Preparing for the Next Pandemic

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AIR WORLDWIDE®

Agenda

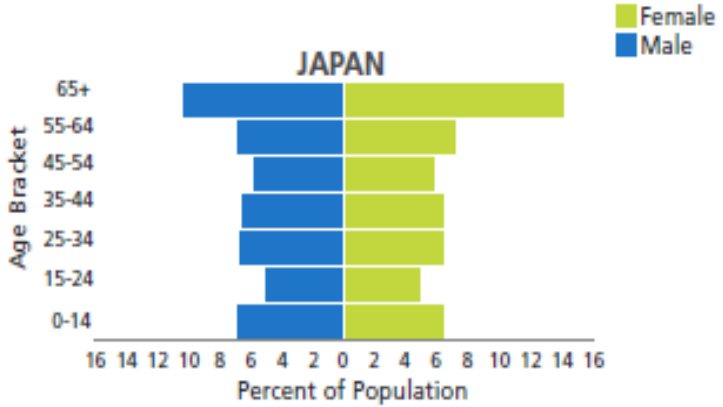
MAKE
LIFE
EASY

1. Overview of the Risk
2. Risk Mitigation Methods
3. Megadisaster Case Study
4. AIR Pandemic Model

What Is the Risk We're Analyzing?

Large-scale infectious disease outbreaks in human populations

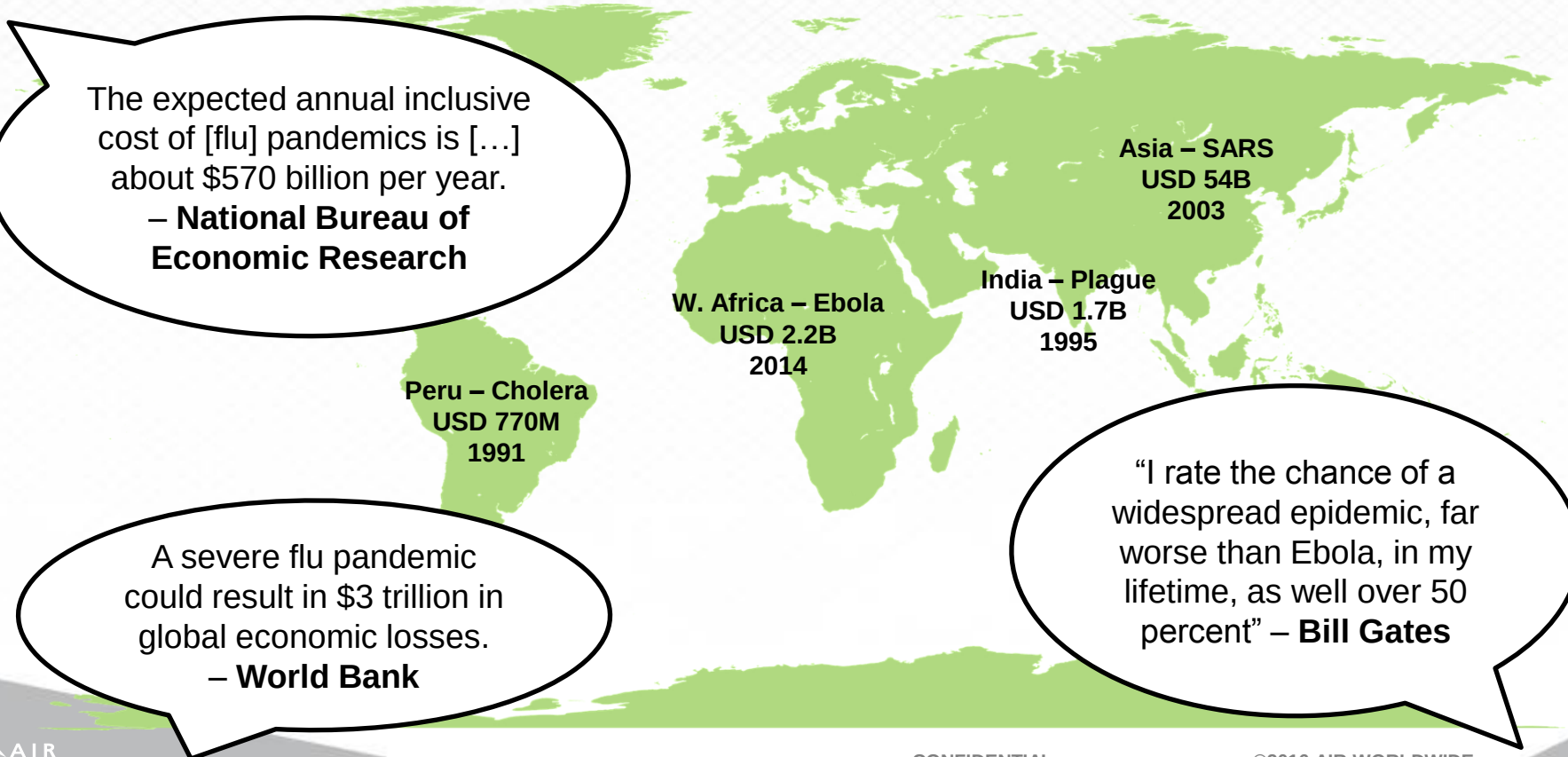
- High morbidity and mortality rates
- Excess insurance claims
- All age groups affected
- Large economic impact potential
- Infectious diseases cross borders



