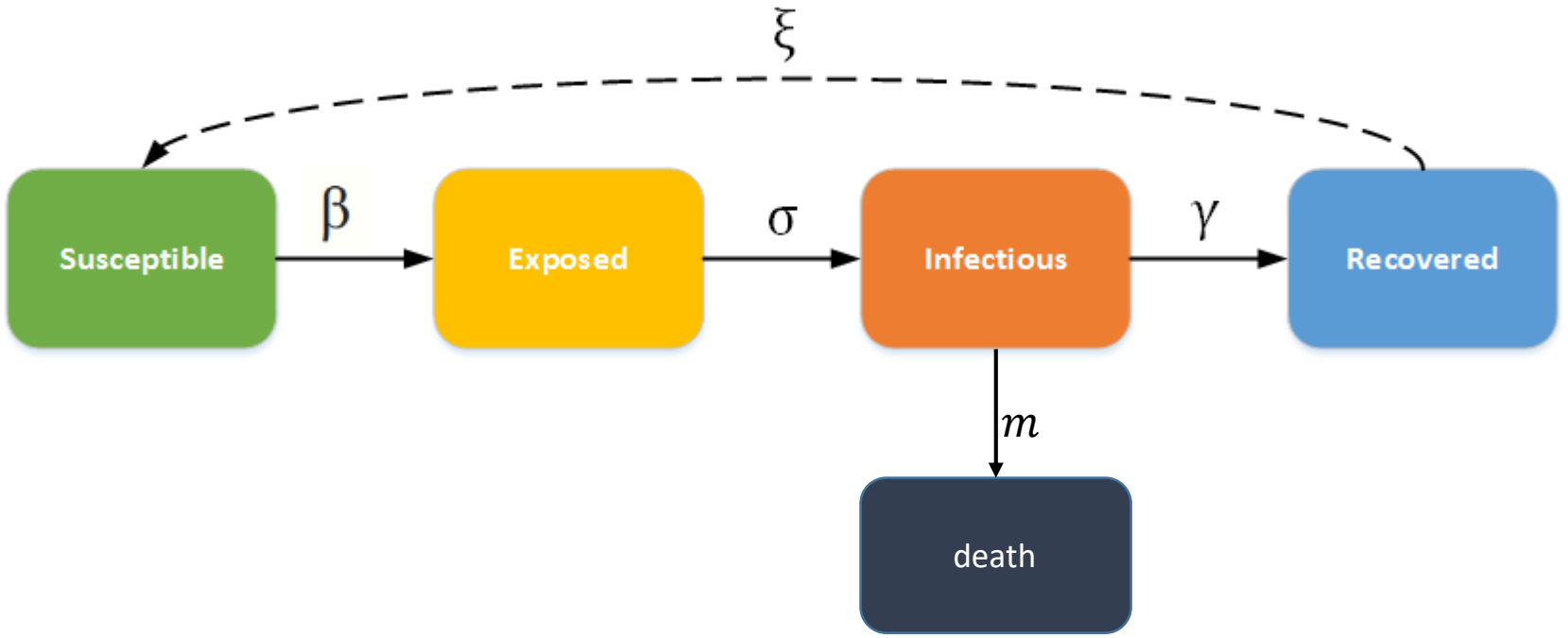
- People's mobility data
  - Descartes lab: https://github.com/descarteslabs/DL-COVID-19
  - Safegraph: https://www.safegraph.com/dashboard/covid19-shelter-in-place?s=US&d=04-26-2020&t=states&m=index
  - Google
  - Facebook
- Social distancing and mask use mandates
  - Government documents/ websites
- Mask use data
  - Premise data: https://www.premise.com/are-americans-wearing-face-masks/
  - Facebook Global symptom survey: https://jpsm.umd.edu/research/facebook-%28covid%29-symptom-survey

Data (cont.)

