Preparing for COVID-29 What can technology-enabled disruption teach us about preparing for pandemics?

Joshua Gans, October 2022

COVID-19 disrupted supply chains, investment, labour markets, education and credit markets

- Why was COVID-19 disruptive (really)?
- Is it different from "Silicon Valley" type disruption?
  - Can you be reactive?
  - What does preparation look like?

# Why was COVID-19 disruptive (really)?

# Why was COVID-19 disruptive (really)?

Public health answer: because people were or were scared of becoming sick

# Why was COVID-19 disruptive (really)?

Real answer: because people do not know who was infectious

Public health answer: because people were or were scared of becoming sick

# THE PANDEMIC INFORMATION GAP

# THE BRUTAL Economics OF Covid-19

# **JOSHUA GANS**



# THE PANDEMIC () INFORMATION GAP

# THE BRUTAL Economics of Covid-19

# **JOSHUA GANS**



# ECONOMICS IN THE AGE OF COVID-19

JOSHUA GANS

MIT Press, April 2020!

# THE PANDEMIC () INFORMATION GAP

# THE BRUTAL Economics of Covid-19

# **JOSHUA GANS**



# ECONOMICS IN THE AGE OF COVID-19

JOSHUA GANS

MIT Press, April 2020!

#### **The Testing Economy**

The cows were not safe. They were mad. But what made them unsafe was that anyone consuming them may well become mad. That is what the United Kingdom discovered in the 1990s. It was found that cattle affected by bovine spongiform encephalopathy (or BSE) could cause a variant of Creutzfeldt-Jakob disease in humans. That disease would mentally impair its victims and eventually take their lives. As of 2013, 177 people in the United Kingdom had died. Not surprisingly, no one wanted to consume cattle that might have BSE.

The reaction of the United States to cases of BSE is instructive. In 2003, a cow imported to the United States from Canada was found to have BSE. Imports were banned. In Canada, cattle prices fell by a half and retail beef prices by 14 percent. Canada's annual beef export revenues to the United States fell by two thirds. At the time, Canadian beef made up three quarters of US beef imports, so this imposed costs on both countries, with losses estimated in the billions.<sup>1</sup> When, later in 2003, an infected cow was discovered in Washington State, the trade bans fell on the other foot.

As internal bans were neither palatable or practical, the US Department of Agriculture (or USDA) ramped up testing. It favored what was argued to be a less accurate "rapid" immunologic test (with results delivered in hours rather than weeks). The cost of these tests was about \$200 million, but the positive impact on reviving the US beef export industry was far in excess of this.

This chapter is about the value of testing and how it can improve the functioning of markets when there are infectious diseases. The BSE example indicates the value of testing for the beef trade and has strong lessons in the wake of COVID-19 for how the testing of humans can make it safe for people to interact with one another. But before getting to the meat (!) of the issue, there was one more twist in the USDA's handling of BSE testing. Having successfully demonstrated the economic value of tests, the USDA promptly banned them.

# THE PANDEMIC () INFORMATION GAP

# THE BRUTAL Economics of Covid-19

# **JOSHUA GANS**



# ECONOMICS IN THE AGE OF COVID-19

JOSHUA GANS

MIT Press, April 2020!

#### The Testing Economy

The cows were not safe. They were mad. But what made them unsafe was that anyone consuming them may well become mad. That is what the United Kingdom discovered in the 1990s. It was found that cattle affected by bovine spongiform encephalopathy (or BSE) could cause a variant of Creutzfeldt-Jakob disease in humans. That disease would mentally impair its victims and eventually take their lives. As of 2013, 177 people in the United Kingdom had died. Not surprisingly, no one wanted to consume cattle that might have BSE.

The reaction of the United States to cases of BSE is instructive. In 2003, a cow imported to the United States from Canada was found to have BSE. Imports were banned. In Canada, cattle prices fell by a half and retail beef prices by 14 percent. Canada's annual beef export revenues to the United States fell by two thirds. At the time, Canadian beef made up three quarters of US beef imports, so this imposed costs on both countries, with losses estimated in the billions.<sup>1</sup> When, later in 2003, an infected cow was discovered in Washington State, the trade bans fell on the other foot.