Age distribution of the population can have a significant impact on morbidity and mortality.

The Overall Financial Risk of Infectious Disease Events: Total Economic Loss from Select Outbreaks

The expected annual inclusive cost of [flu] pandemics is […] about $570 billion per year. – **National Bureau of Economic Research**

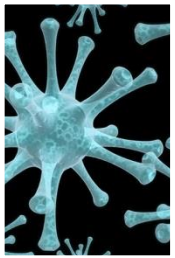


A severe flu pandemic could result in $3 trillion in global economic losses. – **World Bank**

"I rate the chance of a widespread epidemic, far worse than Ebola, in my lifetime, as well over 50 percent" – **Bill Gates**

Means to Manage the Risk

Portfolio analysis



Extreme Mortality Bonds

Pandemic Bonds

1. Global Benefit
2. Public/Private Collaboration

Pandemic Emergency Financing Facility (PEF)

Designed to help facilitate needs of the organizations and governments fighting the outbreak

Funding to fight specific pathogens:

- Flu
- Filoviridae
- Coronaviridae
- Rift Valley Fever
- Crimean-Congo Hemorrhagic Fever
- Lassa Fever

Pandemic Emergency Financing Facility

According to the World Bank:

- “The PEF will accelerate and improve outbreak response, save lives, and reduce the costs of response.”
- “Over time, the PEF is also expected to create a new market for pandemic insurance that will bring greater discipline and rigor to pandemic preparedness and incentivize better pandemic response planning.”
- “The PEF will also stimulate efforts by countries and development partners to build better core public health capabilities for disease surveillance and health systems strengthening, toward universal health coverage.”

Key players:

AIR

The World Bank

Swiss Re

Munich RE

Outbreak Risk Factors Change Over Time

1. Biological Factors
   - Host immunity
   - Pathogen adaptation of transmissibility/virulence
2. Human Behavior
   - Political – prioritization, corruption
   - Social – contact networks
   - Economic – resources, international funding
3. Ecologic Factors
   - Climate change alters geographical range of animal reservoirs
   - Deforestation, urbanization, and land use impact connection between man and environment

The AIR Pandemic Megadisaster Scenario Provides a Glimpse of a Rare, Severe Potential Event

