BioDiaspora

Evidence Based Decision Making for Emerging Global Infectious Disease Threats

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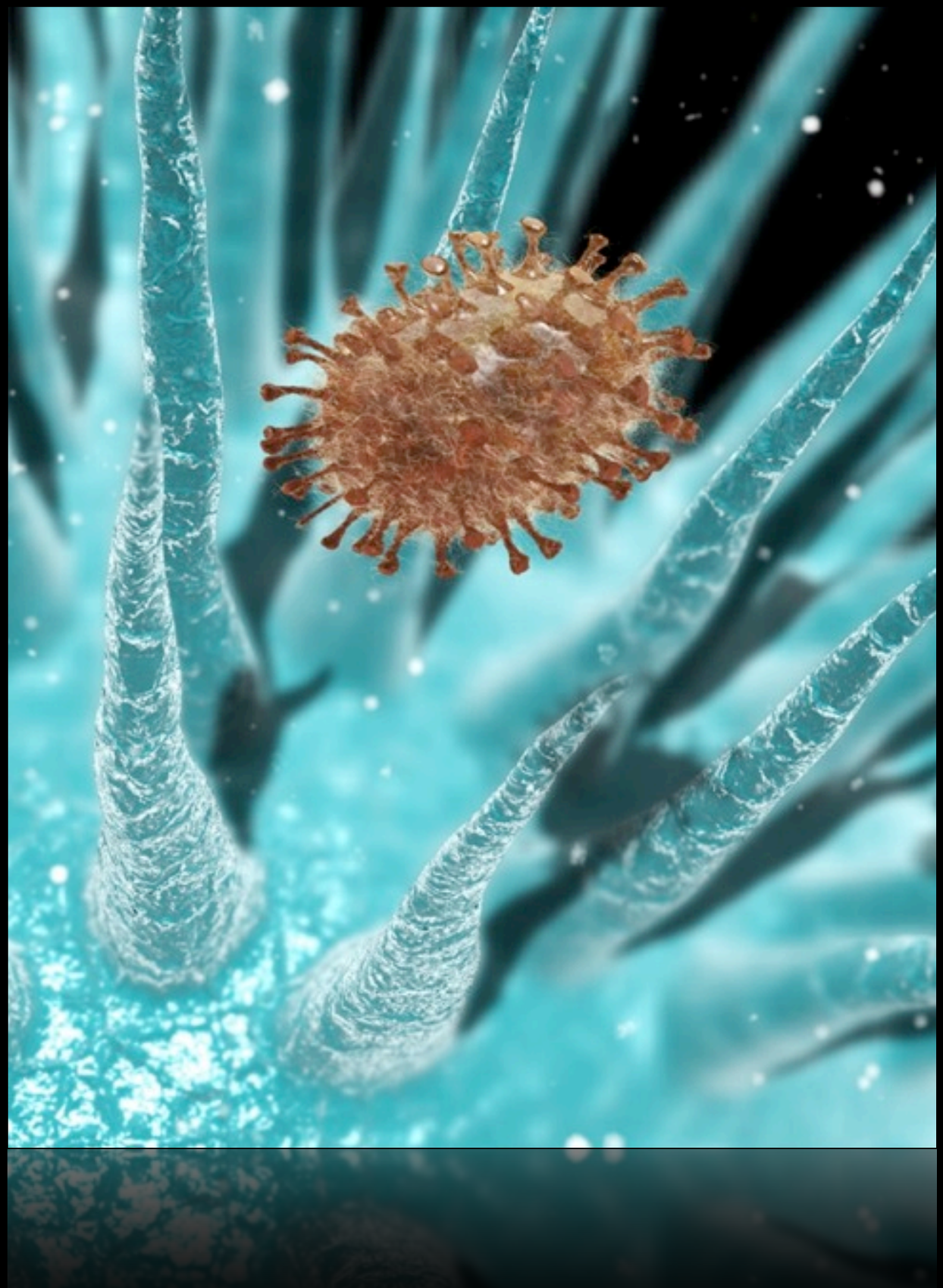
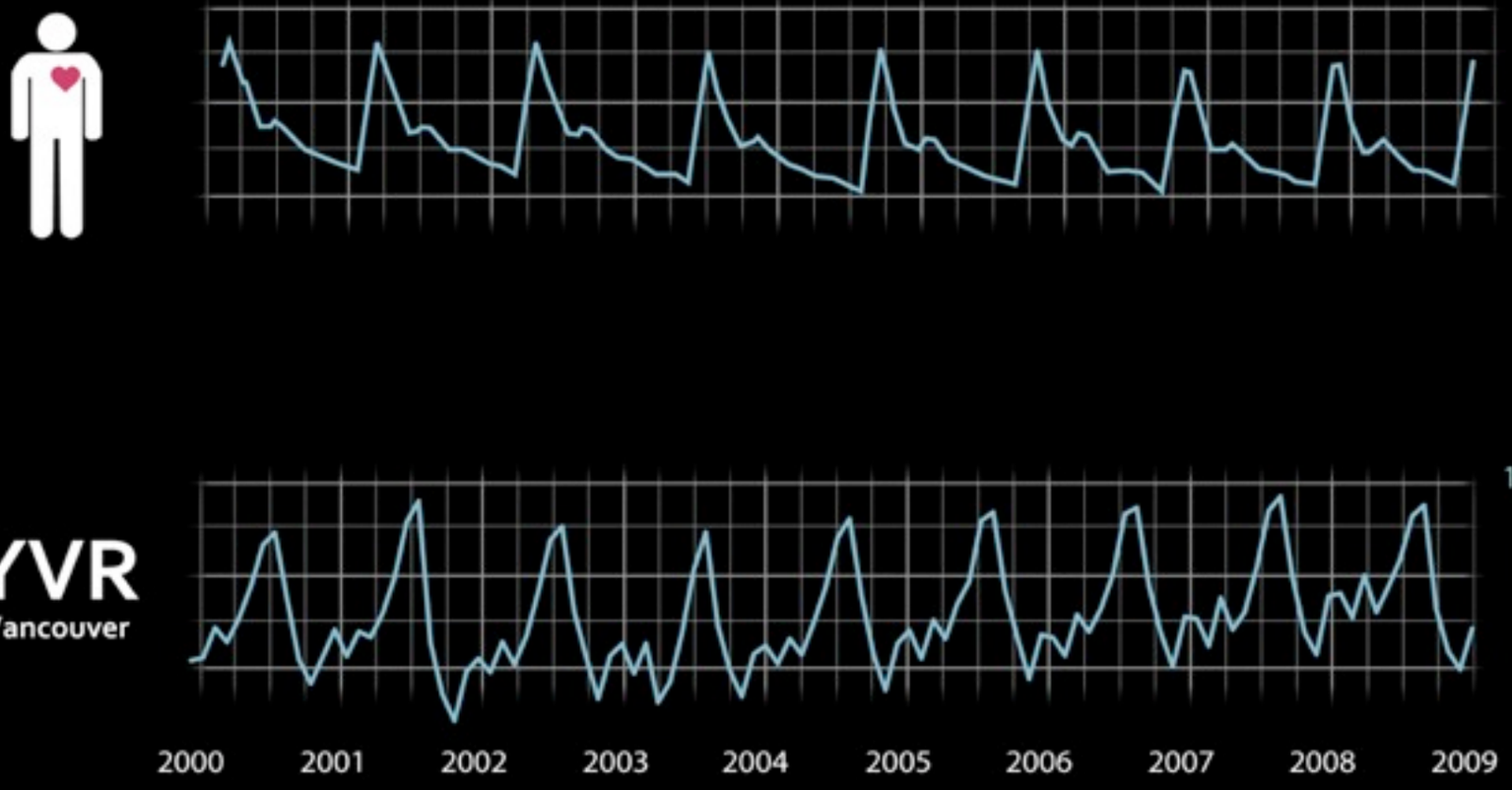
Globalization

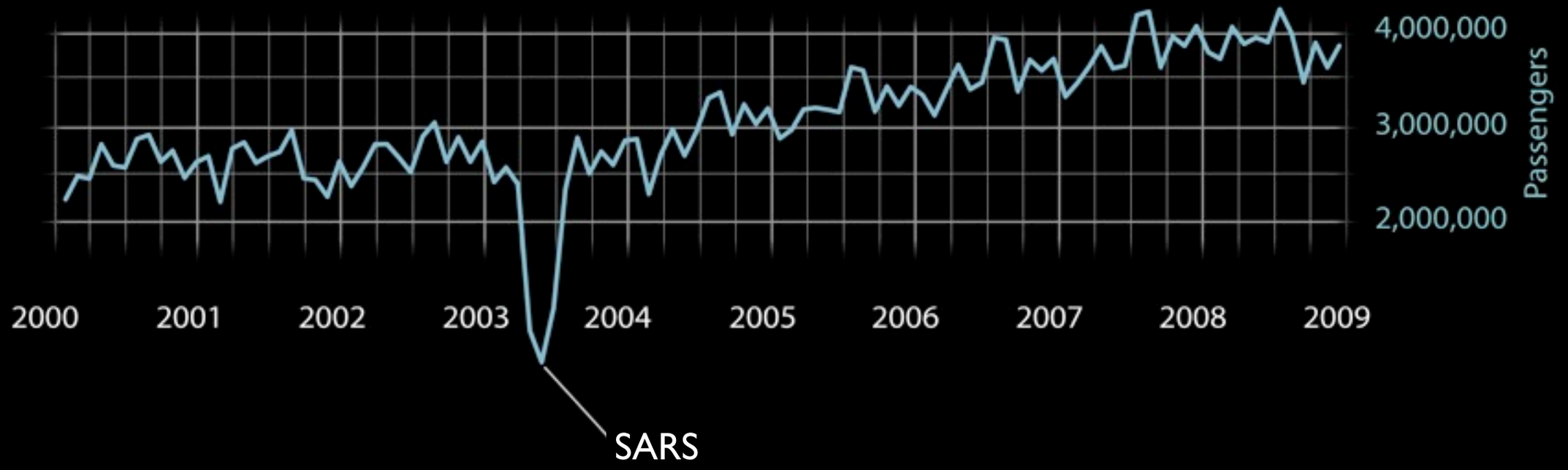
- Population growth
- Urbanization
- Animal health
- Climate change
- Global Air Travel



