# Use of COVID-19 Models in a Public Health Response



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# Data needs for public health decision-making

- Early in the pandemic models were needed to give:
  - reliable estimates of the transmission potential of the infection
  - forecasts of how large the pandemic could be
- As the pandemic progressed, models were needed to asses
  - Potential impacts of non-pharmaceutical interventions (NPIs)
    - Closing schools
    - Stay at home orders
    - Masking
    - Social distancing
  - Hospital Bed Demand
  - Vaccine coverage and immunity



# **COVID-19 Surveillance**

- Unprecedented volume of data
  - Systems were not prepared
- Unprecedented demand for data
  - Workforce and skillsets were not sufficient
  - Insufficient testing capacity
  - Role of asymptomatic infection in transmission not well understood
- Unprecedented timeframe for data
  - Disease surveillance has never been real-time



# **COVID-19 Models**

- Forecasting models
  - Statistical, fit a line or curve and extrapolate
  - yield short-term forecasts not long-term predictions considering underlying epi and transmission dynamics
- Mechanistic Models
  - Attempt to mimic how transmission occurs
  - Assumption-based parameters
  - Simulate future transmission scenarios



# **COVID-19 Model Consumption**

- Rapid learning by the media and public
- Challenges remain
  - Optimizing these models
  - communicating model assumptions, levels of uncertainty, and forecasts
  - public consumption and correct use of model outputs in decision-making



But the true nature of science is that, particularly when you're in an evolving situation, you've got to be flexible enough and humble enough to say...we're starting to see a different set of data and a different set of facts that we may want to modify the kinds of decisions and recommendations that we make.

-Dr. Anthony Fauci, NIAID

"When Public Health Means Business" Harvard Chan School of Public Health August 5, 2020



# **Los Angeles County**

#### Population ~10 million

- >25% of CA residents live in LAC
- Most populous county in the U.S.
- Would be 10<sup>th</sup> largest state in terms of population if a state

Includes 88 incorporated cities & many unincorporated areas

Size: 4,058 square miles

 Larger than Rhode Island and Delaware combined





# LA County COVID-19 Data, announced 8/10/2020











22Jul2020

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# LA County COVID-19 Data, announced 8/10/2020

08/10 Update Data through 8:00pm 08/09/2020

#### **DISCLAIMER:**

Today's numbers do not include backlog numbers; the State has indicated that the backlog of lab reports for L.A County from the State electronic laboratory system (ELR) should be sent shortly. Data sources that track other key indicators, including hospitalizations and deaths, were not affected by this reporting issue.

View other Los Angeles County COVID-19 Data Information Pages

Daily COVID-19 Data

COVID-19 Data Dashboard COVID-19 Recovery Metrics Contact Tracing Dashboard Skilled Nursing Facility Dashboard

#### Case Summary







# A Patient's Journey | COVID-19



oal of physical distancing, public use of cloth face coverings, quarantine, isolation and similar actions <u>is to reduce the</u> <u>number of new susceptible people exposed during this time</u>

### How Many in Los Angeles are Infectious to Others?

- The DHS team's epidemic model estimates the number of people in Los Angeles County who:
  - Are still susceptible to infection if exposed;
  - Have been exposed and are incubating, but not infectious;
  - Have COVID-19 and are infectious to others, though they may have no symptoms; and
  - Have had COVID-19 and either recovered or died, so they are no longer infectious
- The model suggest that about 0.19% (uncertainty of 0.12% to 0.31%) of everyone in Los Angeles County is <u>currently</u> infected and infectious to others.
- This suggests about 1 in 510 (between 1 in 860 and 1 in 320) Los Angeles County residents are currently infectious to others. Last week this estimate was 1 in 450.

#### **Hospital New Patient Projections: From Last Week**



#### **Hospital New Patient Projections**



Additional Uncertainty if R increases

Uncertainty with no change in R



**Effective Transmission Number "R"** 

Note: We have adjusted the R that we present to account for the fraction of the population that is presumed to be immune to reinfection. At the beginning of the pandemic, this fraction was essential zero so this would not have made any difference. But as more people have been infected, and are presumed to have immunity, we are presenting an R that includes this factor.

### How to Model Demand: An integration of prior admissions

- The current hospital census, ICU census, and the number of patients on mechanical ventilation are key targets for demand modeling
- Each category of demand is a function of the number of COVID-19 patients admitted to the hospital in the prior days and weeks and the expected length of stay and the time of course of illness severity
  - No data are available to explicitly inform this relationship
- Key insight: the relationship between prior admissions and each category of demand can be determined <u>empirically</u> using best subset regression
- This approach can be modified to explicitly allow for changes in admission, treatment, and population characteristics over time

#### How to Model Demand: An integration of prior admissions



#### **Predictions of Demand in LA County | Hospital Beds**



Additional Uncertainty if R increases

Uncertainty with no change in R

# **Changes in the Epidemic and Medical Care**

- The COVID-19 epidemic in Los Angeles County is affecting a younger population, on average, than before
- As we have gained greater experience in treating patients hospitalized with COVID-19, we have learned that a greater share can be effectively cared for without placing them in the ICU or using mechanical ventilation
- Because of these changes, there has been a decrease in the need for ICU beds and ventilators relative to the number of hospitalized patients with COVID-19
- These changes are now incorporated into the new projections for the number of ICU beds and ventilators that we expect to be required in the future
  - The projection for future ICU bed utilization is a 10% decrease from what would have been expected early in the epidemic with the same number of hospital admissions
  - The projection for future ventilator utilization is a 25% decrease from what would have been expected early in the epidemic with the same number of hospital admissions
  - These adjustments will continue to be reevaluated in the weeks ahead

#### **Predictions of Demand in LA County | ICU Beds**



#### **Predictions of Demand in LA County | Ventilators**



Additional Uncertainty if R increases

Uncertainty with no change in R

#### **Predictions of Daily Mortality LA County**



Additional Uncertainty if R increases

Uncertainty with no change in R

• Daily reported deaths

 $\Delta$  7-day running average

#### **Effect of Behaviors to Control Transmission**

#### If transmission....



\*(This includes adults and children)



# **Lessons from Smallpox Eradication**

- Develop rigorous surveillance systems and relentlessly seek the truth
  - "You get what you inspect, not what you expect"
- Data Transparency and public trust are vitally important
- The importance of iteration
- Public health leaders and practitioners must learn from one another and share experiences



# **COVID-19 Modeling Collaborations**

- Brings together academic, applied public health, other sectors
  - Challenge assumptions
  - Progress discussion on key assumptions
  - Track important changes and adaptations of human behavior and response
  - Identify outside data sources to validate
  - Identify outside perspectives and research
  - Increase model usefulness for policy-making



# Thank you