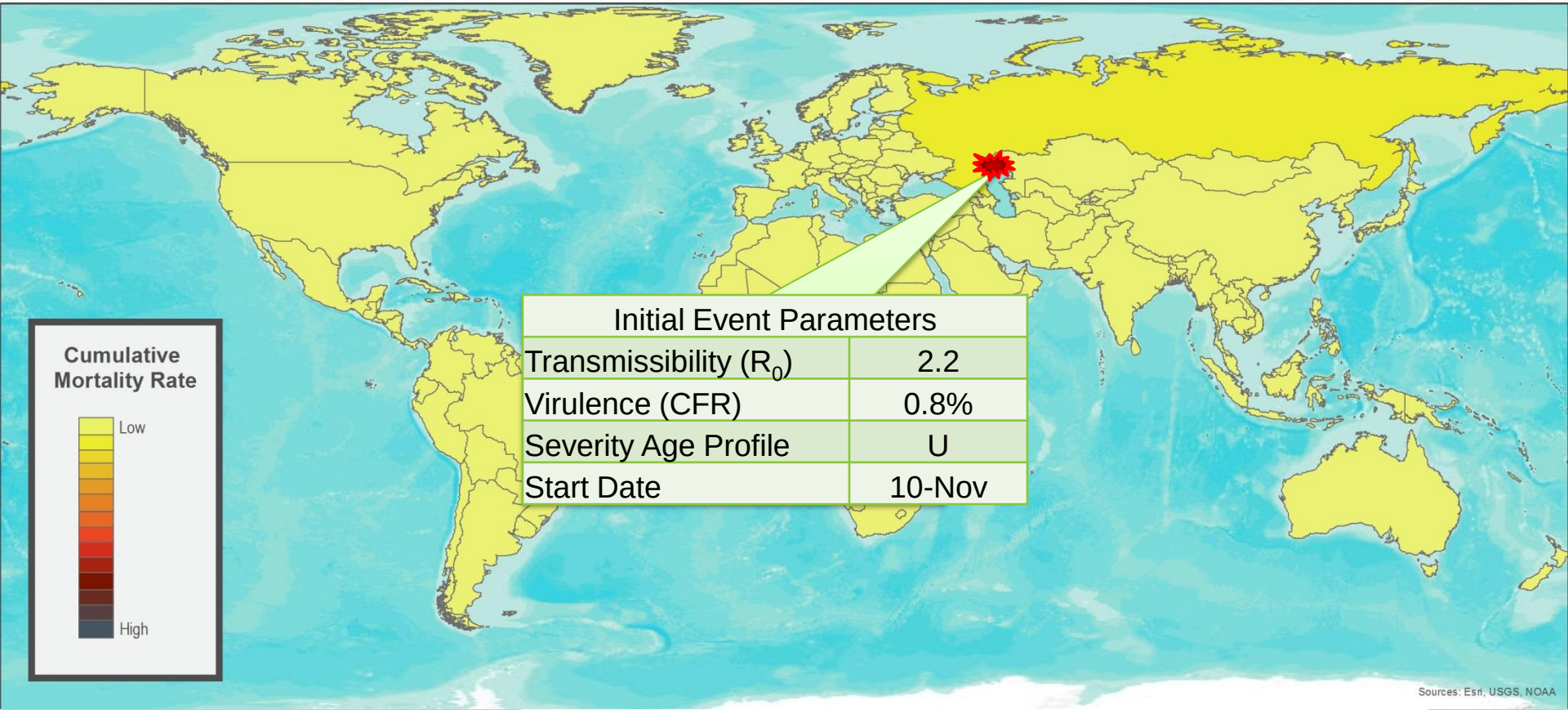
Global Pandemic Megadisaster—Are You Prepared?

April 26, 2016

Event: Catastrophic life and health losses due to infectious disease outbreak
Model: AIR Pandemic Model
Stochastic Event ID: 810254128
Affected area: Globe
Estimated insurable loss: USD 76.2 billion (global life insurance), USD 64.2 billion (U.S. health insurance)
Estimated mortality: 22,849,963
Annual loss exceedance probability: ~1% (100-year return period)

