# Nudging Data-Based Exit Policy: Nearcasting Lessons from the Crucible of Pandemic Crisis[1]

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**Abstract**[2]: Incorporation of administrative records has long been regarded as a way of advancing the quality of surveys as the rising cost of surveys is subject to harnessing. The extent and pace of using massive administrative data in survey statistics varies from continent to continent and from country to country. This paper illustrates the use of administrative epidemic data to nearcast and flatten the COVID-19 pandemic curve. It is among the panel of papers that provides best practices of using massive administrative data for advancing survey methodology or inform policymaking (Chun, Larsen, Reiter, Durrant, a forthcoming Wiley book).

**Key Words**: COVID-19, administrative data, pandemic, Korea.

[1] The views expressed are those of the authors and not necessarily those of the affiliated institutions.

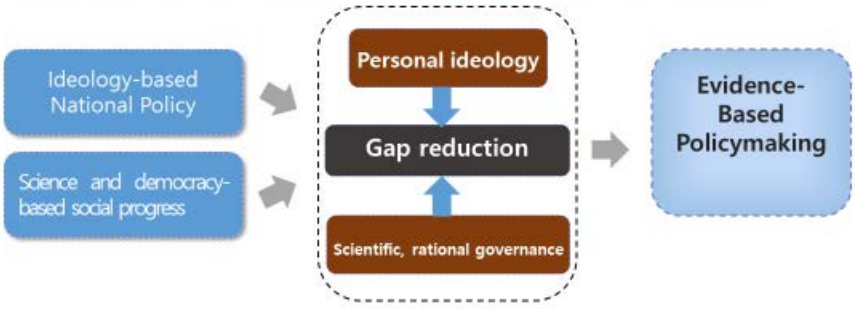
[2] All authors, except being noted below, are affiliated with the ISR Foundation Center for Science Diplomacy as well as the PSI Institute for Data Science, Survey Methodology and Interdisciplinary Research. The PSI is part of the International Strategy and Reconciliation Foundation, a 501(c)(3) non-profit organization based in the Washington metropolitan area. David Fisman and Ashleigh Tuite both are with University of Toronto; Amy Greer, University of Guelph; and Paul Choi, Statistics Research Institute, Korea.

# Outline

- Why Evidence-Based Policymaking?
- Data Science-Based Nearcasting to Flatten the Epidemic Curve
- Next Steps towards AI-Based Innovation with AI-Enabling Massive Data

# 1. Why Evidence-Based COVID-19 Policy?

- A Paradigm Shift towards Evidence-Based Policymaking (UK, 1997; Korea, 2004; U.S, 2014)
- PM Tony Blair of the UK initiated evidence-based policymaking in 1997.
- President Noh Moohyun of Korea established a system of evidence-based policymaking in 2007, including data and statistics-based policycrafting.
- President Obama of the United States launched Evidence-Based Policymaking Commission in 2014, followed by a series of institutionalization across the federal government.




- Pew and MacArthur (2014), Evidence-Based Policymaking: A Guide for Effective Government.
- U.S. Evidence-Based Policymaking Commission (2016) – Chair Katharine Abraham.
- Innovation in official statistics toward social progress (2007) – Launched during President Noh's governance in Korea

## 2. Data-Based Nearcasting to Stem Global Crisis

- Reproduction Number ($R_t$)
- Why IDEA?
- Evidence-Based Response to Stem Crisis

## 2.1 Nonpharmarceutical Intervention with Reproduction Number ($R_t$)

- Assessing Reproduction Number ($R_t$) is essential to designing and implementing Nonpharmarceutical Interventions(NPI)
- $R_t$ is function of the following three factors:

  $$Rt \approx P \times C \times D$$

  - P: Probability of infection
    - Person-level NPI (e.g., masks, hands-washing hygine)
  - C: Contact propensity with the infected
    - Society-level NPI: Social distancing (e.g., virtual education, teleworking, preventing mass gatherings)
  - D: Duration of spread by the infected
    - Government-level NPI: 3 T (Testing kits, ICT-based Tracing, Treating guided by health data)
- Science-Based NPI is critical to controlling the three factors affecting R.

## 2.2 IDEA Modeling and Nearcasting?
### Incidence Decay and Exponential Adjustment

- IDEA reflects the **SIR model** (Susceptibles, Infected, Removed), which is central to modeling epidemic process.