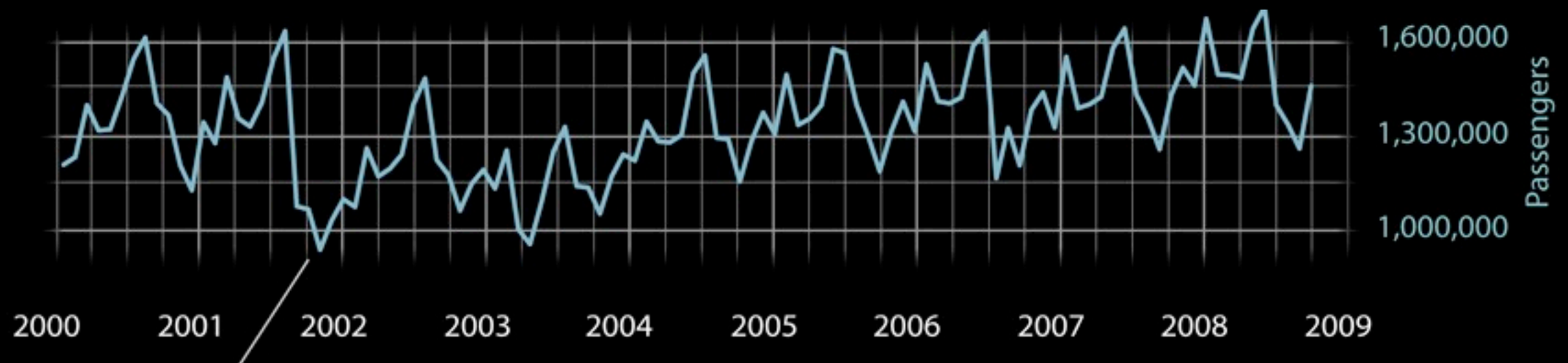


YVR
Vancouver

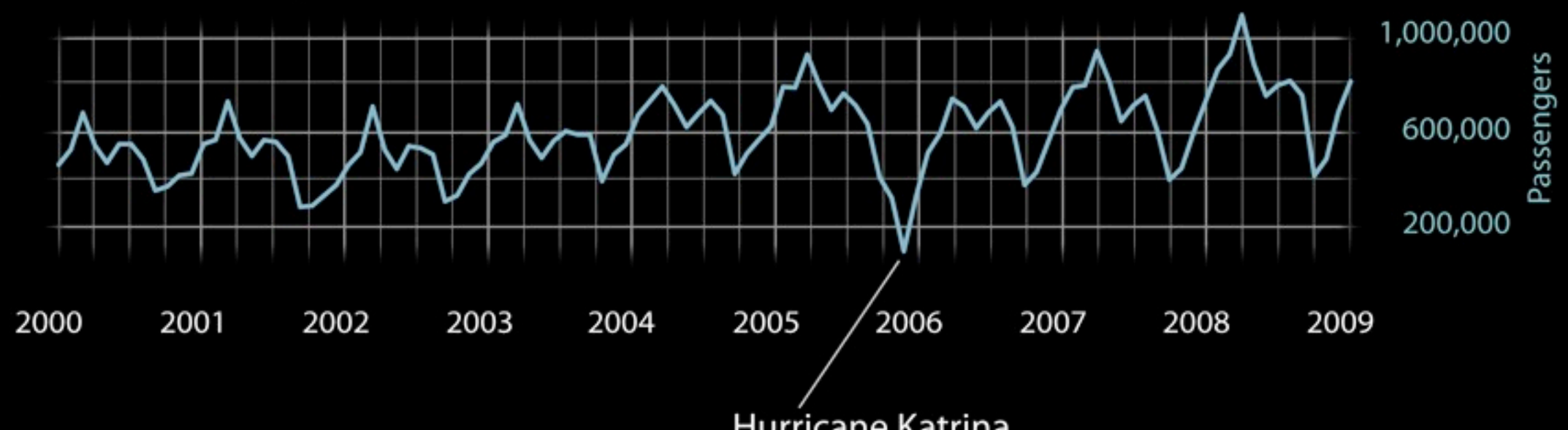
HKG
Hong Kong



YYZ
Toronto

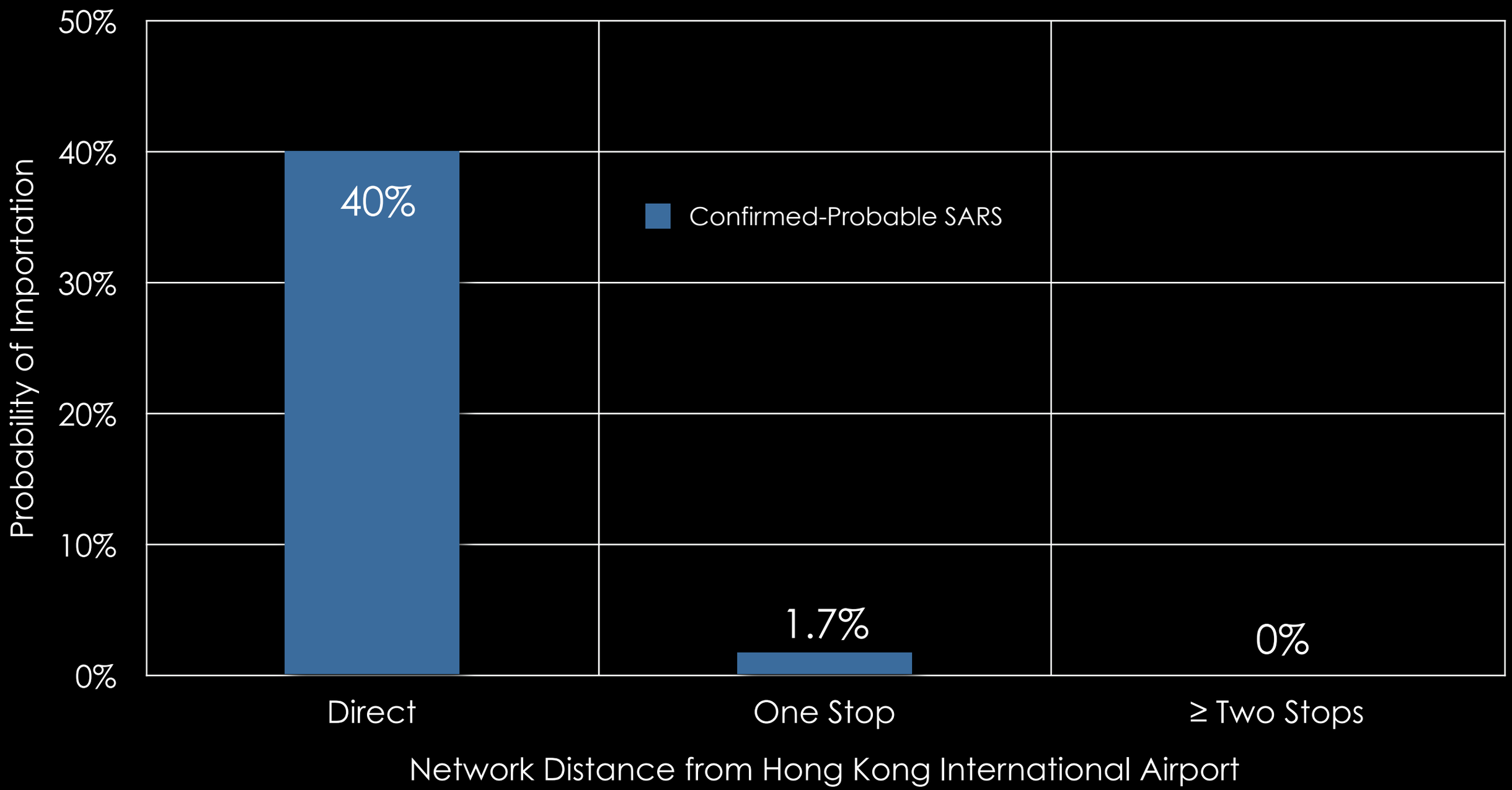


CUN
Cancun

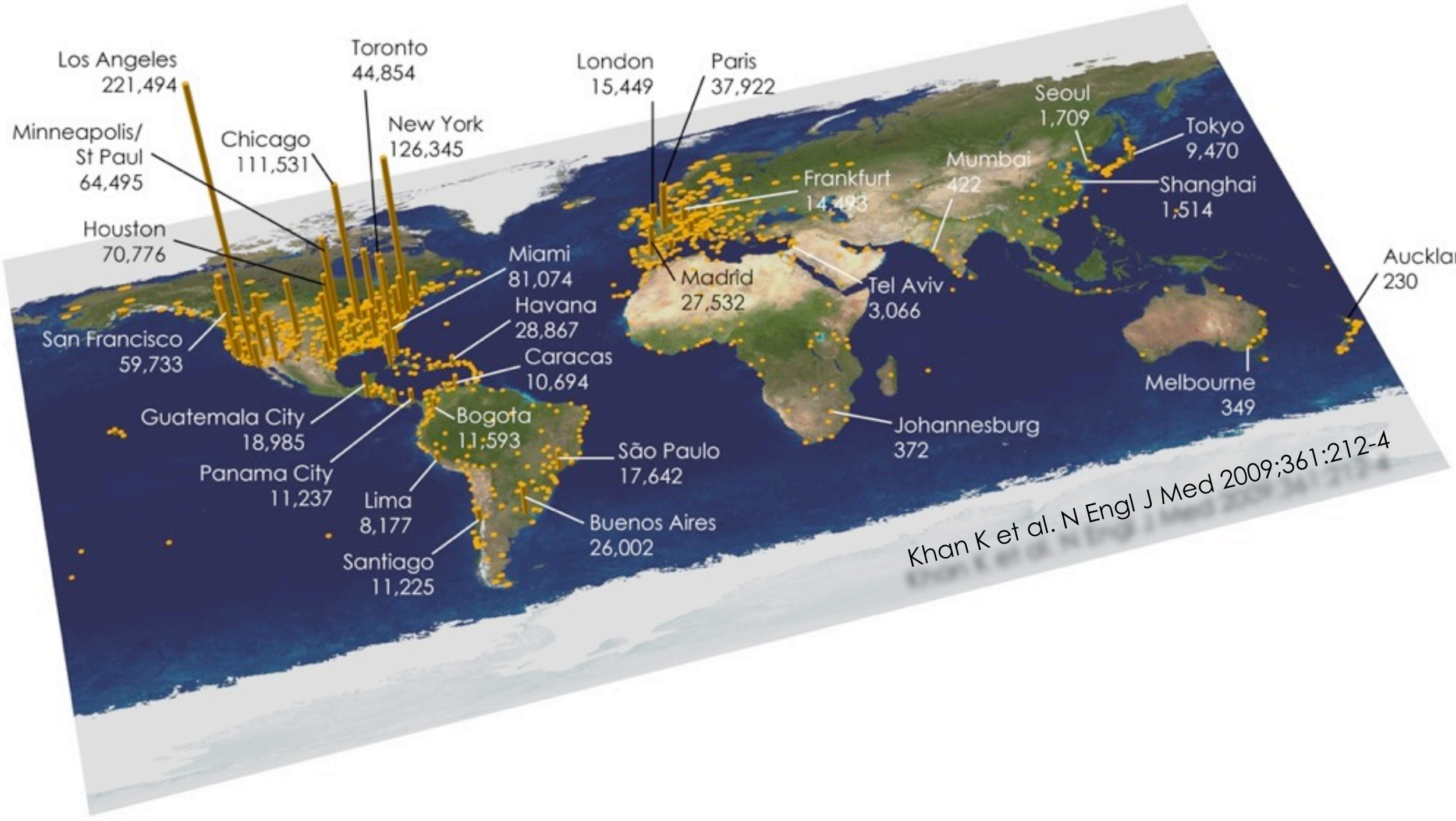


International Spread of SARS

Probability of Importation by Network Distance from Hong Kong



Predicting the Wave of a Pandemic

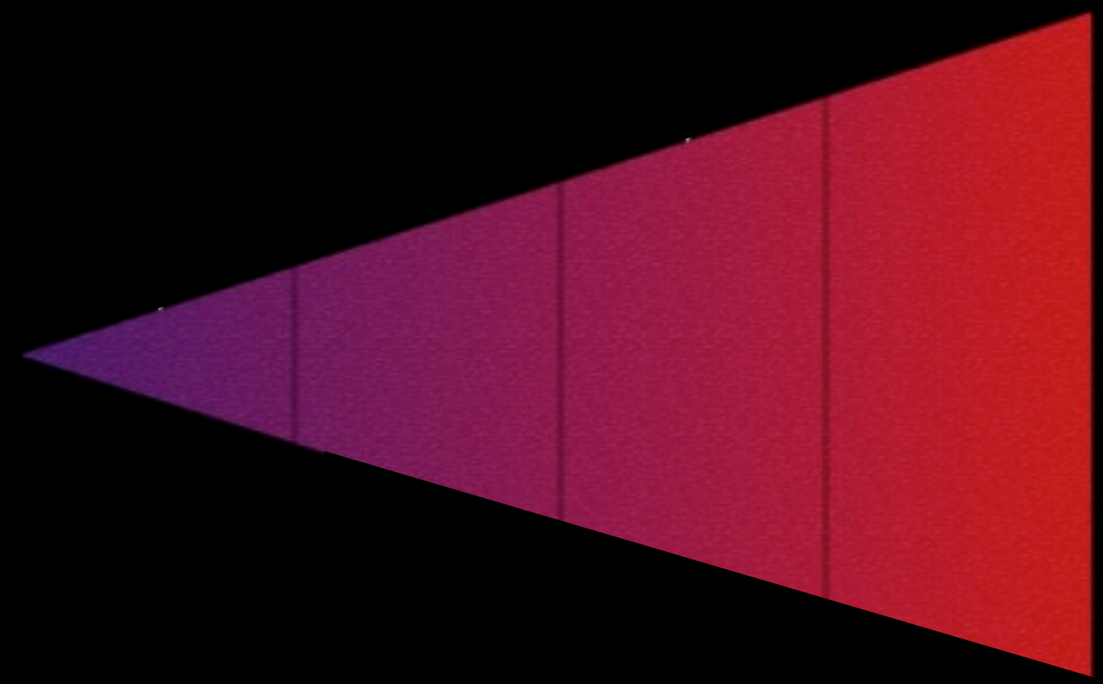


Khan K et al. N Engl J Med 2009;361:212-4

LOCAL

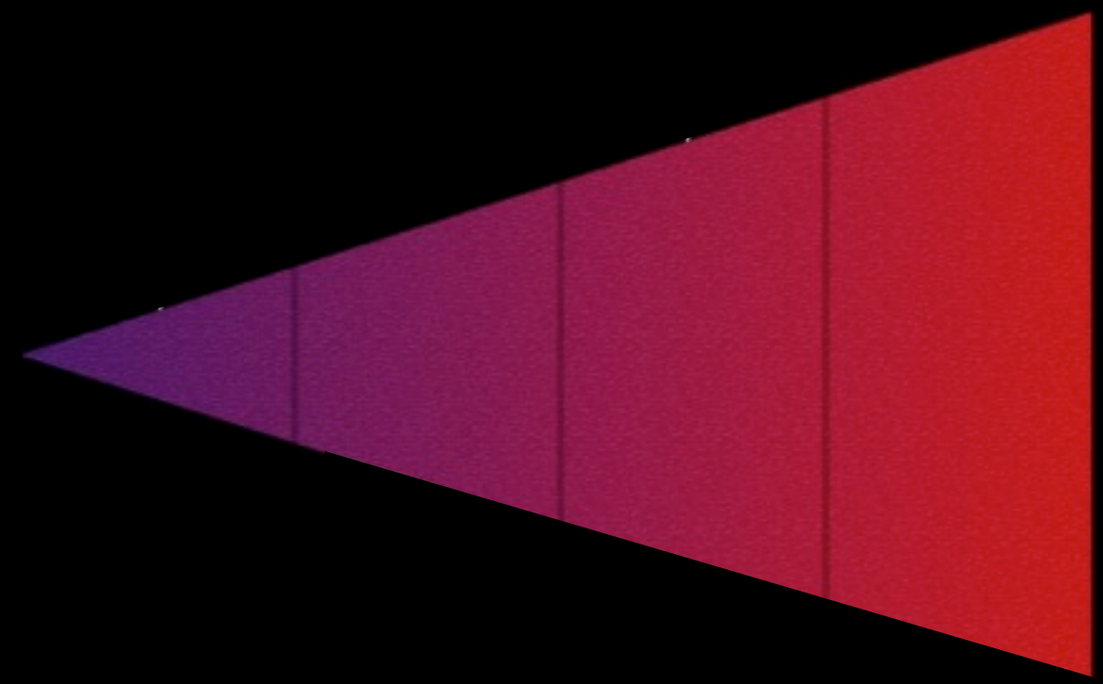
TRAVEL

GLOBAL



MORE REACTIVE

MORE PREVENTATIVE



International Health Regulations

"*...prevent, protect against, control and provide a public health response to the international spread of disease in ways that are* ***commensurate with and restricted to*** *public health risks, and which avoid* ***unnecessary interference*** *with international traffic and trade*".

Purpose and Scope (Article 2)

Entry and exit screening of airline travellers during the A(H1N1) 2009 pandemic: a retrospective evaluation

Kamran Khan,[a] Rose Eckhardt,[b] John S Brownstein,[c] Raza Naqvi,[d] Wei Hu,[b] David Kossowsky,[b] David Scales,[e] Julien Arino,[f] Michael MacDonald,[g] Jun Wang,[b] Jennifer Sears[b] & Martin S Cetron[h]

Objective To evaluate the screening measures that would have been required to assess all travellers at risk of transporting A(H1N1)pdm09 out of Mexico by air at the start of the 2009 pandemic.

Methods Data from flight itineraries for travellers who flew from Mexico were used to estimate the number of international airports where health screening measures would have been needed, and the number of travellers who would have had to be screened, to assess all air travellers who could have transported the H1N1 influenza virus out of Mexico during the initial stages of the 2009 A(H1N1) pandemic.