- Temperature →pneumonia mortality rate
- Air pollution
- Altitude (proportion of the population that live in locations that are under 100 m above sea level)
- Smoking prevalence
- Population density
- Other exploring covariates
  - human contact rates
  - use of public transit
  - Household size
  - Humidity

Methodology

- hybrid epidemiological compartment model (IHME-HSEIR)
  - Curve-fit model
  - SEIR model:



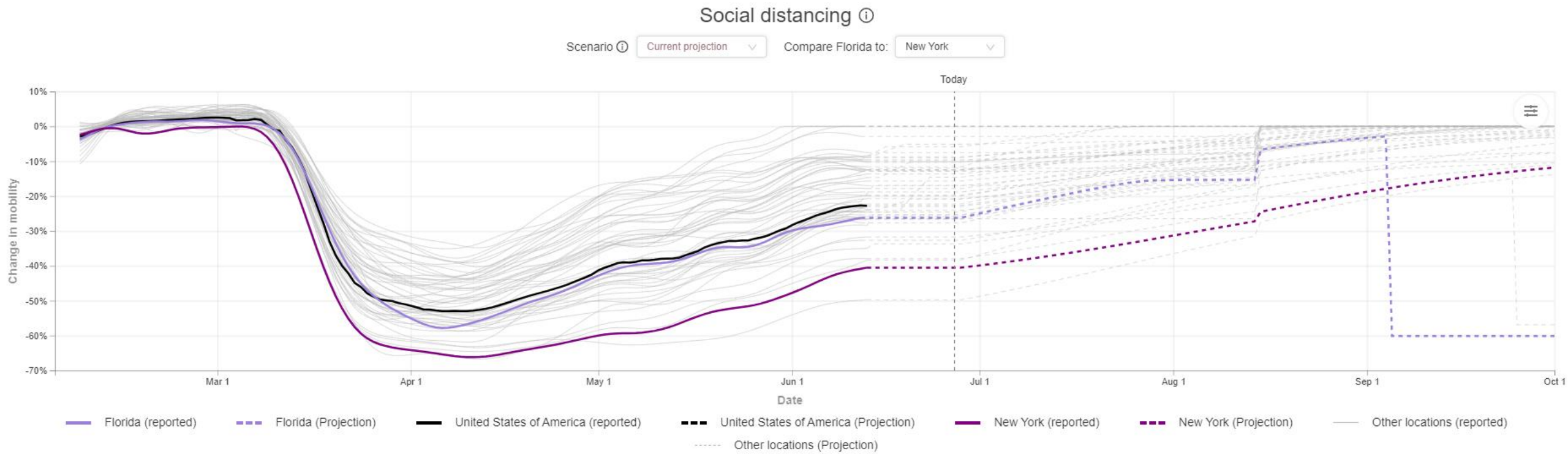
Methodology (cont.)

- Part 1: Estimating COVID-19 deaths and infections
- Part 2: Fitting and predicting disease transmission dynamics (the SEIR model)
- Part 3: Using independent drivers to inform the trend in the COVID-19 epidemic
  - social distancing policies
  - Changes in human mobility
  - COVID-19 testing per capita
  - Percentage of populations living in highly dense areas
  - Mask use