As internal bans were neither palatable or practical, the US Department of Agriculture (or USDA) ramped up testing. It favored what was argued to be a less accurate "rapid" immunologic test (with results delivered in hours rather than weeks). The cost of these tests was about \$200 million, but the positive impact on reviving the US beef export industry was far in excess of this.

This chapter is about the value of testing and how it can improve the functioning of markets when there are infectious diseases. The BSE example indicates the value of testing for the beef trade and has strong lessons in the wake of COVID-19 for how the testing of humans can make it safe for people to interact with one another. But before getting to the meat (!) of the issue, there was one more twist in the USDA's handling of BSE testing. Having successfully demonstrated the economic value of tests, the USDA promptly banned them.

The **pandemic information problem** is that we do not know at any given moment who is infectious and should be isolated.

Without a solution, we treat everyone as equally infectious, which is when a pandemic becomes **disruptive**.

#### Daily new confirmed COVID-19 deaths per million people

7-day rolling average. Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.



Source: Johns Hopkins University CSSE COVID-19 Data



CC BY

#### Daily new confirmed COVID-19 deaths per million people

7-day rolling average. Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.



Source: Johns Hopkins University CSSE COVID-19 Data





CC BY

#### Daily new confirmed COVID-19 deaths per million people

7-day rolling average. Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.



Source: Johns Hopkins University CSSE COVID-19 Data







CC BY

Retail and

Recreation

Groceries and

**Transit Stations** 

Workplaces

Pharmacies

Parks



Sources: Tomas Pueyo analysis, Google: https://www.google.com/covid19/mobility/

#### Tests conducted per confirmed case of COVID-19

7-day rolling average. The number of tests divided by the number of confirmed cases. Comparisons across countries are affected by differences in testing policies and reporting methods.



Source: Official data collated by Our World in Data Note: Our data on COVID-19 tests and positive rate is no longer updated since 23 June 2022.



Is it different from "Silicon Valley" type disruption?

# THE DISRUPTION DILEMMA



This important and thought-provoking book has been a source of fresh, new insights for me. Even when Gans disagrees with my work, it has given me a chance to improve what the theory needs to say.

-----CLAYTON M. CHRISTENSEN-----author of THE INNOVATOR'S DILEMMA

# JOSHUA GANS

# Many Incumbents Saw Disruption Coming









# ... but failed to adjust.









# **Emerald Sea**

\*

12 15

Boliners'

"We needed a code name that captured the fact that either there was a great opportunity to sail to new horizons and new things, or that we were going to drown by this wave." Vic Gundotra

# **Emerald Sea**



Buinter,

"We needed a code name that captured the fact that either there was a great opportunity to sail to new horizons and new things, or that we were going to drown by this wave." Vic Gundotra

# **Emerald Sea**



# Power and Prediction

# The Disruptive Economics of Artificial Intelligence

AJAY AGRAWAL



JOSHUA GANS

AVI GOLDFARB

HBR Press, November 15, 2022



# Prediction Machines



AJAY AGRAWAL

Updated and Expanded





JOSHUA GANS

AVI GOLDFARB

HBR Press, November 15, 2022



# Can you be reactive?

Designing systems on the fly is hard



Politics

#### Feds announce plan to buy 7.9 million rapid COVID tests as Health Canada defends slow response



Health Canada has not yet authorized Abbott Laboratories' ID NOW test





People wait in line for hours at a COVID assessment centre at St. Michael's Hospital in Toronto on Monday, September 28, 2020. (Nathan Denette/The Canadian Press)



The federal government today announced a plan to buy 7.9 million point-of-care COVID-19 tests in the months ahead — and defended a Health Canada regulatory process that has left the country with few rapid testing devices to deploy as cases mount.

John Paul Tasker · CBC News · Posted: Sep 29, 2020 12:42 PM ET | Last Updated: September 29, 2020



# **CDL Rapid Screening Consortium**

Supporting the launch of workplace rapid screening across Canada

Our mission

To develop a cost effective system for reopening the economy during the COVID-19 pandemic.