Findings Exit screening at 36 airports in Mexico, or entry screening of travellers arriving on direct flights from Mexico at 82 airports in 26 other countries, would have resulted in the assessment of all air travellers at risk of transporting A(H1N1)pdm09 out of Mexico at the start of the pandemic. Entry screening of 116 travellers arriving from Mexico by direct or connecting flights would have been necessary for every one traveller at risk of transporting A(H1N1)pdm09. Screening at just eight airports would have resulted in the assessment of 90% of all air travellers at risk of transporting A(H1N1)pdm09 out of Mexico in the early stages of the pandemic.

Conclusion During the earliest stages of the A(H1N1) pandemic, most public health benefits potentially attainable through the screening of air travellers could have been achieved by screening travellers at only eight airports.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Khan K et al. *Bull World Health Organ* 2013; 91:368–376

Basic Anatomy

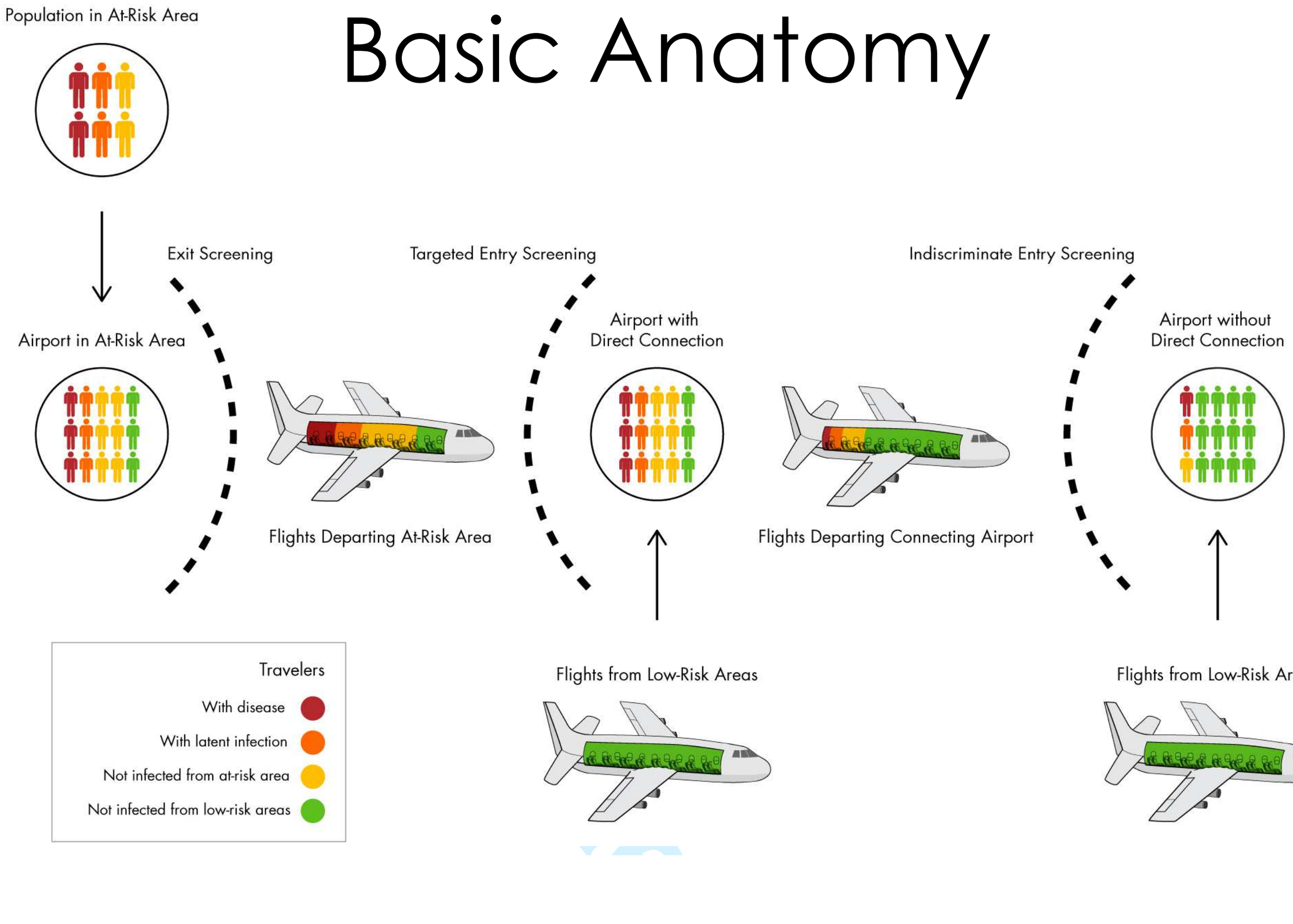
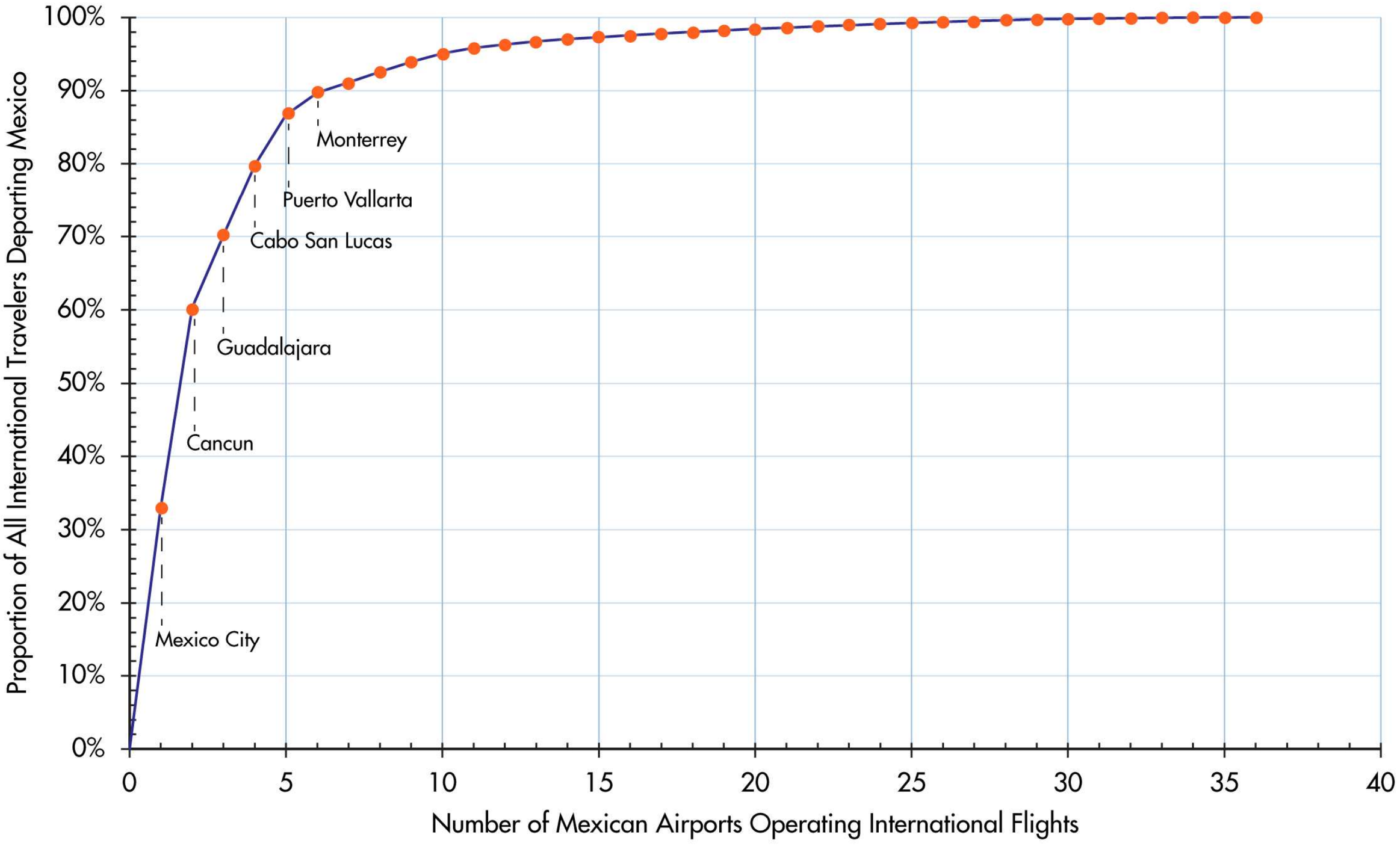


Table 2. **Characteristics of the health screening strategies that might have been used to detect A(H1N1) pandemic influenza in travellers in May 2009[a]**

Characteristic	Strategy		
	Exit	Targeted entry[b]	Indiscriminate entry[c]
No. of cities where screening would have been required	35	82	1111
No. of low-risk travellers who would have had to be screened[d]	6017	6017	67 373 584
No. of travellers who would have had to be screened for every at-risk traveller[d]	1.01	1.01	116.4
No. of travel hours until screening			
Median (interquartile range)	0 (0–0)	3.37 (2.57–4.33)	3.35 (2.5–4.58)
Mean	0.1	4.28	4.32

[a] The data come from modelled scenarios in which the theoretical aim was to prevent air travellers carrying A(H1N1)pdm09 out of Mexico in May 2009.
[b] The screening of travellers on international flights arriving directly from Mexico.
[c] The screening of travellers on international flights arriving from any international airport worldwide.
[d] The 583 774 air travellers who initiated international travel from any domestic or international airport in Mexico in May 2009 were considered "at-risk" while all other travellers were considered "low-risk".