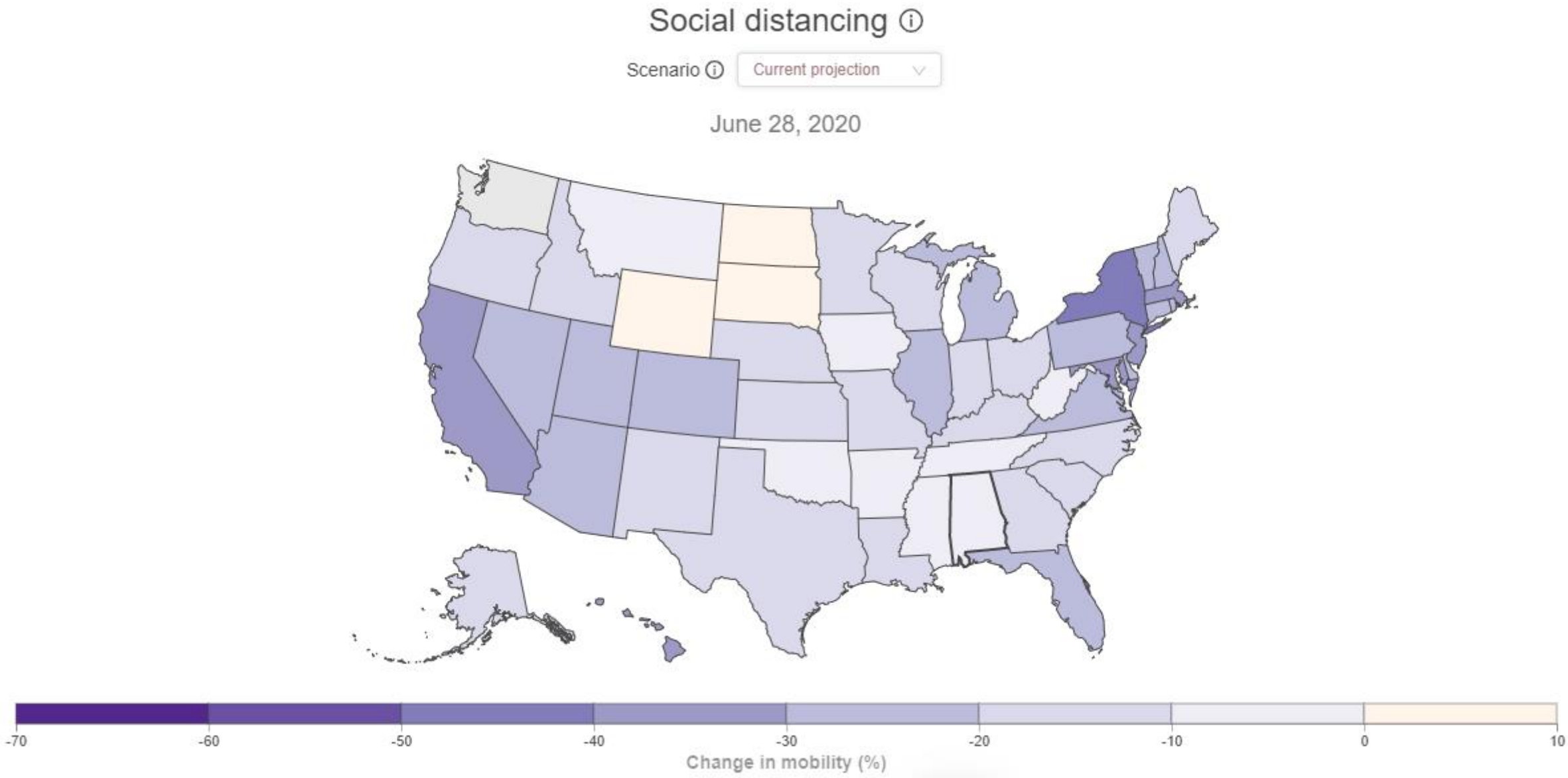
Example 1: human mobility and SD mandates

- Sources
  - Global: Google, Facebook
  - US: Google, Facebook, SafeGraph and Descartes Labs
- Processing
  - Standardization of different data sources
  - Smoothing by taking seven-day moving average
  - Producing composite time series of change in mobility (composite mobility score)
- Predictions
  - Use MR-BRT to estimate the effects of SD on changes in mobility and predict mobility
  - Smooth the residuals using ARIMA and predict residuals
  - Add the predicted smoothed residuals to the predicted mobility.