#### **COVID-19 PREVENTATIVE MEASURES**

# **Layers of Protection**





# **Rapid Screening System**

Physical Distancing

Use of Masks

Hand Washing Stations

Symptom Check



#### **EMPLOYEES GOING INTO WORK**

Infectious employee who does not know they could infect others (asymptomatic)

#### **WORKPLACE WITH RAPID SCREENING SYSTEM**

Ę

#### **EMPLOYEES GOING INTO WORK**

Infectious employee who does not know they could infect others (asymptomatic)

> **EMPLOYEES ARE RAPID SCREENED BEFORE ENTERING THE WORKPLACE** (2x PER WEEK)

#### WORKPLACE

#### **EMPLOYEES IN WORKPLACE ARE INFECTED**

#### WORKPLACE OUTBREAK





#### **EMPLOYEES IN WORKPLACE ARE** NOT EXPOSED TO INFECTIOUS CO-WORKER

SAFER WORKPLACE



EMPLOYEE EXITS WORKPLACE TO **OBTAIN CONFIRMATORY PCR TEST** 

### Why do focus on regularly screened (2x per week)?

Rapid antigen screens are useful for detecting infectiousness. People can be infectious 2-3 days before symptom onset.

Screening employees 2x per week ensures detection during the infectious stage.

Modelling studies show to control transmission it is better to screen more frequently (i.e. at least 2 days a week) with a less sensitive test than less frequently (i.e. only once per week or ad-hoc) with a more sensitive test.\*





# **ANTIGEN TEST Rapid Antigen Screening**



Dinnes et al. Cochrane Database Syst Rev 2020



Reference: American Society for Microbiology: Rapid Antigen Testing (Point-of Care)



Adapted from: Ian M. Campell, https://commons.wikimedia.org/wiki/File:Diagnostic\_Medical\_Dipstick.png

**MOLECULAR DIAGNOSTIC TEST** 

# PCR Testing (NOT for workplace rapid screening)



Reference: Kevadiya et al. Diagnostics for SARS-CoV-2 infections Nature Materials. 2021

#### **CDLRAPIDSCREENINGCONSORTIUM.COM**





Rapid screening systems are operational in a diverse constellation of workplaces across Canada





#### **CDL RAPID SCREENING CONSORTIUM**

# **Participating Organizations**





WORKPLACE RAPID SCREENING PROGRAM

# **Screening Sites Across Canada**

- # of Screening Sites live: 3,550
- # of orgs in CDL RSC: 1,987
  - Cohorts #1 #50



\*Information as of Mar 31, 2022 CDLRAPIDSCREENINGCONSORTIUM.COM



#### CDL RAPID SCREENING CONSORTIUM

# **CDL RSC Growth (Active Organizations)**





Week Starting

#### **CDL RAPID SCREENING CONSORTIUM** Summary Data (March 31, 2022)



**CDLRAPIDSCREENINGCONSORTIUM.COM** 





#### **CDL RAPID SCREENING CONSORTIUM** Screen Usage by Week (March 31, 2022)



#### **CDLRAPIDSCREENINGCONSORTIUM.COM**





# **DATA & RESEARCH Contribution to Provincial Analyses**

**Ontario Science Advisory & Modeling Tables** 

CDL RSC workplace screening data compared with

- Hospital administration screening
- Wastewater signal
- Repeat testers

for analysis & surveillance of the COVID-19 pandemic in Ontario (March 17, 2022).





#### **DATA & RESEARCH**

# **JAMA Research Letter** (January 2022)

#### Letters

#### RESEARCH LETTER

#### False-Positive Results in Rapid Antigen Tests for SARS-CoV-2

Concerns have been raised whether rapid antigen tests for SARS-CoV-2 can result in false-positive test results<sup>1,2</sup> and undermine pandemic management for COVID-19. This study in- in too many false-positives that could overwhelm PCR testing vestigated the incidence of false-positive results in a large capacity in other settings.<sup>1,2</sup> Also, the results demonstrate the sample of rapid antigen tests used to serially screen asymptomatic workers throughout Canada.