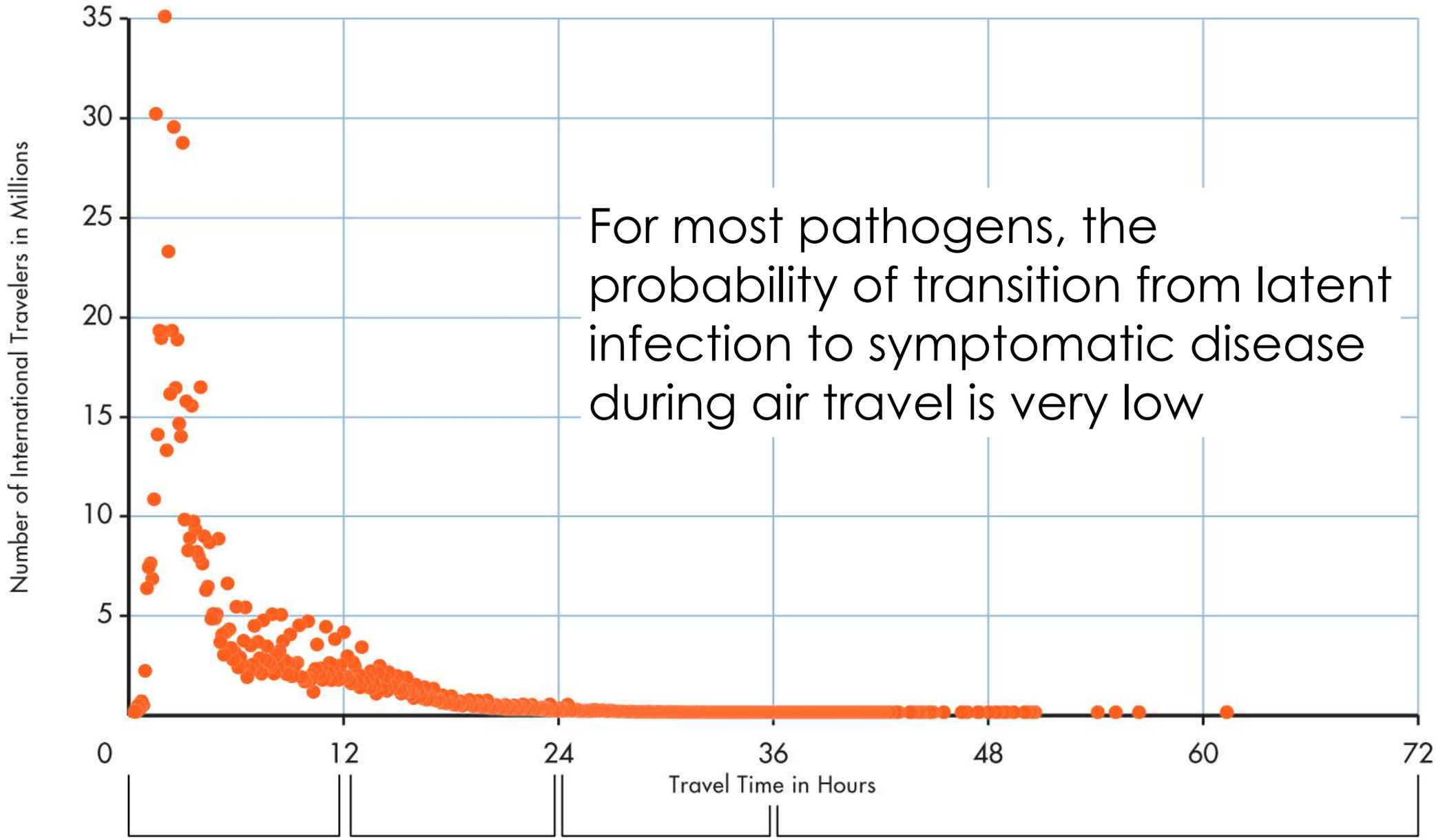
Mexico: Int'l Departures



Exit vs Entry Screening

- Theoretical advantage to entry screening
- Transition of latent infection to active disease?
- Function of flight duration vs incubation period

International Travel Time



Total International Travelers	746.2 M	91.0 M	3.6 M	2,559
Proportion of all International Travelers	88.8%	10.8%	0.4%	0.0003%

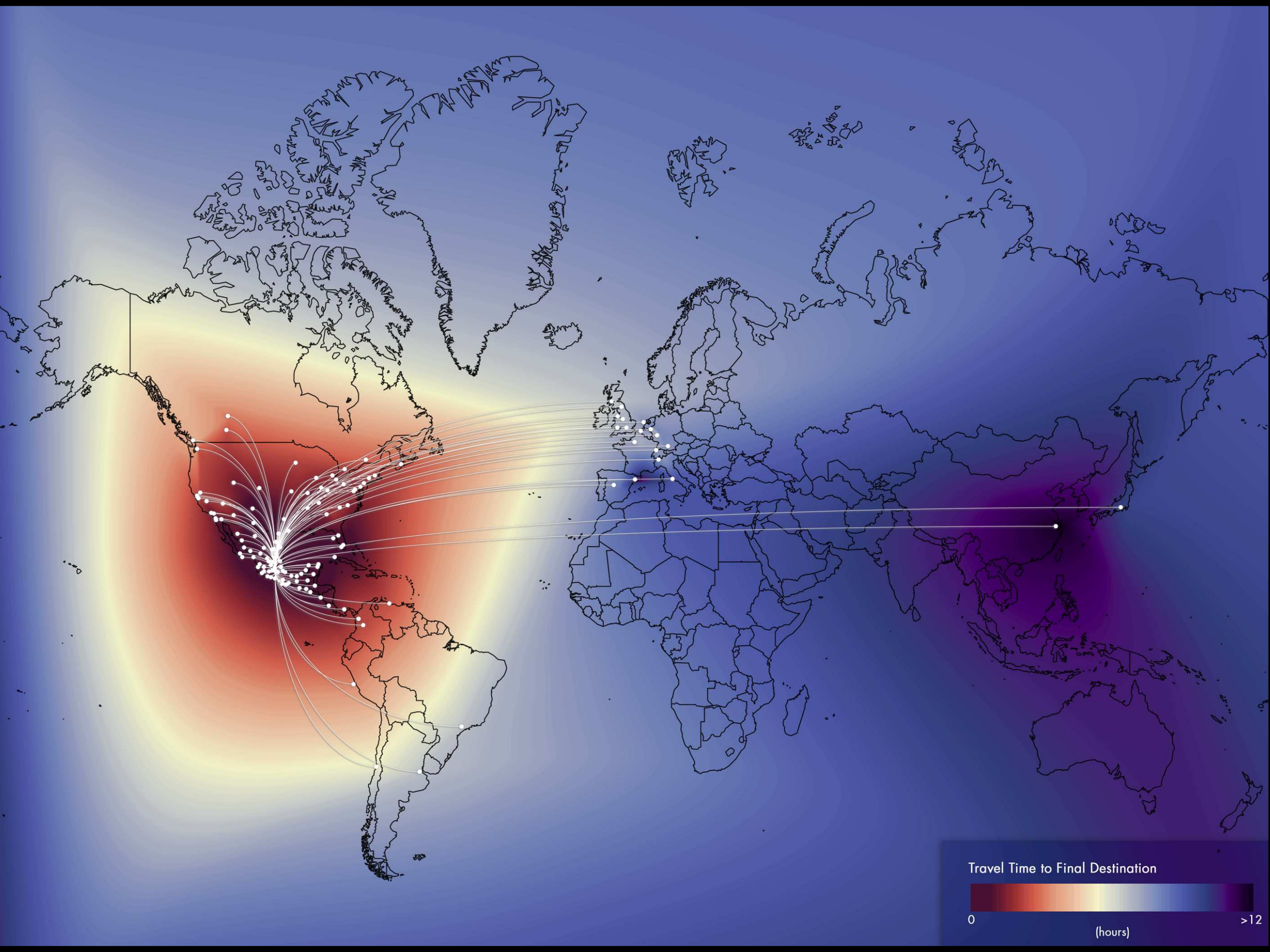
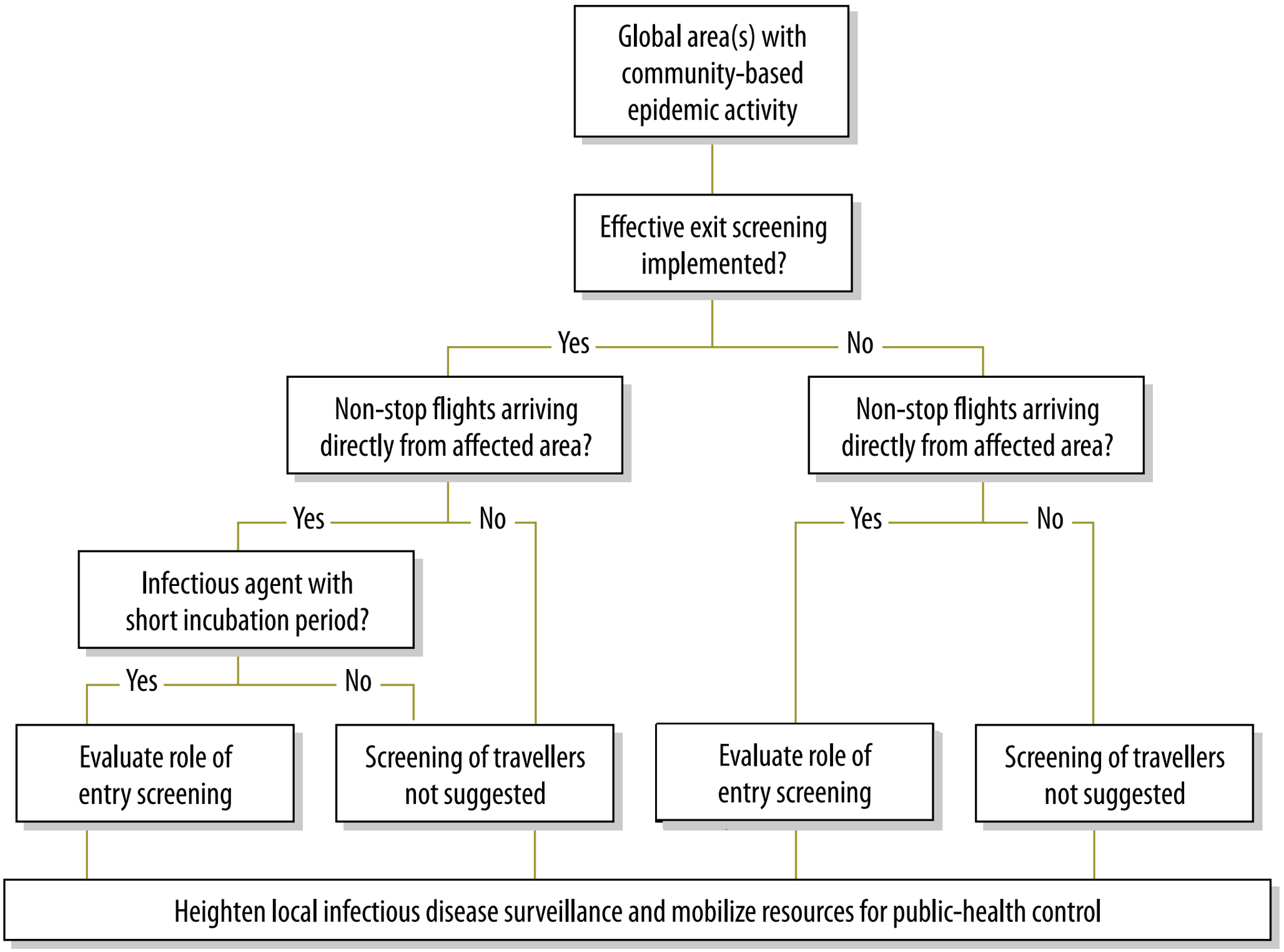