Changes in mobility in the US



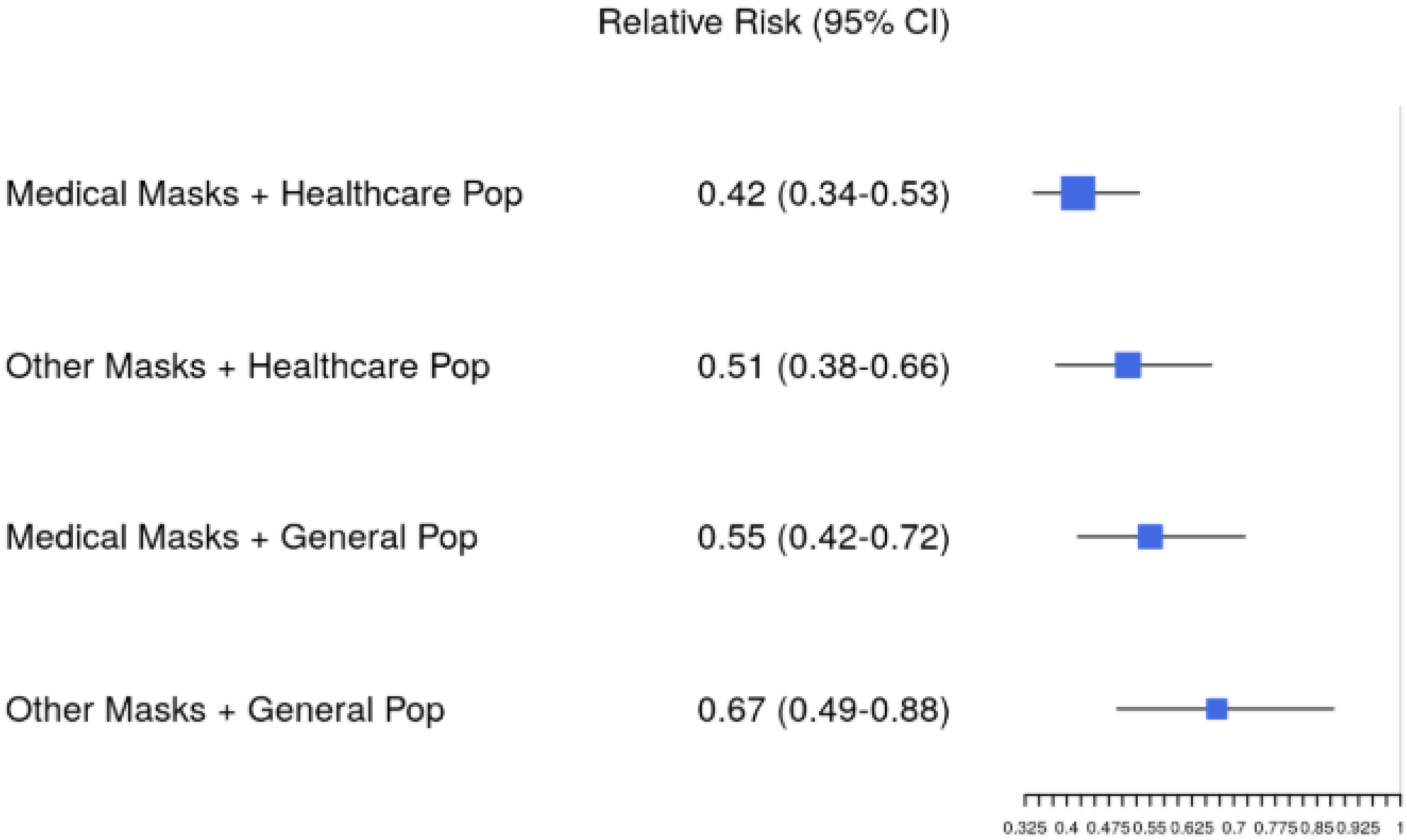
US mobility level as of June 28th



Example 2: effectiveness of mask and level of its use

- How effective are masks?
  - meta-analysis of peer-reviewed scientific studies to examine the effectiveness
  - 41 studies and use MR-BRT