Methods | Rapid antigen tests for SARS-CoV-2 were implemented as an extra layer of protection to control transmission in workplaces throughout Canada by the Creative with the batch, false-positives are possible due to the timing of Destruction Lab Rapid Screening Consortium (CDL RSC). the test (ie, too early or too late in the infectious stage) or qual-Asymptomatic employees were screened twice weekly. Work- ity issues in how the self-test was completed. place participation was voluntary. From January 11 to October 13, 2021, tests were conducted by employees, with some work-of workplaces and that reporting of PCR confirmatory results places providing at-home screening and others on-site screening programs. Over this period, Canada experienced 2 significant Delta variant-driven waves from March to June and August Canada and may not generalize to other countries experiencto October. Screening results were recorded, including a ing different COVID-19 incidence. deidentified record identifier, the place of employment, the test, and (optionally) the lot number. If a test result was positive, the patient was immediately referred for a confirmatory polymerase chain reaction (PCR) test to be completed within 24 hours. Initial data validation was completed at the point of collection. All data collected before June 26 and presumptive Janice Stein, PhD positive screen results and PCR test results reported before Laura Rosella, PhD September 15 were externally verified through an audit process by participant organizations. False-positive results were matched to lot number and test manufacturer. A falsepositive result was defined as a positive screen on a rapid antigen test and a subsequent negative confirmatory PCR.

The data from the CDL RSC were collected to inform the operational requirements of deploying rapid antigen screens in workplaces. All participants provided written consent to participate in the screening program and to share their deidentipublic health authorities. This study was approved by the of the data analysis.

Discussion | The overall rate of false-positive results among the total rapid antigen test screens for SARS-CoV-2 was very low, consistent with other, smaller studies.3 The cluster of falsepositive results from 1 batch was likely the result of manufacturing issues rather than implementation. These results inform the discussion of whether rapid antigen tests will result importance of having a comprehensive data system to quickly identify potential issues. With the ability to identify batch issues within 24 hours, workers could return to work, problematic test batches could be discarded, and the public health authorities and manufacturer could be informed. Aside from issues

Limitations of the study include the convenience sample and identification of lot number was not compulsory. In addition, these results reflect the epidemiology experienced in

Joshua S. Gans, PhD Avi Goldfarb, PhD Ajay K. Agrawal, PhD Sonia Sennik, MBA

Author Affiliations: University of Toronto, Toronto, Ontario, Canada (Gans, Goldfarb, Agrawal, Stein, Rosella); Creative Destruction Lab, Toronto, Ontario, Canada (Sennik),

Accepted for Publication: December 20, 2021.

Published Online: January 7, 2022. doi:10.1001/jama.2021.24355 Corresponding Author: Joshua S. Gans, PhD, Rotman School of Management, University of Toronto, 105 St George St, Toronto, ON M5S3E6, Canada (joshua.gans@utoronto.ca).

Author Contributions: Drs Goldfarb and Rosella had full access to all of the data fied data with the CDL RSC, including for publication, and with in the study and take responsibility for the integrity of the data and the accuracy

University of corc

Results | The over 537 wo d P which 1103 l of screens w re tr false-posit

Views 1,109,185



positive test resu

false-positive resu...., ...., ..... October 8, 2021. All of the false-positive test results from these 2 workplaces were drawn from a single batch of Abbott's Panbio COVID-19 Ag Rapid Test Device.

apart run by different companies between September 25 and (CDL RSC; a nonprofit organization in Canada). Dr Agrawal reported serving on the boards of Genpact and Sanctuary.

> Funding/Support: The CDL RSC was founded with financial support from 12 corporations: Air Canada, CPP Investments, Genpact, Loblaw Companies Limited, Magna, MDA, Maple Leafs Sports & Entertainment Partnership,





# Citations 9 | Altmetric 1298 | Comments 10

# THE



Endeavour Literary Press, 2021

SCOPE AND REACH

# CDL operates five sites in Canada; three in the United States; and four in Europe













# **Increase Probability of Success**

**Equity Value Creation** 



Successful commercialization of cutting-edge science achieved through the program

Sites Focused on **Global Impact** 

12

**CDL** operates ten sites, each tied to a top tier research institution and business school



#### **Participating Companies**

# 675+

675+ companies were accepted into the 2021/22 CDL **Program Year** 

#### **Streams**

- Agriculture
- Artificial Intelligence
- Blockchain
- Climate
- Commerce
- Compute
- Digital Society
- Energy
- FinTech
- Health
- Manufacturing
- Matter
- Neuro
- Oceans
- Prime
- Quantum
- Risk
- Supply Chain
- Space
- Web3





# What does preparation look like?

# What does preparation look like?

Answer: Winnipeg





![](_page_47_Picture_2.jpeg)

![](_page_47_Picture_3.jpeg)

![](_page_47_Picture_4.jpeg)

![](_page_47_Picture_5.jpeg)

![](_page_48_Picture_0.jpeg)

Duff Roblin 1962 - 1966 Constructed the Red River Floodway at a cost of \$63 million.