Travel Time to Final Destination
0
>12
(hours)

Fig. 5. **Evidence-based decision-support tool for cities at risk of the importation of a pathogen causing infectious disease**



Key Messages

- Evaluate **Effectiveness** of Traveler Screening
- Optimize **Efficiency** of Traveler Screening
  - Exit screening most efficient, least disruptive but places further burden on source country
  - Entry screening in cities receiving direct flights from source area a second but less desirable option
  - Entry screening in cities not receiving direct flights from source area highly inefficient & disruptive

90% of all **potential** public health benefits from H1N1 health screening obtainable at just eight airports


60
55
5
30
25
5
50
10
20
10
45
15
40
20
35
30
25
TRANSAIR
PILOT SHOP
1/5 SEC

BioDiaspora

Scattering of Life

The Mission

Support decision making on emerging global infectious disease threats that prevent or mitigate impacts to human health, security, and prosperity

RAW DATA

DECISION MAKERS

Humans

Animals

Insects

Microbes

Environment

Transportation

BioDiaspora Servers

End User

End User

End User

End User

End User

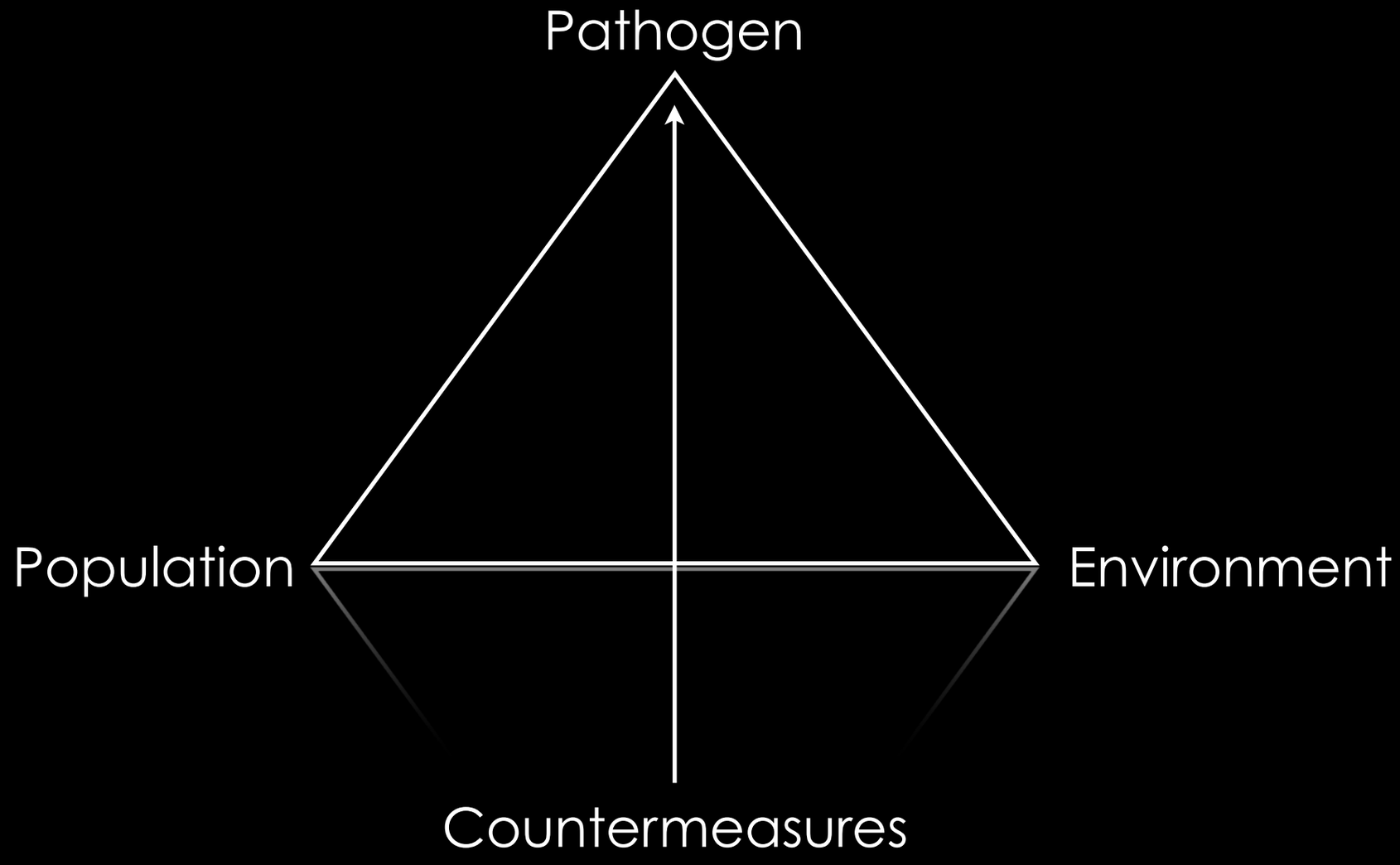
End User

Predictive Analytics
Generated in Real-Time

Remotely Accessible
Anywhere Anytime

Customized To
Space, Time, Pathogen

Anticipating Impact



Rapid Risk Assessment

Suspected or Confirmed Infectious Disease Threats

Pathogen

ONE SOURCE

Population

Environment

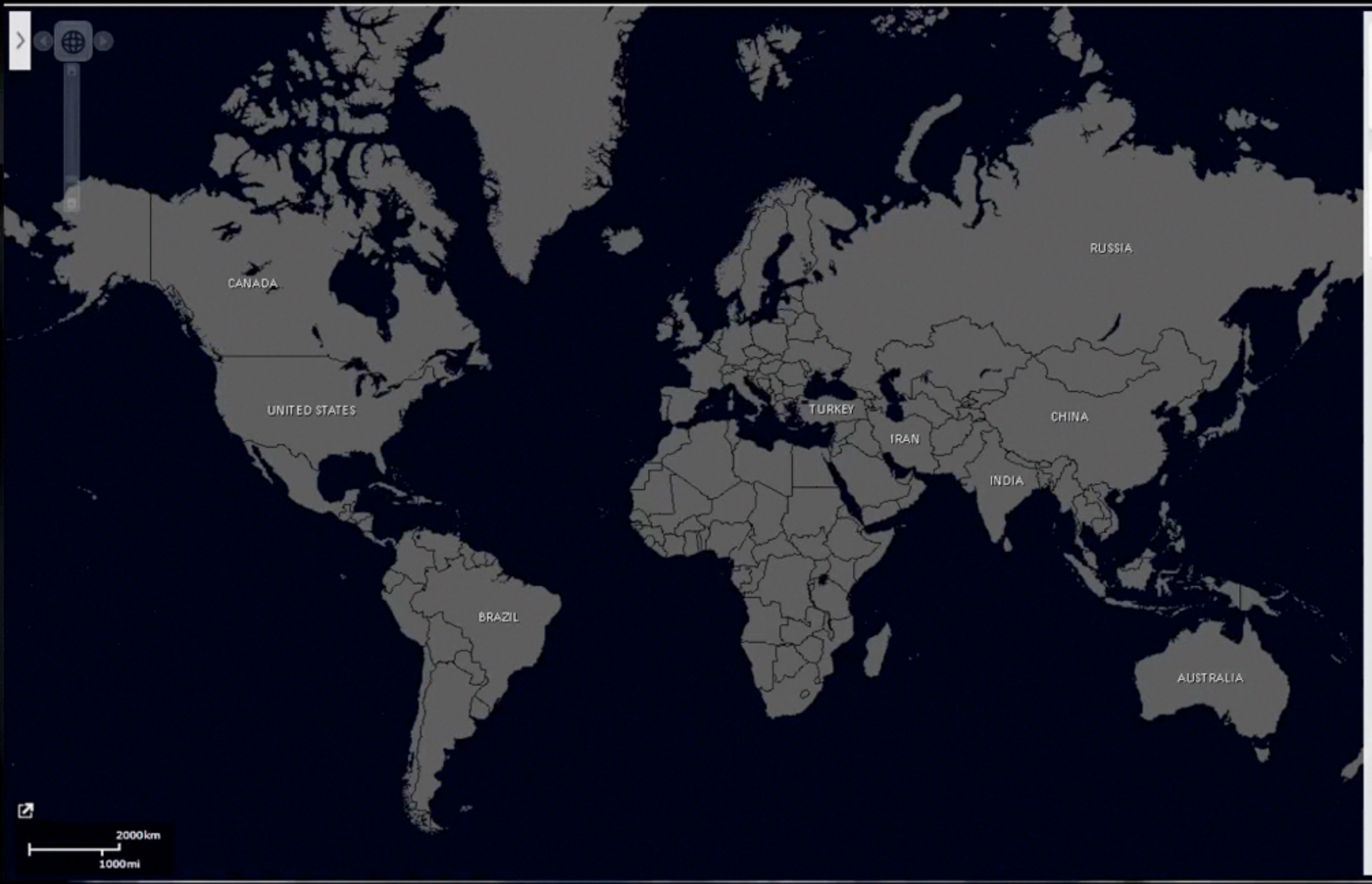
Transportation

Pathogen

MANY DESTINATIONS

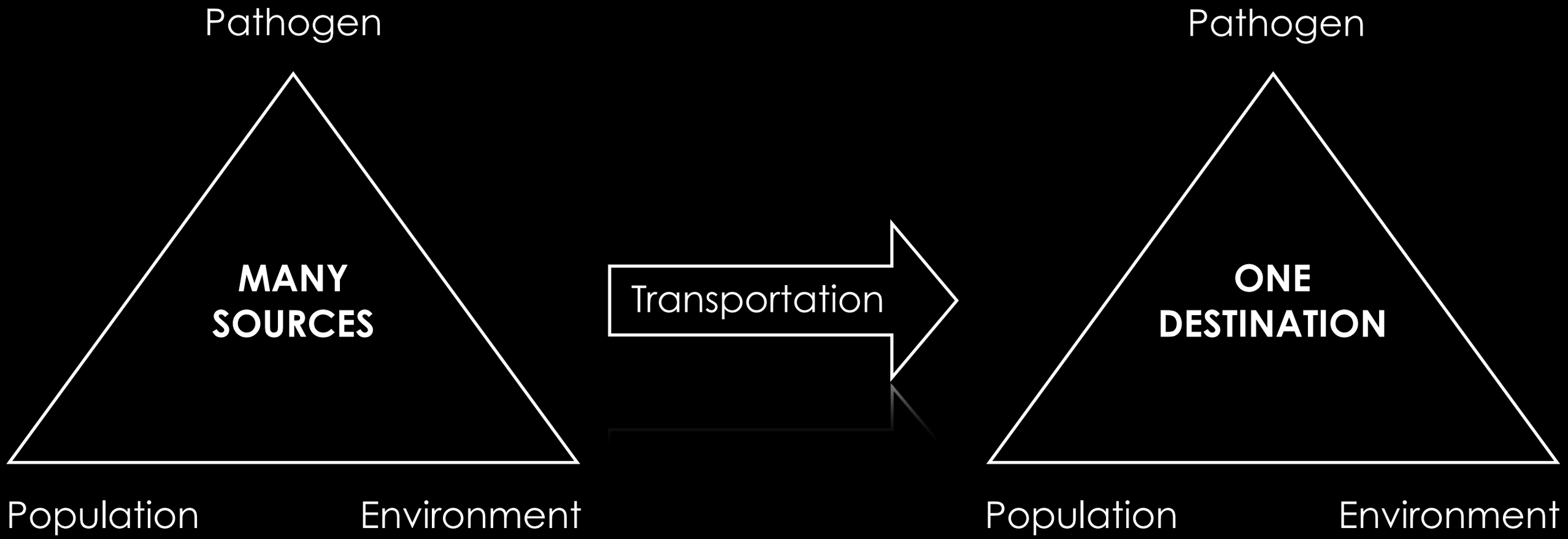
Population

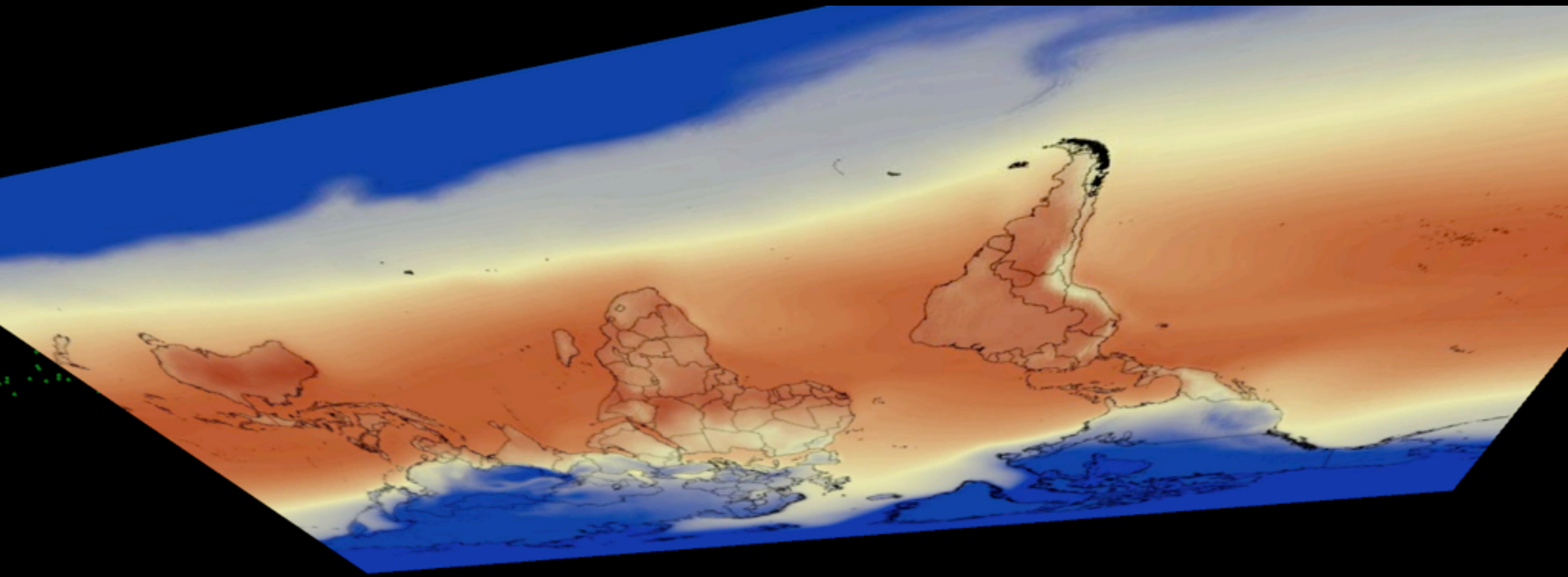
Environment


CANADA
UNITED STATES
RUSSIA
TURKEY
IRAN
CHINA
INDIA
BRAZIL
AUSTRALIA
2000 km
1000 mi
Travel
Demography