- In the absence of intervention or immunity:

$$I(t) = R_0^t$$

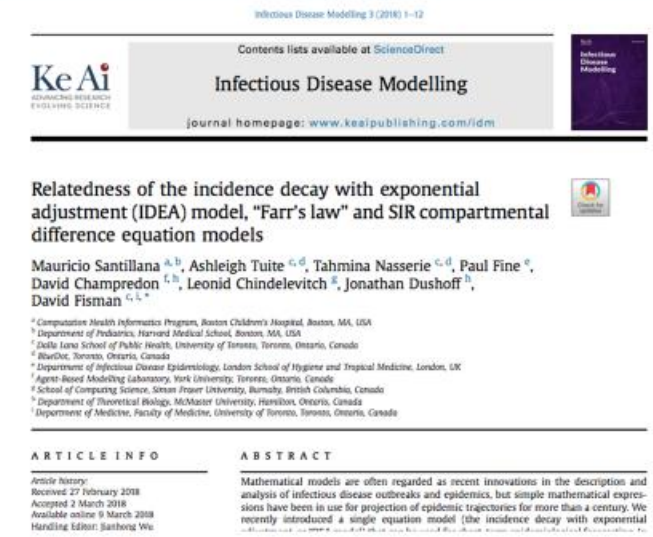
- **But:** intervention occurs, people become immune. Growth decelerates in an accelerating fashion!
- **IDEA Model** (Incidence Decay and Exponential Adjustment):

$$I(t) = [R_0/(1+d)^t]^t$$

- **IDEA Model-2 (Korea)** (Incidence Decay and Exponential Adjustment, Multiple d parameters):

$$I(t) = [R_0/(1+d_0+d_1)^t]^t$$

## 2.3 IDEA (Incidence Decay and Exponential Adjustment)



Infectious Disease Modelling 3 (2018) 1–12

Contents lists available at ScienceDirect

Infectious Disease Modelling

journal homepage: www.keaipublishing.com/idm

Relatedness of the incidence decay with exponential adjustment (IDEA) model, "Farr's law" and SIR compartmental difference equation models

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ARTICLE INFO

*Article history:*
Received 27 February 2018
Accepted 2 March 2018
Available online 9 March 2018
Handling Editor: Jianhong Wu

ABSTRACT

Mathematical models are often regarded as recent innovations in the description and analysis of infectious disease outbreaks and epidemics, but simple mathematical expressions have been in use for projection of epidemic trajectories for more than a century. We recently introduced a single equation model (the incidence decay with exponential

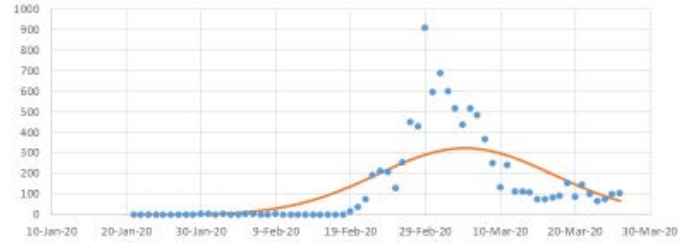
## 2.4 IDEA Model-Based Forecasts to Inform Policymaking
(March '20 to Present - 8 Modelings)

- Epidemic Modeling is Science and Art
- Reduce Uncertainty
- Administrative Data-Based Nearcasting
- Evidence-Based Policycrafting

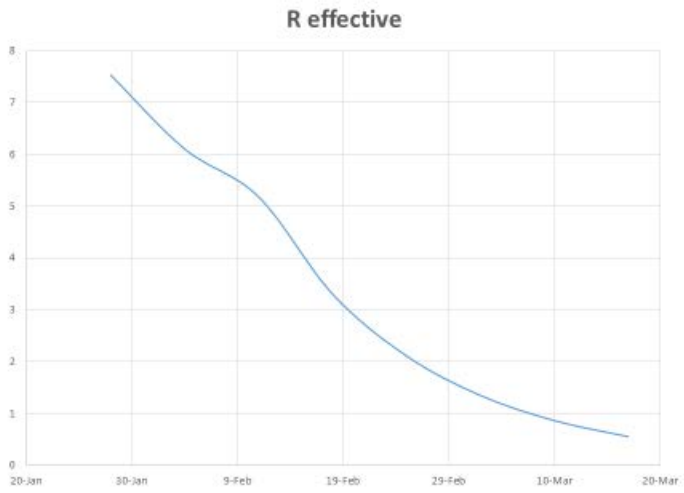
## 2.4.1 IDEA Model for Korea (March 12; March 30)

- Apex in early March → Lowest in early April → Forecasted 11,000 ~ by the end of May

