Center for Forecasting & Outbreak Analytics (CFA)
Better Data, Better Analytics, Better Response

CFA 101 for Industry Event

Thank you for joining us!
Our broadcast will begin shortly

April 21, 2022
Washington, DC
Center for Forecasting and Outbreak Analytics (CFA)

Opening Remarks – Alison Kelly, CDC/CFA

April 21, 2022
Washington, DC
Participation

Online Participation

• Please email all questions to CFA@CDC.GOV

In-Person Participation

• Please raise your hand to ask a question during the designated Q&A sessions
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<tr>
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<tr>
<td>10:00 – 10:15</td>
<td>Welcome Address – Alison Kelly, CDC/CFA</td>
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<tr>
<td>10:30 – 11:00</td>
<td>Keynote Speaker – Nirav Shah, Stanford University</td>
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<td>11:00 – 11:10</td>
<td>Predict Division Overview – Marc Lipsitch, CDC/CFA</td>
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<td>Inform Division Overview – Caitlin Rivers, CDC/CFA</td>
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<td>Technology &amp; Innovation Division Overview – Rebecca Kahn, CDC/CFA</td>
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<td>11:30 – 12:00</td>
<td>Q&amp;A</td>
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<td>Lunch on your own</td>
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<td>Industry Panel: Data, Analytics, and Technology Requirements to Transform Health Emergency Response</td>
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<td>2:55 - 3:00</td>
<td>Closing Remarks – Dylan George, CDC/CFA</td>
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Center for Forecasting and Outbreak Analytics (CFA)

Introduction to CFA: Purpose, Mission, Vision – Dylan George, CDC/CFA

April 21, 2022
Washington, DC
CFA Leadership & Key Players

Dylan George
Director of Operations

Marc Lipsitch
Director of Science

Alison Kelly
Deputy Director

Caitlin Rivers
Associate Director

Rebecca Kahn
Senior Scientist

Karen Stamey
Management Officer
Problem Statement

Data for Action in a Pandemic

- Disease outbreaks are becoming more frequent and more disruptive.

- The nation lacks data, analytical systems to identify and respond quickly, effectively.

- The U.S. must improve these systems and develop capabilities for producing forecasts and analytics that leaders can use to make timely, informed decisions about how to best prepare for and respond to infectious disease threats.

- Models and analytics need to be responsive to concerns of underserved communities, and address issues of health equity directly.
What is Forecasting and Outbreak Analytics and What is the Value?
Example COVID-19 Questions that Modeling Can Inform

- What is the probability of a future surge?
- What degree of immune escape in a variant would cause a surge?
- How many tests would be needed to support widespread diagnostic and screening testing?
- What role will vaccine availability for young children play in changing the epidemic's trajectory?
- How would 50% booster coverage change the epidemic's trajectory?
Proposed CFA Value in the Outbreak of Novel Pathogen

**Make sense of uncertainty early in an outbreak**
- Assess epidemic potential and severity
- Quantify risk and timing of imported cases
- Assess risk to the homeland

**Provide early warning, situational awareness**
- Develop good-bad-worst planning scenarios; bound uncertainty
- Assess expected impact of interventions
- Produce short term forecasts

**Get critical data for the response**
- Resource demand projections
- Inform design and targeting of prevention measures
- Monitor vax, treatment effectiveness over time
- Provide data to update scenarios and forecasts

**Support policy and guidance**
- Inform policy and guidance on:
  - Border controls
  - Testing, quarantine & isolation
  - Countermeasure demand
  - Vaccine prioritization
  - Surveillance design
CDC Plans for Building the Center for Forecasting and Outbreak Analytics
CFA Organization

**PREDICT**
- Analytics team – Real-Time Monitoring team, Analytics Response Team
- Targeted studies
- Engagement, strategic partnerships

**INFORM**
- Federal support
- STLT decision support
- General public risk communication

**INNOVATE**
- Science / contract management
- Product development – applications, enterprise
- Test beds – STLT, payer/provider

**TECHNOLOGY**
- Develop and Refine Technology for the Analytics Platform
- Build Products
- Establish CFA Data Requirements
Principles to Guide Decisions

1. Mission Impact
   CFA will focus on saving lives and protecting people through outbreak data, forecasts and analytics.

2. Open and Transparent
   CFA will make data, analyses, and scientific methods open to the public in human and machine-readable formats as much as possible.

3. Collaborative
   CFA will work with partners, including in the public sector, private sector, academia, and civil society to coordinate efforts and maximize impact.