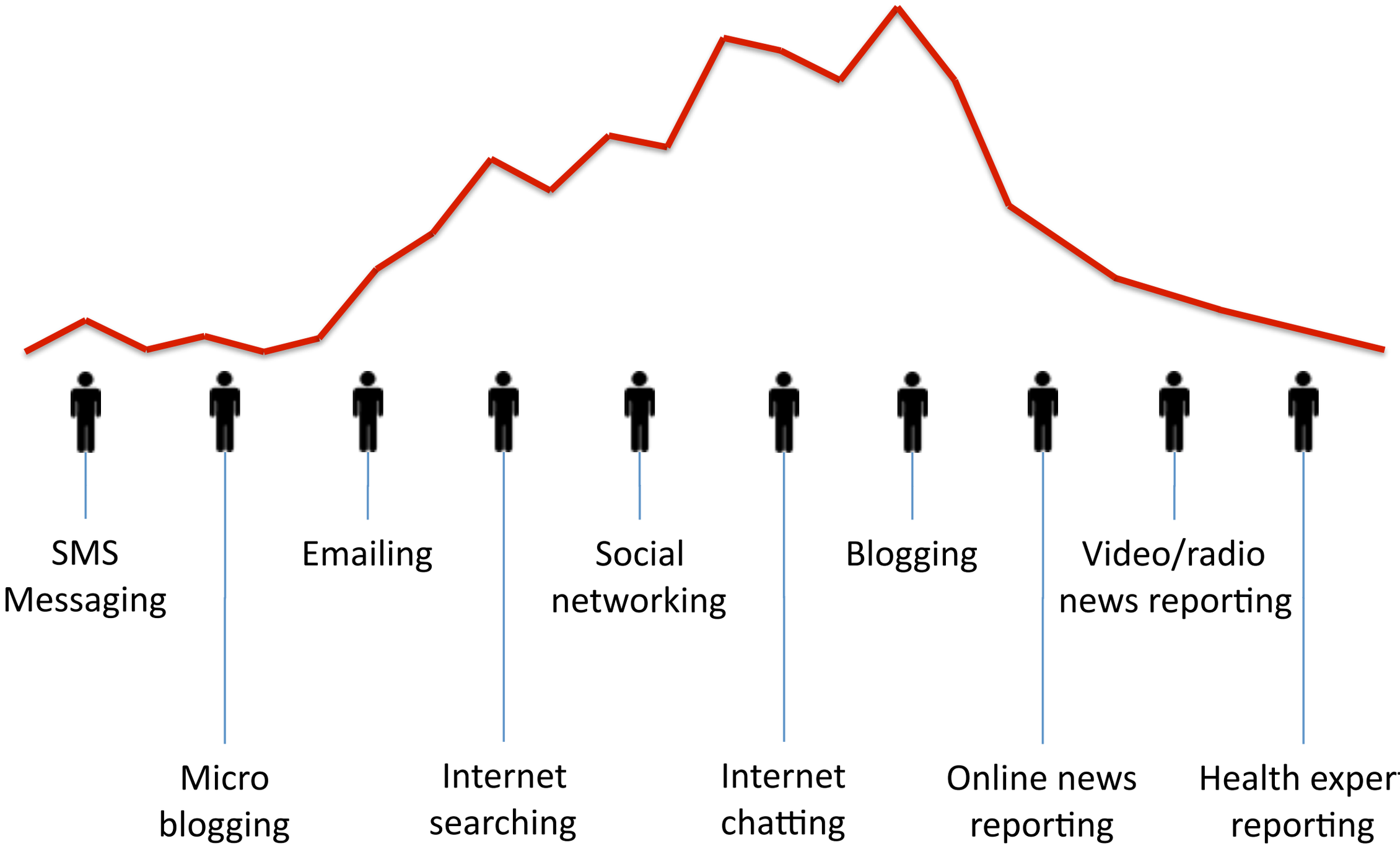
Local Risk Anticipation

Scheduled Events such as International Mass Gatherings



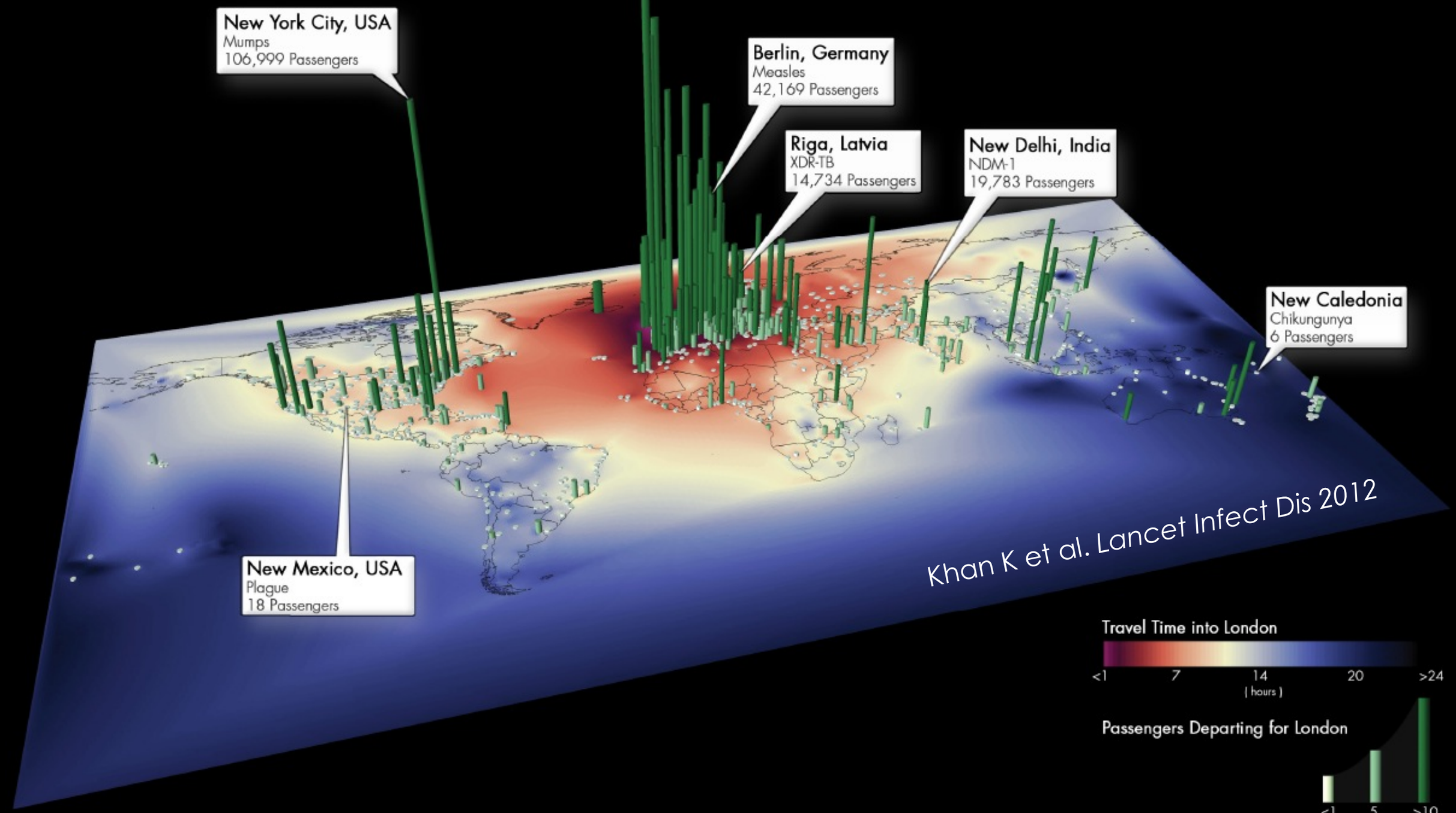


Internet-Based Disease Surveillance



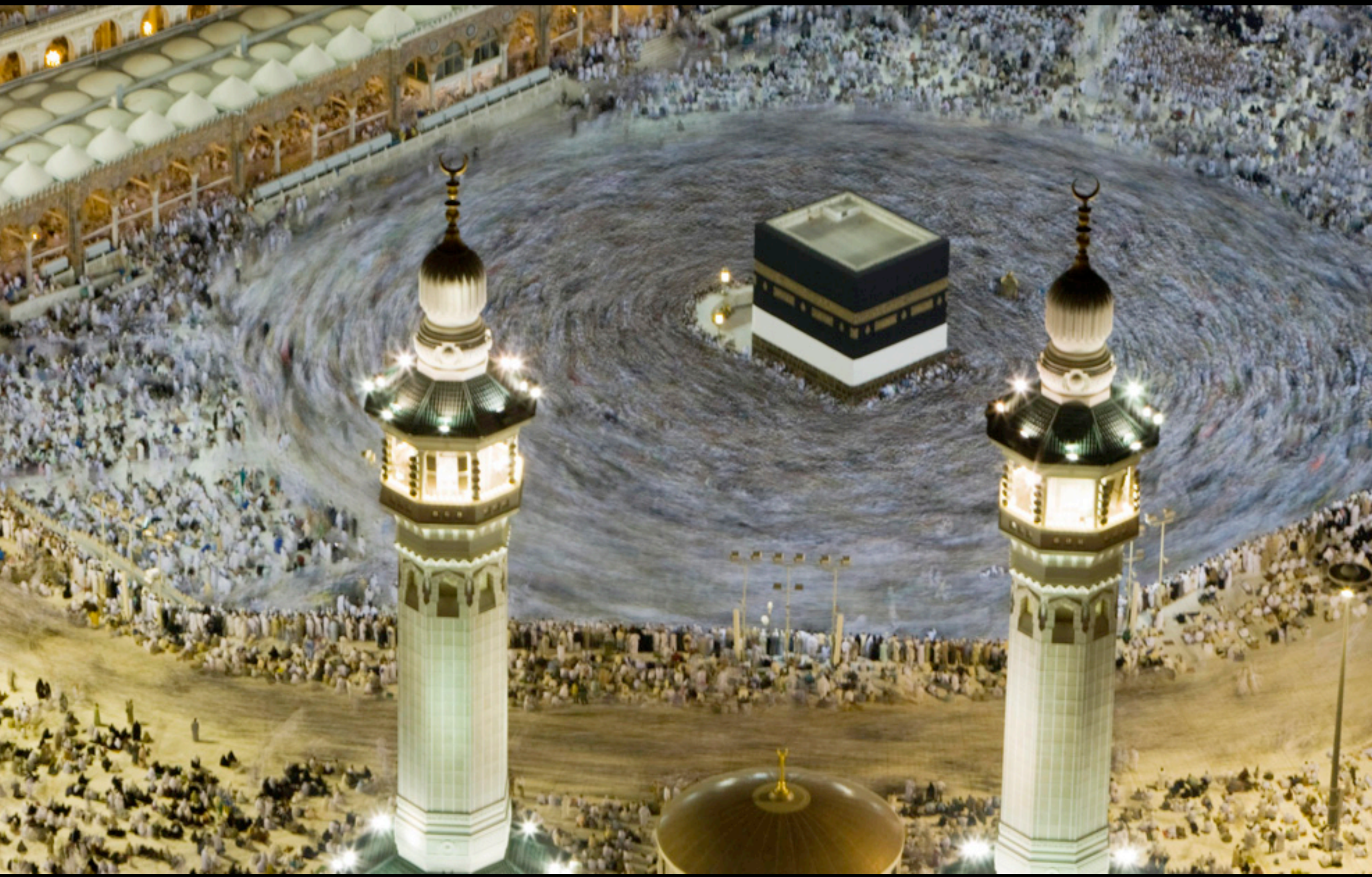
London Olympics 2012

Integrated Global Epidemic Surveillance & Transportation Modelling



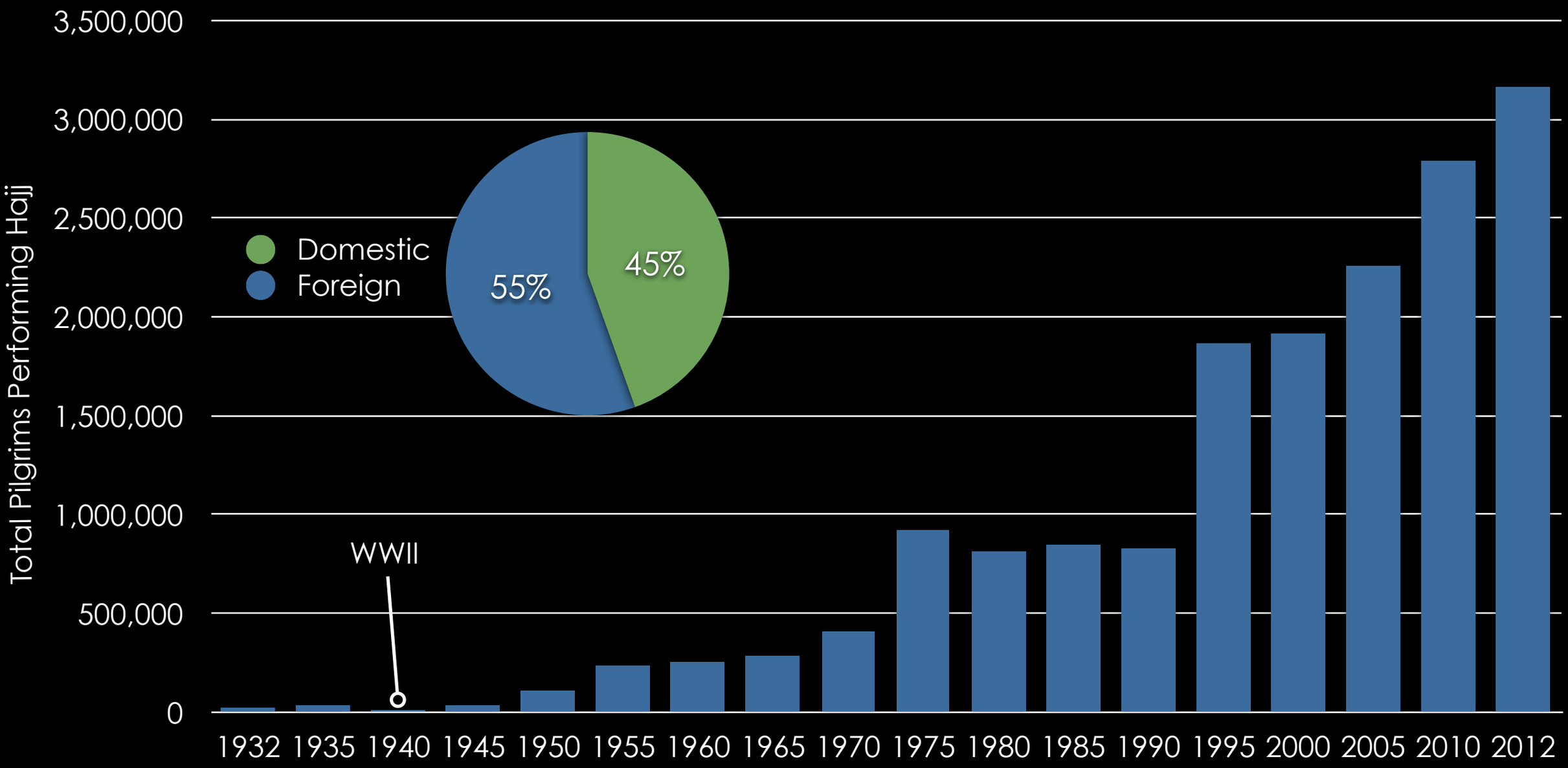
"Proclaim the *Pilgrimage* to all people. They will come to you on foot and on every kind of swift mount, emerging from every deep mountain pass."