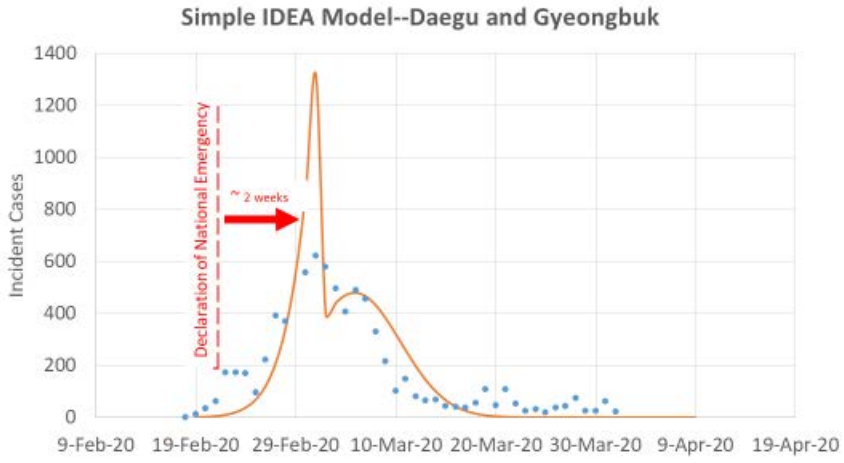

Simple IDEA Model: 3rd Modeling



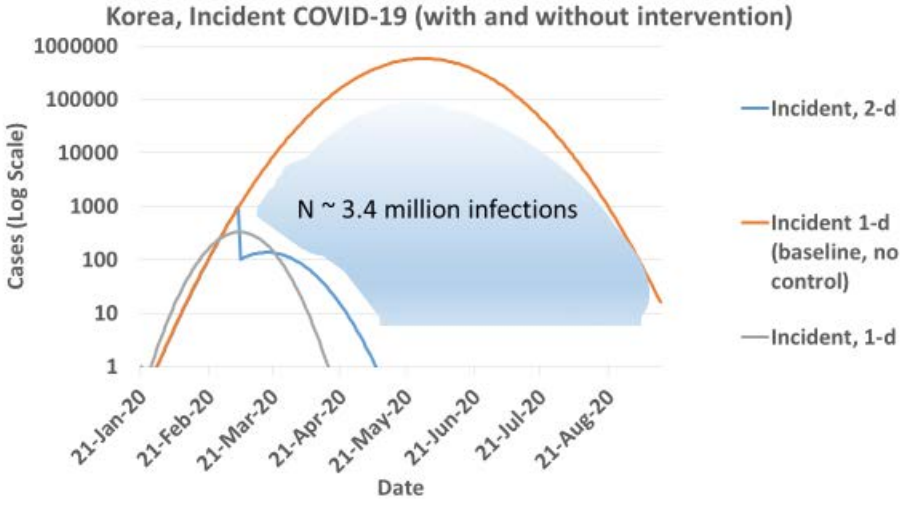
## 2.4.2 IDEA-Based $R_t$
(3rd Modeling, 3/30) 1.28~3.30



