Understanding the epidemiology of COVID-19 and the effectiveness of non-pharmaceutical interventions

Development Policy and COVID-19 eSeminar Series
April 14, 2020
9:00 AM ET
The epidemiology of COVID-19 and the effectiveness of non-pharmaceutical interventions

• The WB has re-oriented much of staff efforts to countering effects of the pandemic

• It will be useful to review epidemiological models that predict the future course of illness, and the estimated effectiveness of various interventions to lower transmission

• Seminar discuss the epidemiology of the SARS-CoV-2 virus, and the effectiveness of strategies to reduce the spread in a population
Brief overview of key terminology

• Reproduction number, $R_0$ – the average number of secondary infections resulting from an initial infected person
  • Basic $R_0$ – maximum epidemic potential of a pathogen
  • Effective $R_0$ – depends on population’s susceptibility and interventions – including changing rates of contact

• Latent period – Time (days) from infection to onset of infectiousness

• Infectious period – Average time (days), a person is infectious
  • Serial interval – Time between onset of symptoms in index case and onset of symptoms in their contacts

• Seasonal forcing – Amplitude of seasonal variation in transmission

• Case fatality ratio – number of deaths/total number of people diagnosed for a certain period of time
  • Infection fatality ratio – accounts for asymptomatic and undiagnosed infections

• Health system features: hospital beds, staffing, ICU beds, duration of treatment/stay, key equipment: oxygen, ventilators, personal protective equipment (PPE)

• Non-pharmaceutical interventions (NPIs): type, compliance/enforcement, duration
Many types of NPIs

• Various categories of NPIs, all attempt to reduce transmission of virus
  • Surveillance
    • Test, trace, isolate
  • Trade and travel restrictions
    • Visa restrictions, traveler screening, forced traveler quarantine, border closure to people or goods
  • Quarantine
    • Of existing cases in household, of entire regions
  • Social distancing
    • Ban on public gathering, public transport ban, school/business closure, stay-at-home orders
  • Hygiene recommendation/enforcement
    • Preventive behavior promotion, facemask recommendation/mandate
• Effectiveness will depend on numerous factors: duration and compliance/enforcement of NPI, epidemiological factors (R0, latency, etc.)
Online resources for epidemiological modeling and projections

• Review in blog post.
• WB, International Decision Support Initiative (IDSI), Gates Foundation and WHO have developed partnership to review and compare all models.
• Imperial College COVID-19 Response Team provides estimates under 5 scenarios, from unmitigated to early suppression strategy.
  • Online appendix provides country-level estimates with further possibility to adjust some parameters such as baseline Ro and the intensity of social distancing measures.
• University of Basel COVID-19 scenarios: online tool allowing to run your own projections and enter country-specific numbers. Intuitive, flexible, but users will have to closely calibrate parameter estimates to data. Age structure of the population is preloaded for each country.
Example of NPI effectiveness:
Effects of 2 months lock-down in a large middle income country
(as projected by a WB team using the U of Basel tool)

COVID-19 Patients Requiring Hospitalization

- No action
- 2 month lockdown

COVID-19 Cumulative Fatalities
Central role of testing: effectiveness of NPIs depends on information available (de Walque, Friedman, Gatti, and Mattoo)

Figure 1. When the PCR Assay and the Antibody Test Are Most Useful

Regular antibody testing of a representative sample, as well as morbidity and mortality monitoring, at the sub-national level to inform choice of strategy.
Outline of e-seminar

• Patrick Walker and Azra Ghani, Imperial College COVID-19 Response team:
  • Underpinnings of model and its main predictions
  • How are the effectiveness of NPIs modeled?
  • What are the main policy recommendations?
  • Specific issues for low and middle-income countries: age structure of the population, multigenerational households, crowded habitat (slums), and difficulty to enforce social distancing measures with people living in the informal sector.

• David Wilson and Marelize Gorgens (World Bank HNP):
  • Trade-off: need to curb coronavirus, but pressure to reopen economies
  • Key considerations: (i) epidemic force; (ii) capacity to manage reduced measures; (iii) population health; (iv) public health capability; (v) health system capacity; (vi) national decision-making capability; and (vii) technological innovations.