Qur'an
Chapter 22 verse 27



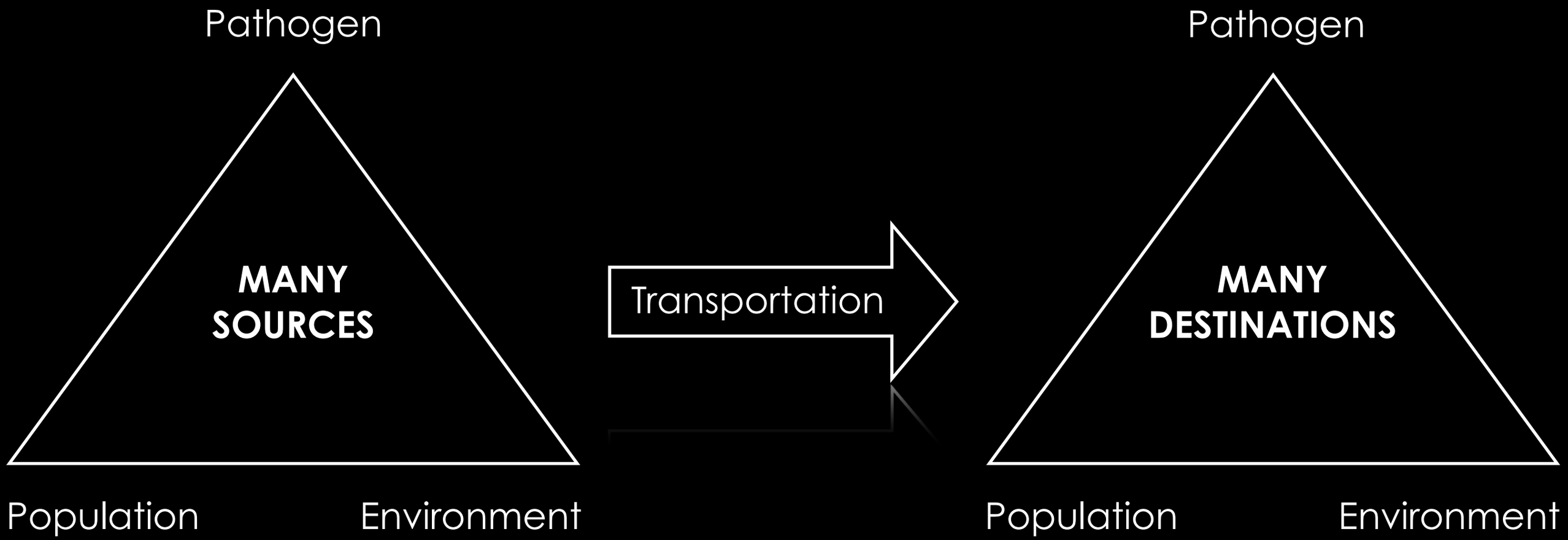
Pilgrims Performing Hajj

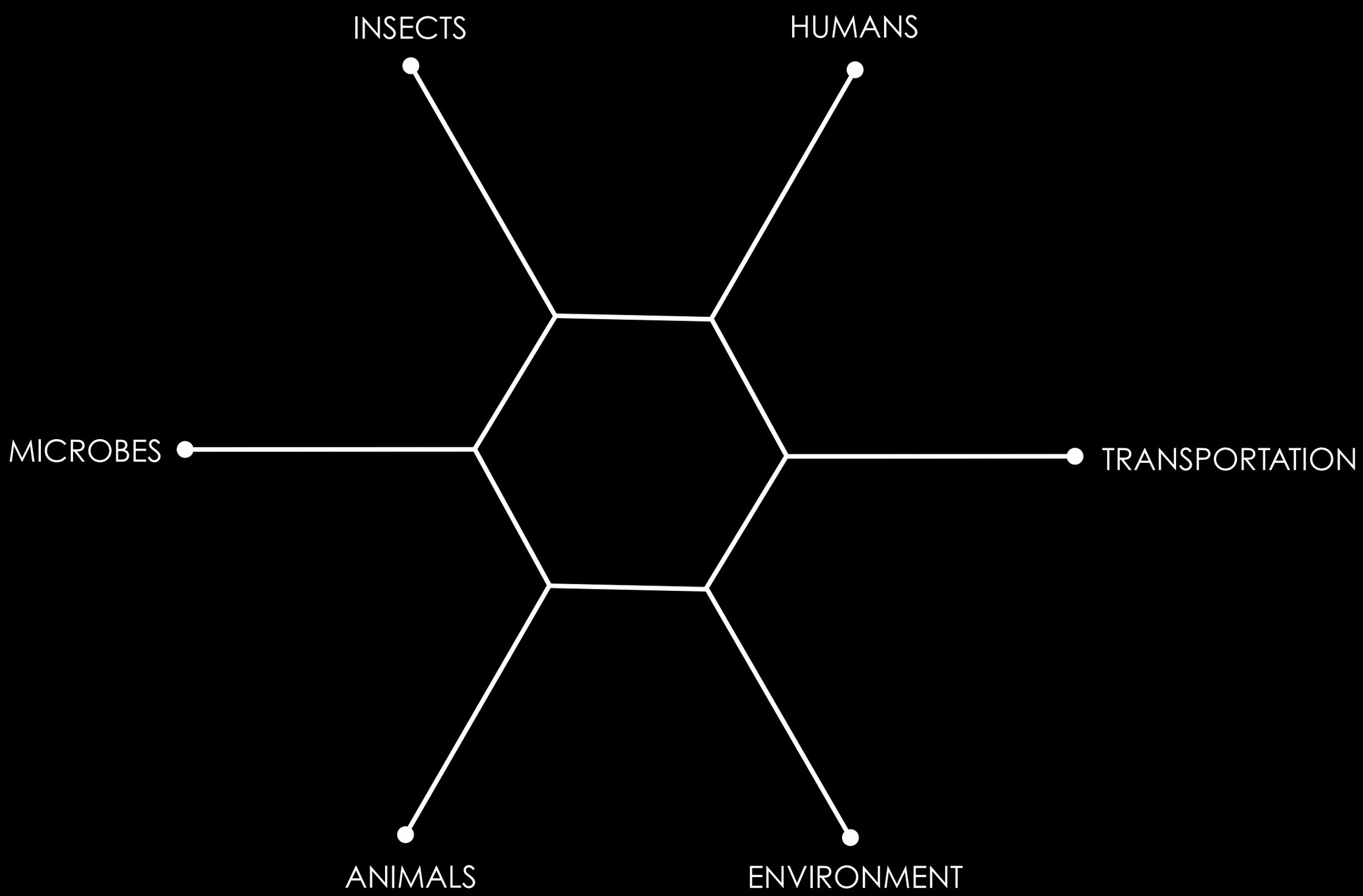
From 1932 to 2012



Global Epidemic Forecasting

Unknown or Unrecognized Infectious Disease Threats




INSECTS
HUMANS
MICROBES
TRANSPORTATION
ANIMALS
ENVIRONMENT

Ottawa
Montréal
Québec
Maine
Wisconsin
Ontario
Burlington
Augusta
Michigan
Vermont
Toronto
Rochester
Syracuse
Milwaukee
Buffalo
New York
Detroit
Boston
Illinois
Massachusetts
Chicago
Connecticut
Cleveland
Bridgeport
Pennsylvania
New York
Pittsburgh
Ohio
Philadelphia
Indiana
Indianapolis
Baltimore
Cincinnati
Washington, D.C.
West Virginia
Charleston
Kentucky
Virginia
Richmond
Norfolk
Nashville
Knoxville
Raleigh
Tennessee
North Carolina
Wilmington
Alabama
Georgia
Atlanta
South Carolina
Columbia

Population Density

People / Hexagon

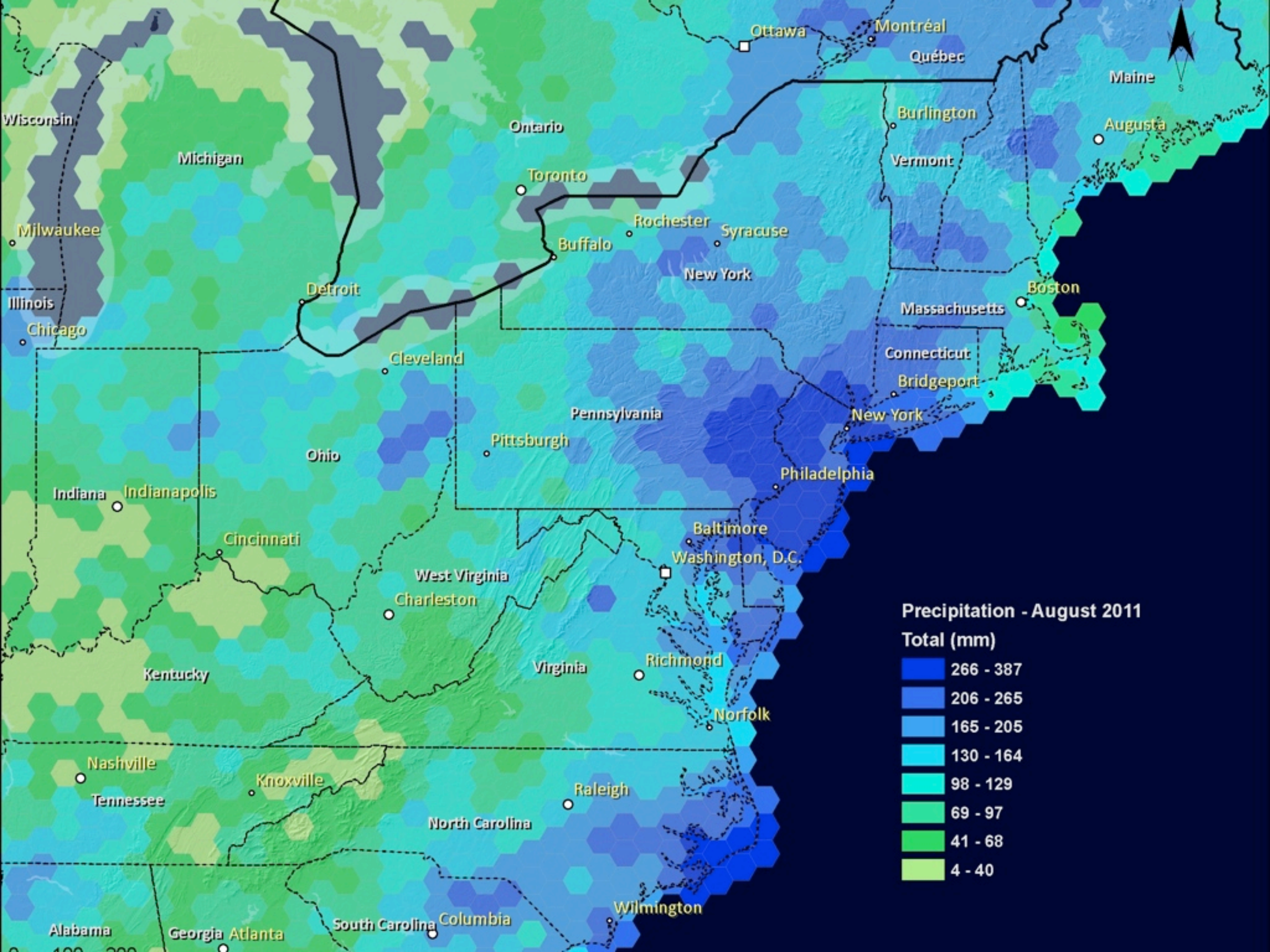
- 3000001 - 6229717
- 1750001 - 3000000
- 1000001 - 1750000
- 650001 - 1000000
- 450001 - 650000
- 250001 - 450000
- 150001 - 250000
- 70001 - 150000
- 20001 - 70000
- 0 - 20000

Ottawa
Montréal
Québec
Maine
Wisconsin
Ontario
Burlington
Augusta
Michigan
Vermont
Toronto
Milwaukee
Rochester
Syracuse
Buffalo
New York
Detroit
Boston
Illinois
Massachusetts
Chicago
Connecticut
Cleveland
Bridgeport
Pennsylvania
New York
Pittsburgh
Ohio
Philadelphia
Indiana
Indianapolis
Baltimore
Cincinnati
Washington, D.C.