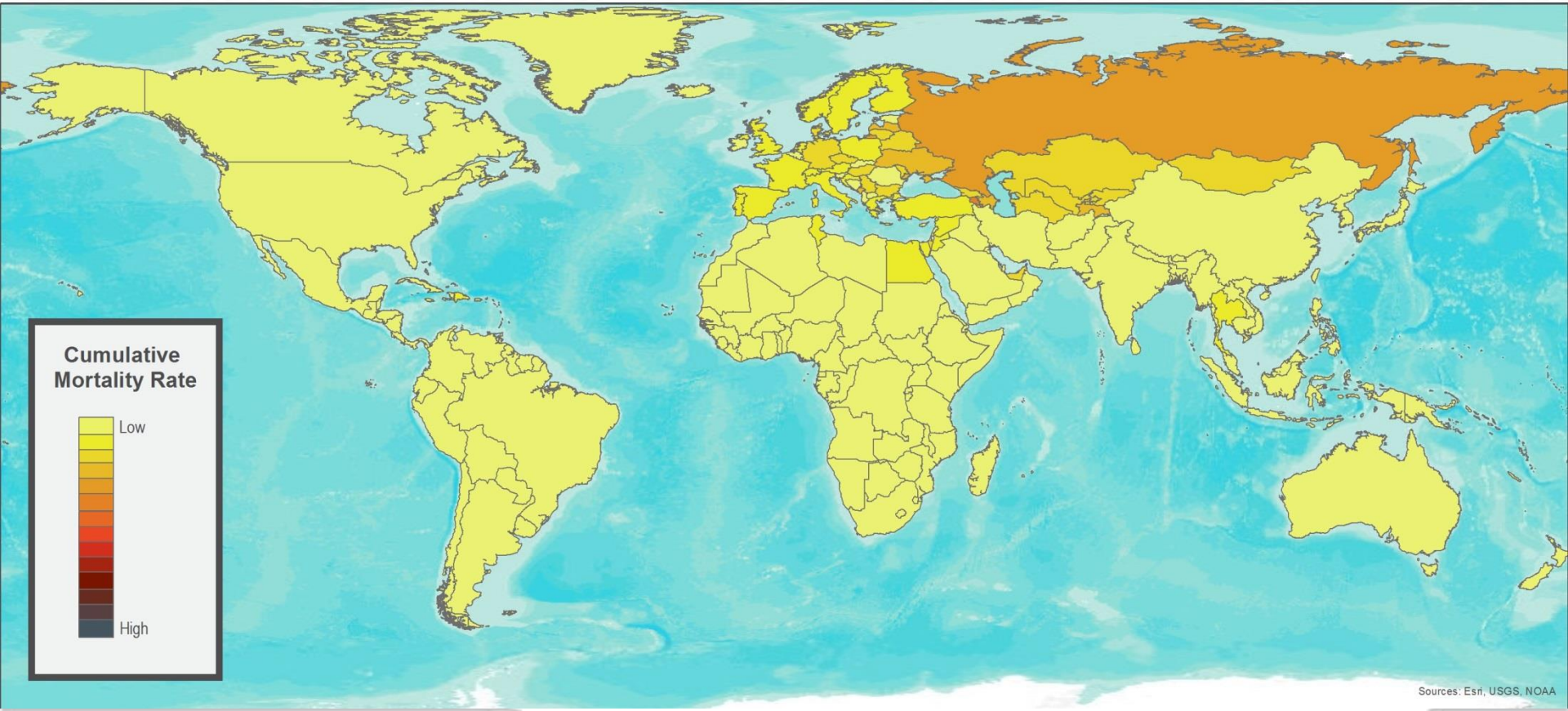
Each edition of this **quarterly feature** in AIR Currents presents a **megadisaster scenario** taken from an AIR model's **stochastic catalog**.