4. Equity Focused
   CFA will support efforts to achieve health equity by using data to identify and track health disparities in outbreaks and inform policies to address those disparities.
Developing Outbreak Analytics & Forecasting Will Take Time, Resources

Advancing Weather Forecasting: Took Time, Data, Models, and Resources to Develop

- Advancing weather forecasting capabilities took decades
- Needed ingredients:
  - Data
  - Models
  - People
  - Computational Power
  - Specific Use Cases
  - Sustained Funding
- Diseases forecasting, analytics still in early stages

Increases in numerical weather forecasting skill through time

![Graph showing increases in forecasting skill over time](image)
Center for Forecasting and Outbreak Analytics

Keynote Speaker: Nirav Shah, Stanford University

April 21, 2022
Washington, DC
Accelerators of Actionable Data

Center for Forecasting and Outbreak Analytics
Industry Day – April 21, 2022
Great Hall, Washington, DC

Nirav R. Shah, MD, MPH
Senior Scholar, Stanford University
Chief Medical Officer, olea.health
Disclosures

- Senior Scholar at Stanford University
- Chief Medical Officer of olea.health
- Board Member at STERIS plc, CovidActNow.org, Kinsa
- Advisor to GSR Ventures
- Advisory Committee to the Director of the CDC
- Commissioner, Commonwealth Fund Commission on a National Public Health System
- Senior Fellow of the Institute for Healthcare Improvement (IHI)
- Trustee of the John A. Hartford Foundation
- Prior Board Chair, Linux Foundation Public Health
- Prior service as Commissioner, NY State Department of Health, and Chief Operating Officer, Kaiser Permanente in Southern California

All views expressed are my own
What metrics to follow?

- New infections
- ER visits (A/D/T feeds)
- Hospitalizations
- Beds available in ICUs
- Mortality

AND

- Hospital workers out with COVID
- Wastewater surveillance
- Daily average fever counts
- New data sources
Daily average share of population with a fever

The New York Times

Omicron Is in Retreat

Dec. 15, 2021

Jan. 17, 2022

Chart shows 7-day average. | Source: Kinsa
Sharecare Community Well-Being Index Score for Michigan

Well-Being Index Score: 55/100

Michigan
U.S. Ranking #38 of 50

Well-Being Dimensions

- Community
- Economic Security
- Financial
- Food Access
- Healthcare Access
- Housing and Transportation
- Physical
- Purpose
- Resource Access

Monroe County
Well-Being Index Score: 50
MI Ranking #26 of 83
Digital Health Companies:
Addiction treatment / opioid use disorder

Digital health’s investments of $37.9 billion in 2021
$793M invested in Substance Use Disorder startups

Bicycle Health
Wayspring
Boulder
Workit
Ophelia
In RECoVER, researchers can perform queries across all institutions participating in the consortium, without any compromises on privacy or security.

Data remains local and private within each participating institution—no records ever leave each institution. Software modules from Onai run at each institution and jointly construct a single aggregate statistical result, without exposing any institution's local results to any other institution. This mechanism enables greater security and speed than traditional approaches.
Lessons Learned & Next Actions

- Measurement needs and reporting needs change in real time
- Communicate about data in ways that the public can receive & understand it
- There’s more than enough data, we have to look for it and accept it from the private sector and others
- Technology can already address many privacy and security concerns

What you can do...
- Standardization is Innovation, e.g. for interoperability
- Embrace private and nontraditional data
- Support people doing great work: Kenneth Mandl, Rick Hawes, Aneesh Chopra, Bala Hota, many others on the stage today, and of course Dylan, Marc, Rebecca, and Caitlin
Center for Forecasting and Outbreak Analytics (CFA)

CFA 201 – Breakdown by Division

April 21, 2022
Washington, DC
Predict Division Overview

Marc Lipsitch, DPhil
Director for Science
Center for Forecasting and Outbreak Analytics
GOALS

• **Generate forecasts and analyses** to support outbreak preparedness and response efforts
• **Support critical data collection efforts** to address response priorities
• **Respond to needs** of Federal, State, Tribal, Territorial and local leaders for analytical, forecasting results
Analytics Inform Response Efforts Across an Epidemic

Examples of Outbreak Analytics

- Prospective Scenario Analyses
- Risk Assessment Tools
- Parameter Estimations
- Vaccine Effectiveness
- Phylogenetics
- Disease Forecasting
- Outbreak Management Scenario Analyses
- Pathogen Characterization
- Disease Risk Mapping
- Burden, Impact Assessments
- Therapeutic Effectiveness

Graphic courtesy of bnex/iqt

Draft / Pre-Decisional
Planned Analytic Products

Real-Time Monitoring (Routine, Periodic)
- Forecasting, Nowcasting
- Scenario Analysis
- Natural History / Parameter Estimation