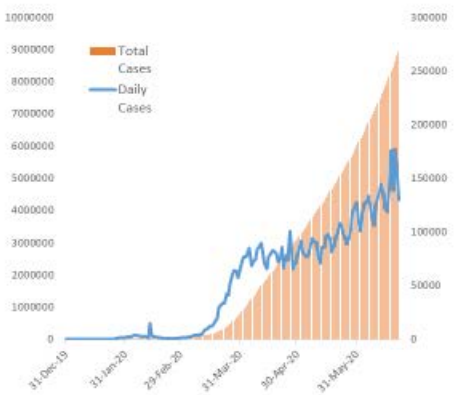

## 2.4.3 IDEA Mdoel for Daegu & Gyeongbuk
(4th Modeling, mid-April)

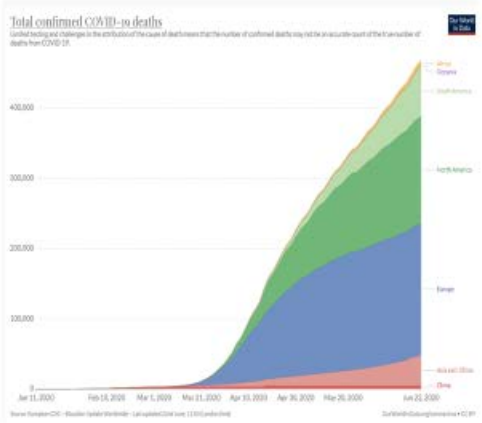


# Estimation of Cases Prevented

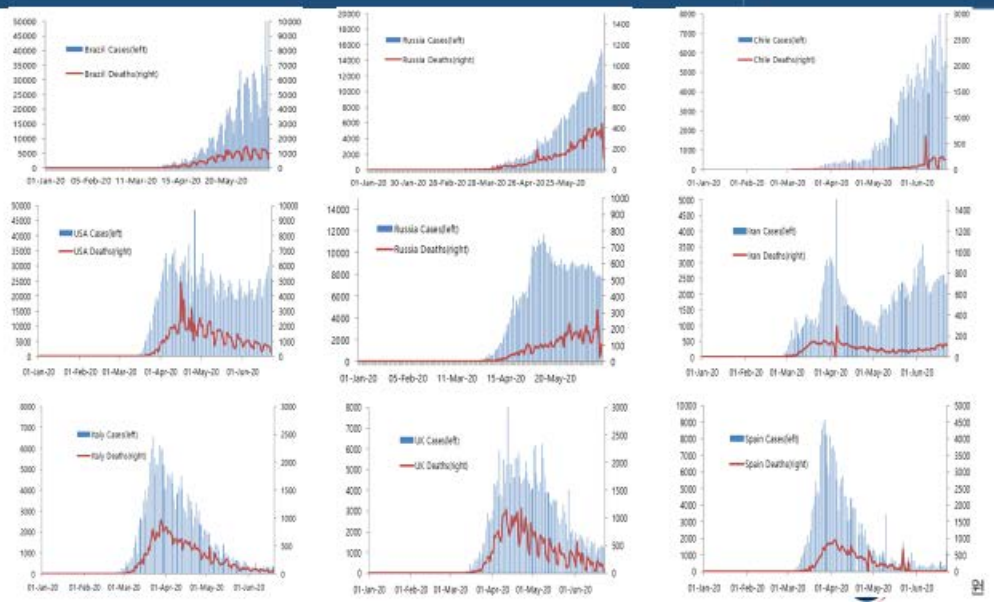



## Worldwide Trend of the Infected and Deaths (2019.12.31 – 6.22)



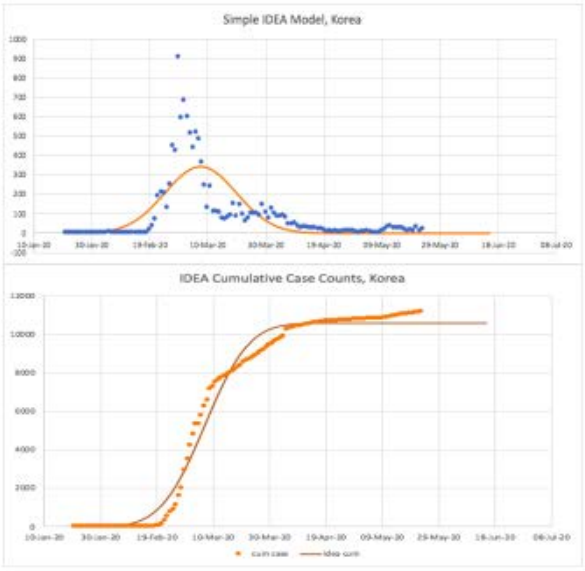
## Worldwide Trend of Daily Cases (~6.22)