Megadisaster – Month 1

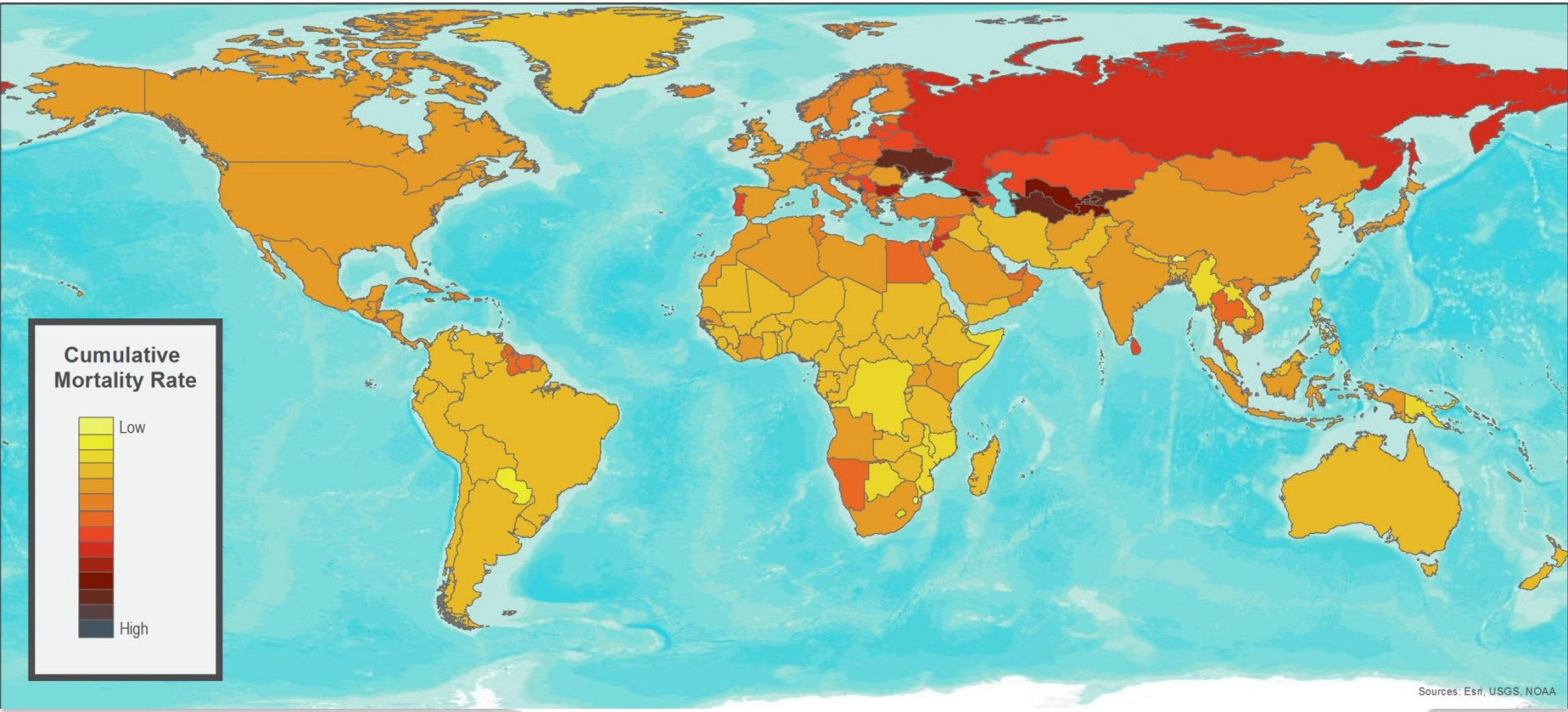


Initial Event Parameters	
Transmissibility (R_0)	2.2
Virulence (CFR)	0.8%
Severity Age Profile	U
Start Date	10-Nov