Topical Analytics (As Needed per Response Priorities)
- Health Equity and Vulnerable Populations
- Community Mitigation
- Vaccines
- Therapeutics
- Testing and Diagnostics
- Pathogen Variants
- Mobility and Borders
- Setting-specific Transmission
Planned Critical Data Collection Activities

**Targeted Studies to Answer Key Questions**
- Transmissibility
- Viral Kinetics
- Severity
- Immune escape
- Vaccine escape
- Diagnostic sensitivity

**Random Sample of the Population for Virologic Testing**
- Possible models: UK’s Real-time Assessment of Community Transmission (REACT) and Office for National Statistics (ONS) studies
- Continuous sampling with multiplex assays and sequencing of positives

**Potential Partners Include but not Limited to:**
- Payer-provider networks/managed care
- Nursing homes
- Academia
- Industry
Work to Date & Early Successes
Scenarios developed in November/early December 2021 as South African surge was under way

<table>
<thead>
<tr>
<th>Scenario *</th>
<th>Inherent transmissibility relative to Delta</th>
<th>Immune escape relative to all prior strains</th>
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<tbody>
<tr>
<td>Faster growth (Higher transmission**, Mid escape)</td>
<td>1.6x</td>
<td>43%</td>
</tr>
<tr>
<td>Slower growth (Higher transmission. Low escape)</td>
<td>1.5x</td>
<td>10%</td>
</tr>
<tr>
<td>Faster growth (Unchanged transmission. High escape)</td>
<td>1.0x</td>
<td>85%</td>
</tr>
<tr>
<td>Slower growth (Lower transmission. Mid escape)</td>
<td>0.8x</td>
<td>50%</td>
</tr>
</tbody>
</table>

*Parameters were chosen to span a range of apparent growth rate advantage for Omicron over Delta of ~2-3.5x in an environment where 75% of the population has immunity to infection due to vaccination or prior infection.

**Relative to Delta
Assessed Omicron severity relative to Delta using data from Kaiser Permanente Southern California

A: Symptomatic hospitalization

52% reduction in hospitalization

B: ICU admission

74% reduction in ICU admission

For latest results:
https://www.medrxiv.org/content/10.1101/2022.01.11.22269045v2
• CFA, in collaboration with teams in academia and experts in the office of the Assistant Secretary for Preparedness and Response, have contributed analyses related to:

- School test-to-stay guidance
- Travel policy
- Nursing home guidance
- Vaccine guidance
Inform: Customer-Driven Risk Communications

GOALS

• Communicate with expert disease modelers, emergency responders to meet the needs of decision-makers

• Share timely, actionable information with the Federal government; STLT leaders, and the public

• Coordinate early warning efforts between CDC subject matter experts and USG interagency
Objectives & Stakeholders

• Objectives
  • Inform stakeholders of the **modeling results** and **analyses** produced in the Predict Division
  • Learn and relay stakeholders’ **questions** and **priorities** to the Predict and Innovate Divisions
  • Raise **awareness** and **support** for the role of **modeling** and **analytics** in **outbreak preparedness** and **response**
  • Ensure communications are **fast**, **effective**, and **oriented** for decision-making
Inform Staff – Responsibilities

• Responsibilities to Include:
  ✓ Maintain an informal network of academic modelers (and participate in existing networks, e.g., Models of Infectious Disease Agent Study (MIDAS)) to advance R&D priorities and establish reserve capacity for times of pandemic.
  ✓ Participate in STLT task force in Incident Management structure
  ✓ Coordinate with the Federal Emergency Management Agency and the Department of Health and Human Services regional coordinators and associated data analysts
Inform Staff

- Visualization Experts
- Interagency Liaisons
- Public Liaisons
- CDC Liaisons
- State and Local Liaisons
Work to Date & Early Successes
State, Tribal, Local, and Territorial (STLT) Focus Groups

- Sharing examples of **products** and **tools** CFA could **provide** and soliciting feedback on if they are useful
  - Notification of Significant Findings
  - Omicron Severity Analysis
  - Outbreak analytic tools (nowcasting, Rt, descriptive analyses)
- Collecting **feedback** from State and Local Public Health **partners**
- Feedback will help shape CFA's **work**, for example the **test bed pilot**
Requirements for Success
Information Management and Process

Information Management

• Data set responsibilities within CFA
• Data use agreements with key partners - other CDC programs, Federal departments and agencies, STLT partners, private sector
• Processes to manage requests for information
• Approaches for managing variations on products, e.g., one set of analytical results with communication materials tailored to different audiences
Process

• Tools for communicating and visualizing modeling and analytical results
• Approaches for visualizing uncertainty
Innovation & Technology Division Overview

Rebecca Kahn, PhD
Senior Scientist
Center for Forecasting and Outbreak Analytics
GOALS