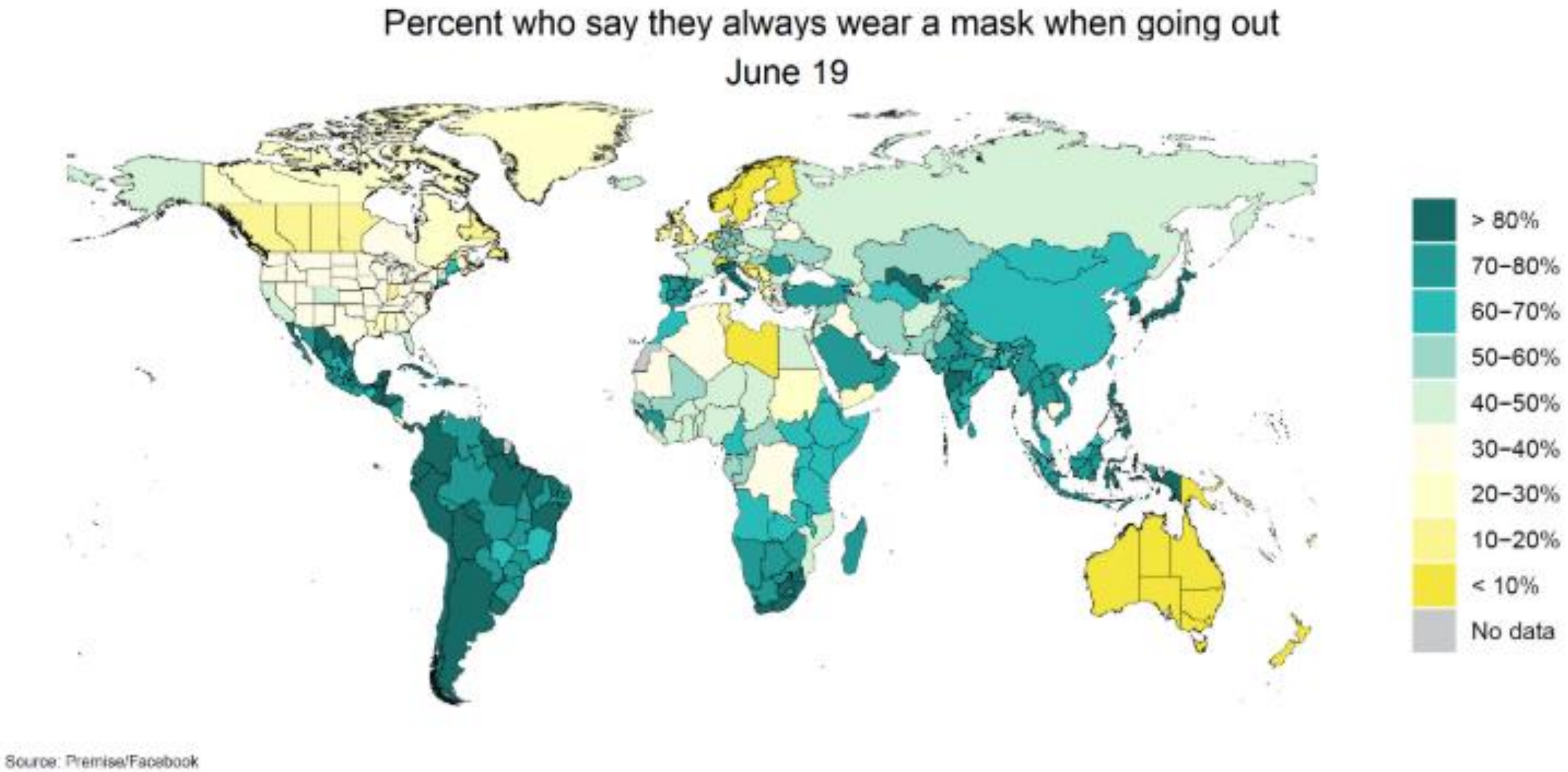
Effectiveness of mask use (Forest plot)