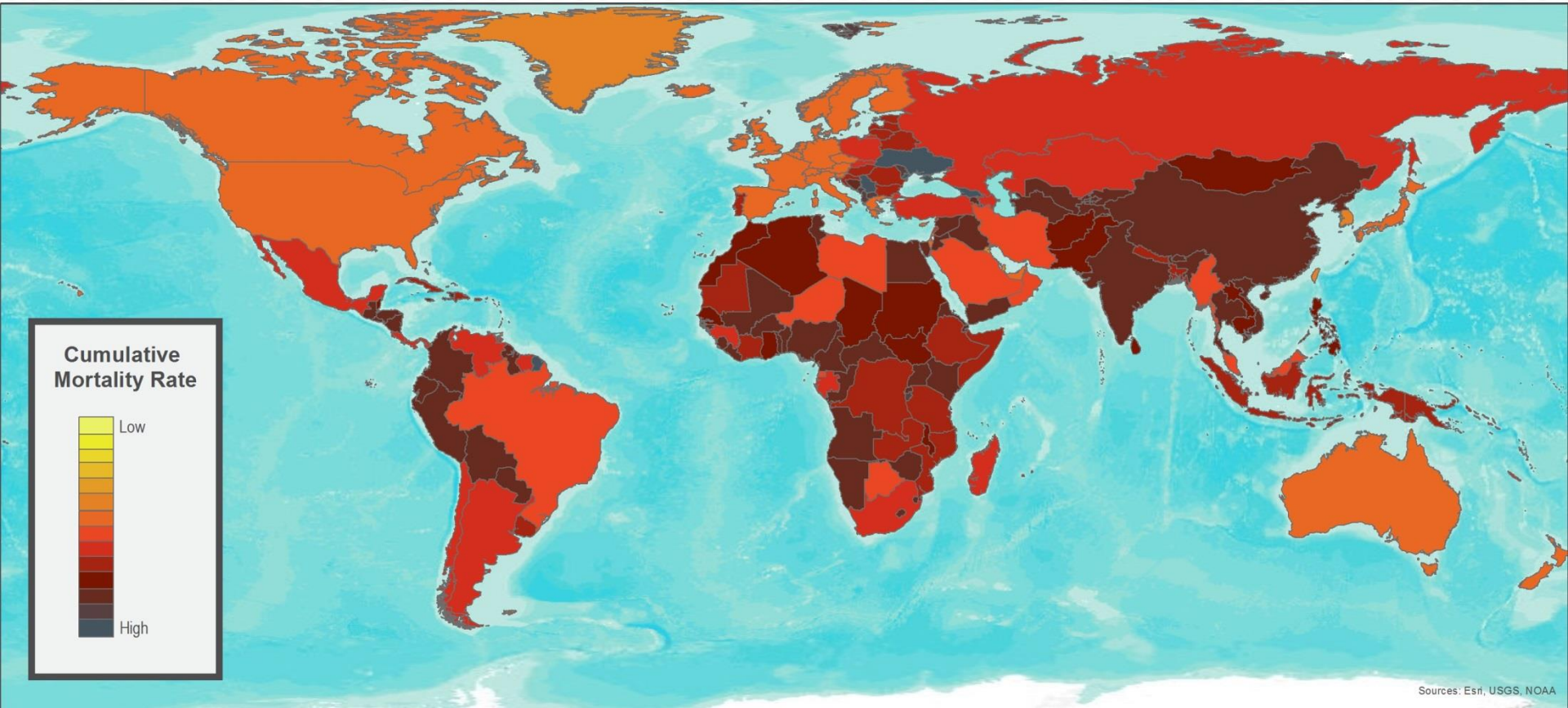
Megadisaster – Month 2



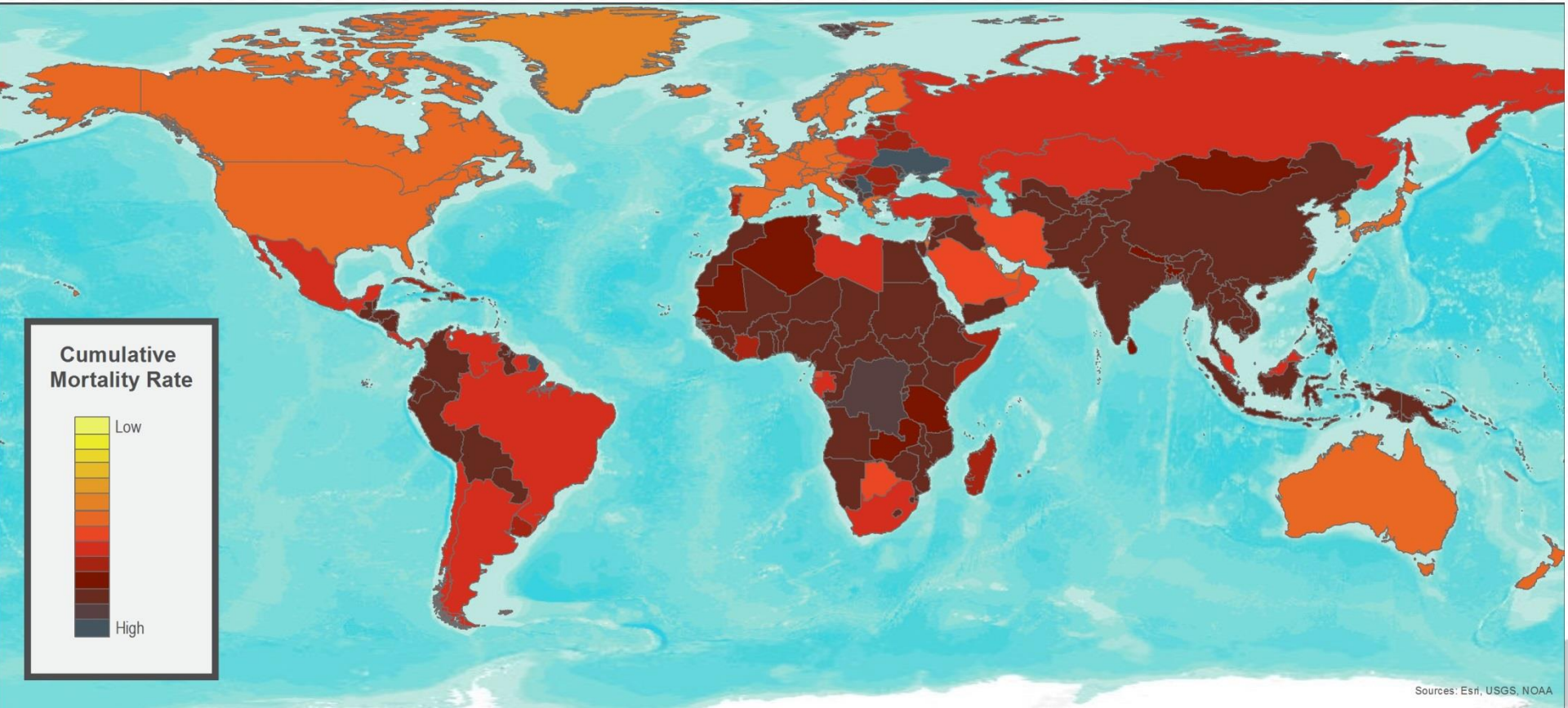
Megadisaster – Month 6



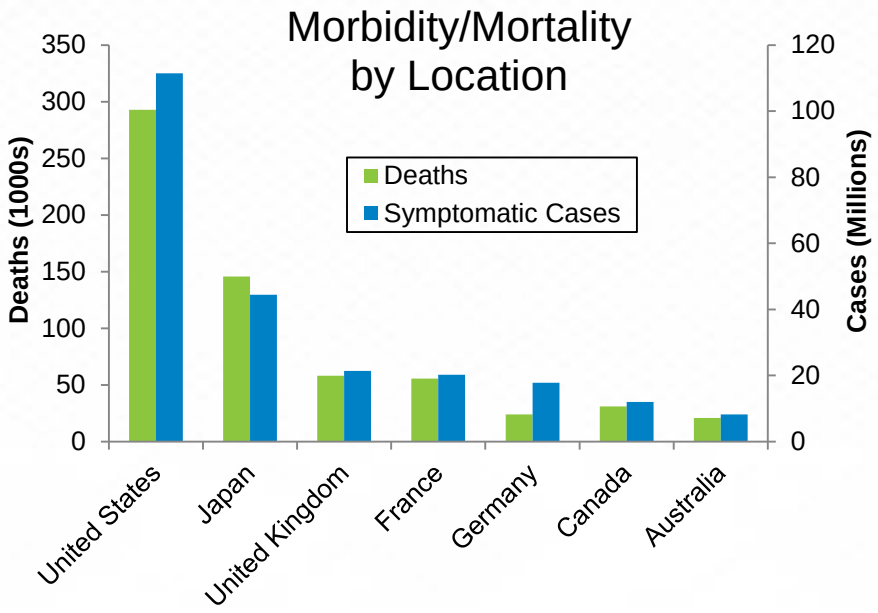
Megadisaster – Month 9



Megadisaster – Month 18



Modeled Losses During the Megadisaster Event for Select Countries



Country	Insurable Life Insurance (USD Billions)
United States	33.8
Japan	17.8
United Kingdom	9.0
France	6.1
Germany	4.7
Canada	3.8
Australia	1.0

AIR Life and Health Modeling Services Overview

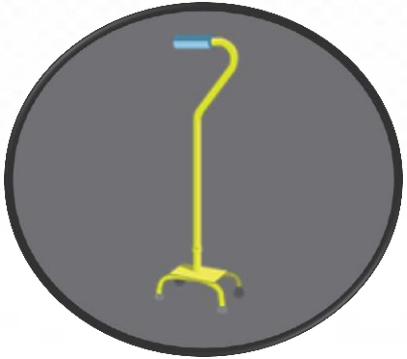
Provide solutions for the life and health insurance space through a suite of stochastic modeling tools

Perils currently modeled

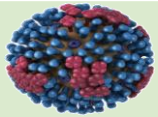
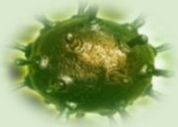
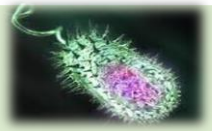
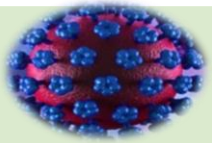
Morbidity and Mortality

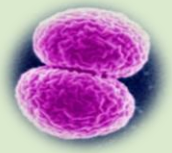
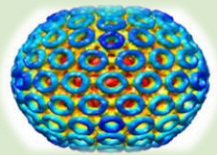
Pandemic
Earthquake
Terrorism

Longevity



AIR Pandemic Model Now Covers Nine Types of Infectious Disease

	Influenza	Coronaviruses	Filoviruses	Cholera	Lassa Fever
					
Recent Example	2009 H1N1 250K-300K deaths	2003 SARS 774 deaths	2014 West Africa Ebola 11,316 deaths	2010 Haiti 9,000 deaths	2012 Nigeria 700 deaths
Mode of Transmission	Airborne	Airborne (close contact)	Bodily fluids (close contact)	Fecal-oral	Rats, bodily fluids
Virulence (CFR)	0.1-30%	5-15%	25-80%	1-40%	1-15%