More earth moved than for the Suez Canal

![](_page_48_Figure_3.jpeg)

![](_page_48_Figure_4.jpeg)

![](_page_49_Picture_0.jpeg)

# "Duff's Folly"

# **Red River Floodway**

One of the most significant flood protection measures in Manitoba is the Red River Floodway, which protects the City of Winnipeg. Starting in 2005, Canada and Manitoba invested \$665 million to further expand the Red River Floodway.

- The original floodway was built between 1962 and 1968 and cost \$63 million.
- (second only to the Panama Canal and larger than the Suez Canal project).
- development of the floodway.
- At the same time, it drops below its natural level, south of the floodway inlet.
- continues as long as the flow in the Red River continues to increase.

• At the time, excavation of the floodway channel was the second largest earth moving project in the world

• Since 1968, it has prevented more than \$40 billion (in 2011 dollars) in flood damage in Winnipeg.

• It is often referred to as Duff's Ditch in recognition of then-Premier Duff Roblin, who spearheaded the

• The expansion of the current floodway system (including the West Dike and channel outlet) began after the 1997 flood, to protect the City of Winnipeg from a one-in-700-year flood. It increased the floodway's capacity - from 90,000 cfs (cubic feet per second) to 140,000 cfs. The floodway operates by diverting a portion of the Red River flow around Winnipeg through the floodway channel. During flooding, as the river naturally rises, it spills over the floodway channel entrance and flows down the floodway channel. When this happens, the river water flows through two routes - through the city and through the floodway.

• When the floodway gates are raised, the water level south of the floodway inlet is restored to its natural level which, in turn, allows more water to spill into the floodway. As Red River flows continue to increase, the level south of the inlet drops below natural again and the gates are raised further. This process

• During the majority of floods, the floodway is operated to ensure that the water level south of the city is maintained at the natural level - that is the level that would occur if the flood control works did not exist.

# What does preparation look like?

# What does preparation look like?

Answer: South Korea

![](_page_53_Figure_2.jpeg)

Preparing for disruption — technological or biological — is possible

- Preparing for disruption technological or biological is possible
  - History tells us it requires investing in a system

- Preparing for disruption technological or biological is possible
  - History tells us it requires investing in a system
    - That takes time and effort

- Preparing for disruption technological or biological is possible
  - History tells us it requires investing in a system
    - That takes time and effort
- It requires sacrificing short-run benefits as the premium paid on insurance

- Preparing for disruption technological or biological is possible
  - History tells us it requires investing in a system
    - That takes time and effort
- It requires sacrificing short-run benefits as the premium paid on insurance
  - but ...

A restaurant owner in Vermont and a professor from New Zealand are among the few to commemorate the most lethal pandemic since the bubonic plague.

![](_page_60_Picture_2.jpeg)

The 1918 flu memorial bench, center, in Hope Cemetery, in Barre, Vt. Caleb Kenna for The New York Times

By <u>David Segal</u> May 14, 2020

At Hope Cemetery in Barre, Vt., a five-ton granite bench sits on a triangle of grass. It is a mere five feet high and three feet deep, which seems modest in scale relative to the calamity it commemorates.

"1918 Spanish Flu Memorial" reads an inscription on the front. "Over 50 million deaths worldwide" is chiseled on the back.

# Why Are There Almost No Memorials

![](_page_61_Picture_0.jpeg)

# Web: <u>www.joshuagans.com</u>

# **Twitter:** @joshgans

Newsletter: joshuagans.substack.com

![](_page_61_Picture_5.jpeg)

![](_page_61_Figure_6.jpeg)