West Virginia
Charleston
Kentucky
Virginia
Richmond
Norfolk
Nashville
Knoxville
Raleigh
Tennessee
North Carolina
Wilmington
Alabama
Georgia
Atlanta
South Carolina
Columbia

Poultry Production

Total Poultry Units / Hexagon

- 0
- 1 - 250
- 251 - 500
- 501 - 1000
- 1001 - 5000
- 5001 - 10000
- 10001 - 50000
- over 50000


Ottawa
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Buffalo
New York
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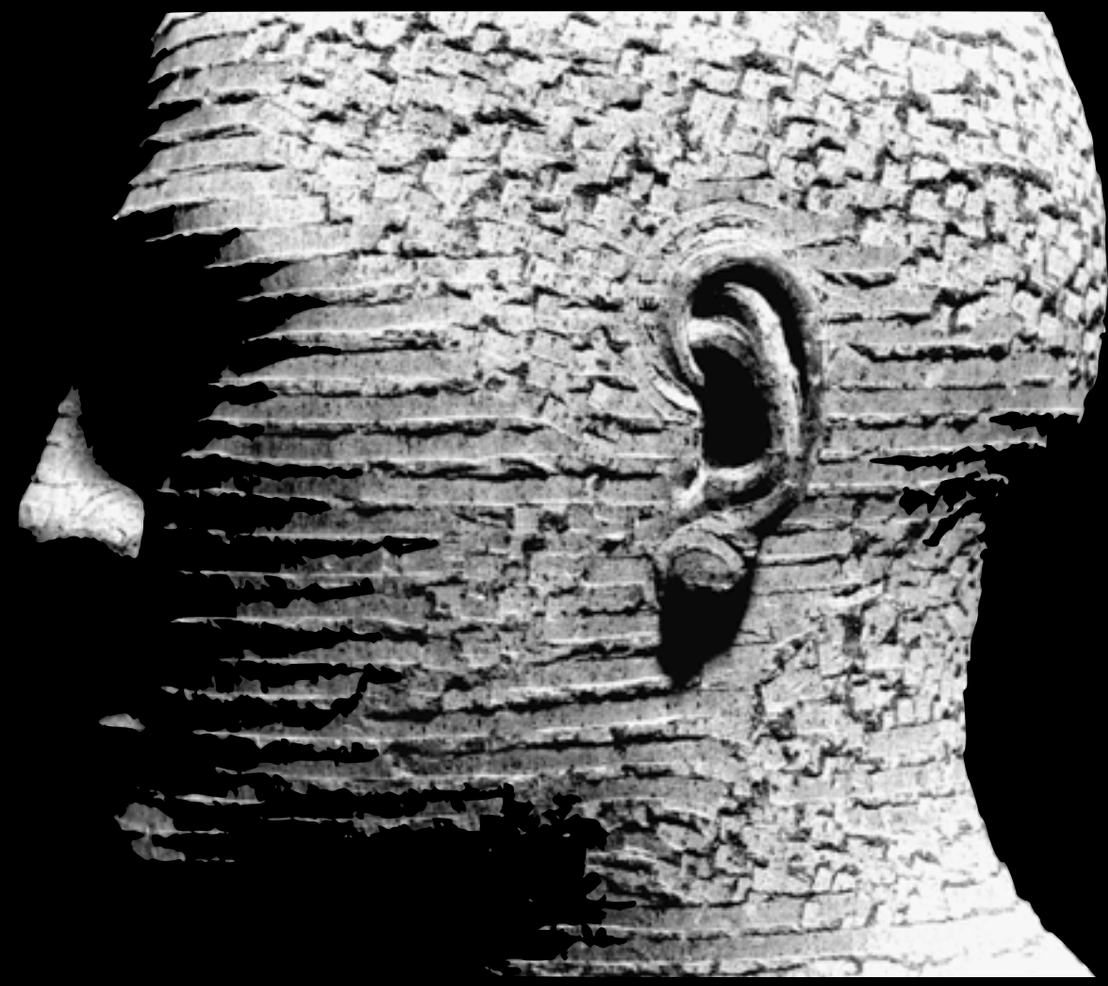
Illinois
Massachusetts
Chicago
Cleveland
Connecticut
Bridgeport
Pennsylvania
New York
Pittsburgh
Ohio
Philadelphia
Indiana
Indianapolis
Baltimore
Cincinnati
Washington, D.C.
West Virginia
Charleston
Kentucky
Virginia
Richmond
Norfolk
Nashville
Knoxville
Raleigh
Tennessee
North Carolina
Wilmington
Alabama
Georgia
Atlanta
South Carolina
Columbia
Precipitation - August 2011
Total (mm)
266 - 387
206 - 265
165 - 205
130 - 164
98 - 129
69 - 97
41 - 68
4 - 40

Neural Network

- Identify local convergence of global risks
  - For every major pathogen
  - For every geography in the world
  - Updated every day
- Foundation for global forecasting system



Synthesis

- Three frontiers to confront disease
- Protect health - Preserve travel
- Timely evidence based decision making
- Evolution from reactive to anticipatory

Thank You

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