Example 2: effectiveness of mask and level of its use

- How many people are wearing masks around the world?
  - Proportion of people reporting always wearing a mask when outside their home
  - Data sources: Premise (US) and Facebook Global symptom survey (other countries)
  - Covers 101 countries with subnational level data for key countries

Level of mask use around the world



Results

- Key findings from most recent release
  - US: By Oct 1st, cumulative COVID-19 deaths could reach 175,168 in the US
    - Predicted deaths (July to Sept): 52K
    - No mandates: 175K
    - Universal mask: 150K
    - About half the deaths that are predicted between now and October 1 would be avoided.
  - Global: Universal mask use could lead to reductions in mortalities by greater than 50% in many locations around the world

Discussion

- Strengths
  - Prediction since Feb 5th, 2020
  - Cover a key set of countries in the world
  - Provide subnational projections for eight countries (Brazil, Canada, Germany, Italy, Mexico, Pakistan, Spain, US)
  - Explicitly take into account variation in age-structure, which is a key driver of all-age mortality
  - Dynamic systems to accommodate new info and demands

- Limitations
  - Observed epidemic curves for COVID-19 deaths define the likely trajectory (Limited number of completed epidemic)
  - Accuracy of reported deaths attributable to COVID-19
  - Quantified the potential gap in physical resources, but there is an even larger potential gap in human resources (HR); no measure of healthcare quality
  - Other covariates to consider: sex, the prevalence of co-morbidity, population density, individual behavior change not captured by mobility metrics, and a host of other individual factors that may potentially influence the immune response
  - Estimating first wave of the pandemic

Model comparisons

Model	Data Access	Model Type	Geographies	Range
IHME – Hybrid SEIR	http://www.healthdata.org/covid/data-downloads	Hybrid SEIR + Curve fit	73 Countries	October 1
Youyang Gu	https://github.com/youyanggu/covid19_projections	SEIR	76 Countries	October 1
MIT – DELPHI	https://github.com/COVIDAnalytics/DELPHI	SEIR	151 Countries	6 weeks
Imperial–LMIC	https://github.com/mrc-ide/global-lmic-reports	SEIR	109 Countries	12 weeks
LANL– Growthrate	https://covid-19.bsvgateway.org/	Dynamic Growth	121 Countries	6 weeks

Summary

- The COVID-19 projections made by IHME are comprehensive efforts
- The pandemic is affecting more and more developing countries
- Social distancing and universal mask use are very important to control the pandemic

Acknowledgements

- ACAPS
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- California Health Care Foundation
- Carnegie Mellon University
- Department of Political Science, University of Washington
- Descartes Labs
- Facebook Data for Good
- Google Labs
- John Stanton & Theresa Gillespie
- Julie & Erik Nordstrom
- Kaiser Family Foundation
- Medtronic Foundation
- Microsoft AI for Health
- National Institute on Minority Health and Health Disparities (NIMHD) at the National Institutes of Health (NIH)
- National Science Foundation
- Our World in Data
- Premise
- Qumulo
- Real Time Medical Systems
- Redapt
- SafeGraph
- The COVID Tracking Project
- The Johns Hopkins University
- The Kuwait Foundation for the Advancement of Sciences (KFAS)
- The New York Times
- UNESCO
- University of Maryland
- University of Miami Institute for Advanced Study of the Americas (Felicia Knaul and Michael Touchton)
- Wellcome Trust
- World Health Organization
- And finally, the many Ministries of Health and Public Health Departments across the world, collaborators and partners for their tireless data collection efforts

More info

- Pre-review paper:
  - IHME COVID-19 health service utilization forecasting team, and Christopher JL Murray. 2020. “Forecasting the Impact of the First Wave of the COVID-19 Pandemic on Hospital Demand and Deaths for the USA and European Economic Area Countries.” Preprint. Infectious Diseases (except HIV/AIDS). https://doi.org/10.1101/2020.04.21.20074732.

- Visualization tool: https://covid19.healthdata.org/united-states-of-america

- Data download: http://www.healthdata.org/covid/data-downloads