• Support research and development to improve outbreak forecasts and analyses
• Collaborate with and support academic, private sector, and interagency partners
• Create translational tools, products, enterprise enhancements to make analyses of pandemic data flexible, fast, and scalable for STLT authorities
Support Research and Development to Improve Outbreak Forecasts and Analyses
Initial Work

- Funded academic partners (Harvard, Utah, Johns Hopkins) to:
  - Improve forecasting and outbreak analytics for emergency decision-making
  - Use modeling to inform public health actions with emphasis on equity
  - Expand and upskill the public health workforce

- Established partnership with National Science Foundation (NSF) to
  - Sustain the ability to rapidly fund academic groups to address emerging priorities (modeling and non-modeling) during any response

- Established partnership with Department of Energy (DOE) to
  - Bring DOE’s advanced computing capabilities in high performance computing hardware, software, algorithms and expertise to bear on epidemiological modeling
  - Develop novel algorithms and new software to meet CDC requirements
Create Translational Tools, Products, and Enterprise Enhancements to Make Analyses of Data Flexible, Fast, and Scalable
• Develop innovative, analytical capabilities and partnerships with state/local public health agencies, healthcare organizations, private sector, and academia

• Establish a multidisciplinary community of practice to evaluate, share, and scale successes and innovations
Test Bed Objectives

• Integrate **novel data sources** or technology into **outbreak analytic tools** or pipelines. Examples include:
  • Integrate **wastewater, genomic**, or **mobility** data into forecasts or analyses
  • Develop **novel survey approaches**, particularly behavior related
• Create, enhance, or integrate **analytical tools** for **outbreak response** at federal and local levels. Examples include:
  • Tools for **nowcasting** (i.e. adjusting for reporting delays), geographic **targeting of interventions**, or strategies for **implementing interventions**
• Develop and enhance **visualization, communication** of results to **decision makers**
• Enhance ability to **quickly respond** to **outbreaks** and **inform decisions**
Technology: Architecture Upon Which CFA is Built

GOALS

- **Develop** and **Refine** Technology for the Analytics Platform
- **Build** Products
- **Establish** CFA Data Requirements
• Develop CFA **technology architecture, critical workflows**
  • **Cloud-first** approach
• Enable **surge capacity** – preparation, onboarding, access control for additional analysts, and technologists in an emergency situation
• Develop and maintain **back-up, “on-premise” analytical platforms**
• Develop and refine **visualization, communication, and decision-support capabilities**
Building Products – Tooling and Enterprise Capabilities

- Develop analytical tools and products for CFA and CDC enterprise systems
- Transition successful innovations to operations
- Create flexible analyst tools to support rapid response needs
- Improve and automate mission critical workflows
Analytics Platform – Early Products
Initial Analytics Workflows & Products

Forecasting & Scenario Models

• Internal modeling capability (enterprise level software)
• External contributions
• Ensemble process

Question X – Support for the Analytics Response Team

• Refine general data science and analytics tools
• Develop rapid response tools
• Establish an efficient, flexible and collaborative data science platform
High Level Technology Requirements
Technology Requirements & Components

Data Lake / Data Warehouse
- Secure data repository

Data Tools
- Unified data foundation: ingest, store, share

Metadata Management
- Data provenance, version control

Access
- Cloud environment, on-prem capabilities, web hosting, public access
Technology Requirements & Components contd.

- **Predictive Analytics / Advanced Data Tools**
  - Customizable models, code repository, scalable compute

- **Business Intelligence Tools**
  - “No-code” solution for retrieving, analyzing, transforming, and reporting data

- **Decision Support**
  - Dashboards, reports, bespoke analytics, publishing tools
Questions?

Online participants:
Email questions to CFA@CDC.GOV
CFA 101 for Industry Event

We are on lunch break – please plan to return by 1:30 PM EST
Afternoon Session Overview

• Agenda Items
  • Industry Panel (45 min)
  • Lightning Talks from Industry Leaders (35 min)
  • Closing Remarks (5 min)
Industry Panel: Data, Analytics, and Technology Requirements to Transform Health Emergency Response

Panelists:
Michelle Holko – Google
Ethan Berke – United Health
Caitlin Rivers – CDC/CFA

Moderator:
Dylan George, CDC/CFA
Lightning Talks from Industry Leaders

Databricks
Peraton
Microsoft
RTI
Dell Technologies
Red Hat/Carahsoft
Optum Serve
Maximus Public Health Analytics

Moderator:
Alison Kelly, CDC/CFA
Please visit us at www.cdc.gov/cfa

For any outstanding questions, comments, or to stay in touch, please email CFA@CDC.GOV