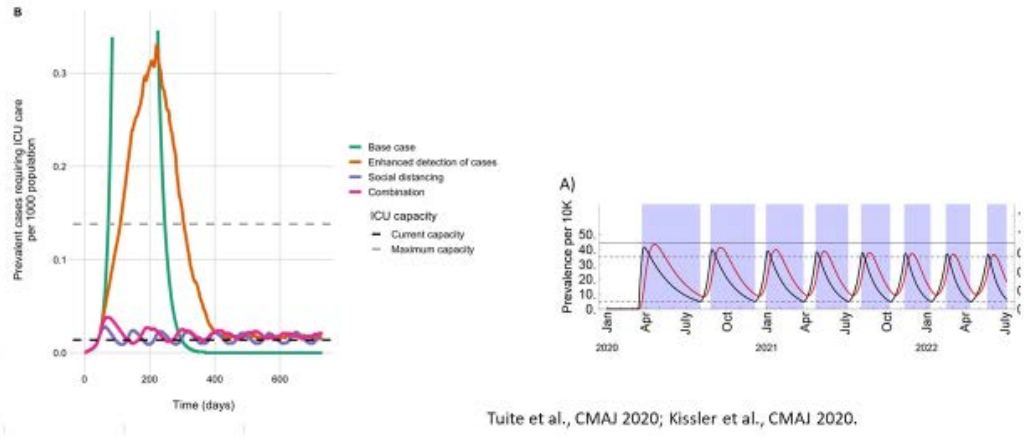

## Exit Strategy

# Data-Based Responses in the Era of "New Normal"

# 2.4.5 Dynamic Distancing in IDEA Forecasting (6th Modeling, 5/25)

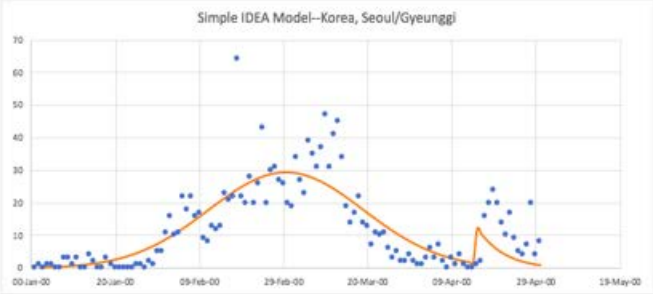



# Dynamic Distancing: Paradox of Prevention

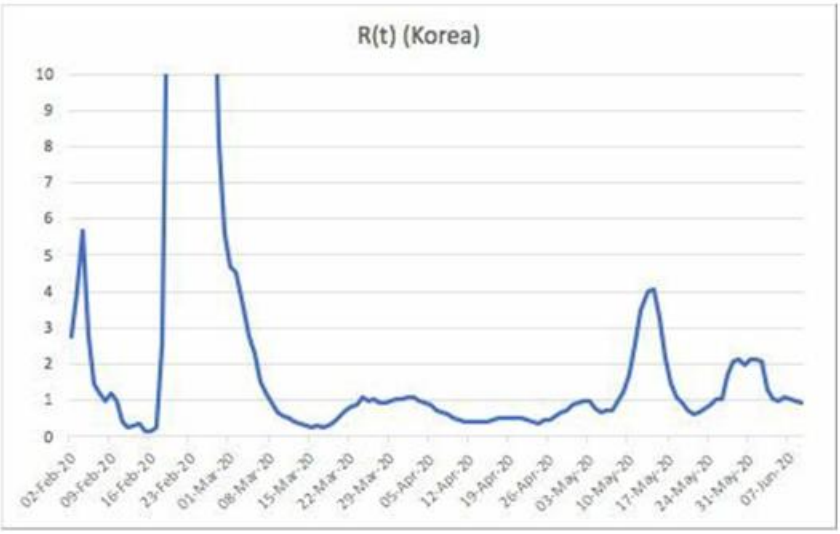



Tuite et al., CMAJ 2020; Kissler et al., CMAJ 2020.

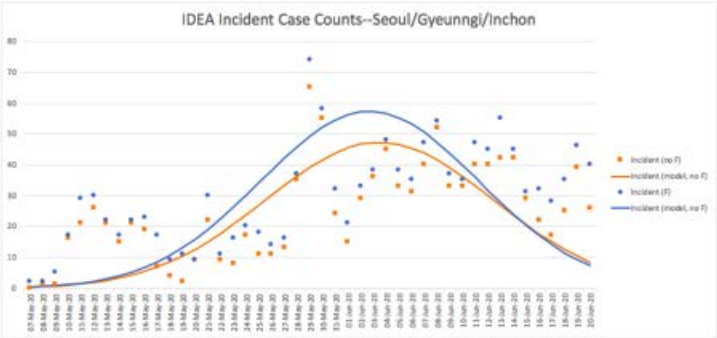
## 2.4.6 IDEA Model-Based Forecasting for Seoul Metro (6th Modeling, 5/25)




## 2.4.7 IDEA-Based $R_t$ across Korea (7th Modeling, 6/9)



## 2.4.8 IDEA Forecasting for Seoul Metro
(8th Modeling, 6/20)




## 3. Next Steps towards AI-Based Innovation

**Evidence-Based Policymakers**

(Science-Based Health Policy → Serological survey, innovation in vaccine and medical treatment)

**Blue Data Designers**

(Data Lake, Data Mountain, Data Ocean → Blue Data) Harnessing Multiple Sources of Data and Data Linking

**AI/Data Science-Based Seers**

(AI-Based Clinical Data Modeling for Saving More People and Faster Recovery; Prep for the n-th Waves of the Pandemic)

### References

Santillana, M., Tuite, A. Nasserie, T., Fine, P. Champredon, D., Chindelvitch, L., Dushoff, J. Fisman, D. (2018). Relatedness of the incidedence decay with exponential adjustment (IDEA) model, “Farr’s law” and SIR compartmental difference equation models. Journal of Infectious Disease Modeling 3 (2018) 1-12.