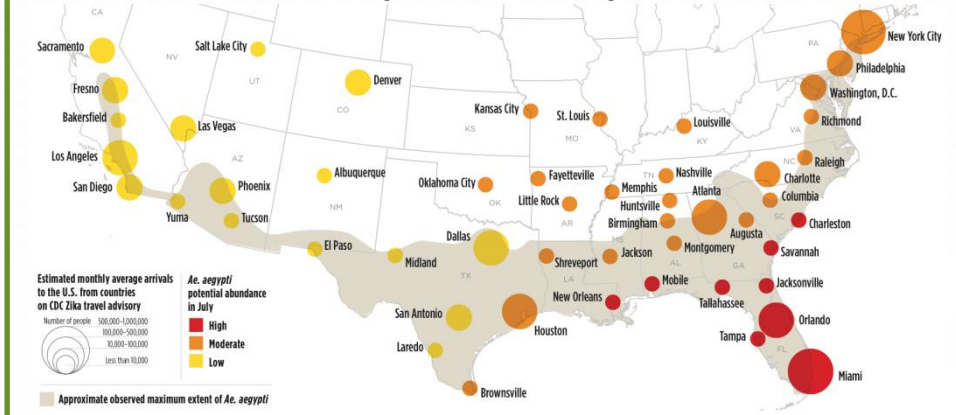
	Crimean-Congo HF	Bacterial Meningitis	Plague (*Y. pestis*)	Rift Valley Fever
				
Recent Example	2007 Turkey 33 deaths	1997 African Meningitis Belt 25,000 deaths	2014 Madagascar 81 deaths	1997 Kenya 500 deaths
Mode of Transmission	Ticks, bodily fluids	Bodily fluids	Fleas, bodily fluids	Mosquitoes
Virulence (CFR)	3-30%	5-50%	10-80%	10-50%

Zika Virus Update

Event Summary (Source: WHO) Reported 6/2/2016	
Transmission method	Mosquito (primarily) Sexually
Symptoms	Fever, rash, conjunctivitis, headache, malaise, myalgia
Prevention method	Mosquito control
Demographic group at greatest danger	Pregnant women Newborns
Rare, severe outcomes	Microcephaly, Guillain-Barré Syndrome, possibly other neurological syndromes
Areas of risk	Health claims Travel claims Business interruption Economic recession

Latest Reported Counts	
Countries with locally acquired cases	39
Suspected cases	363,990
Confirmed cases	52,003

Estimated Risk in U.S.
(Source: UCAR)

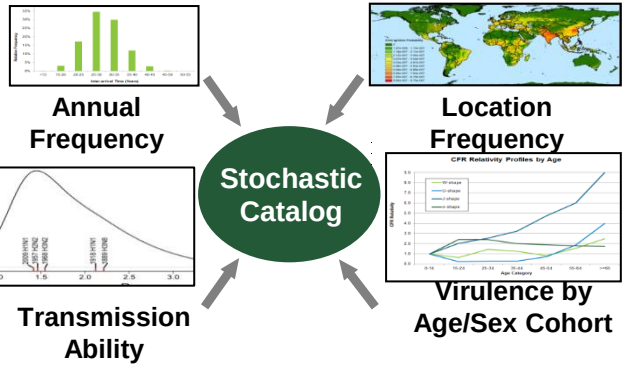


A risk-assessment map shows Aedes aegypti potential abundance for July and the monthly average number arrivals to the U.S. by air and land from countries on the Center for Disease Control Zika travel advisory. Red dots represent areas with potentially high abundance, while yellow dots represent potentially low abundance areas. Shaded regions represent the approximate maximum range of Aedes aegypti.

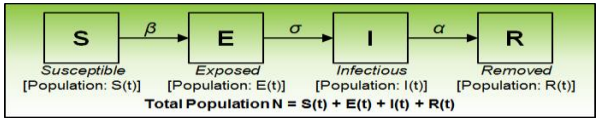
Credits: UCAR

Probabilistic AIR Pandemic Model Estimates Morbidity and Mortality Risk

Stochastic Event Generation

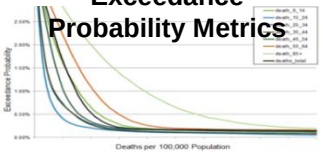


Epidemiologic Model Coupled with Long- and Short-Range Travel and Mitigation Measures



Pharmaceutical Interventions	Non-Pharmaceutical Interventions
Vaccines	Travel Restrictions
Antivirals	Active Containment

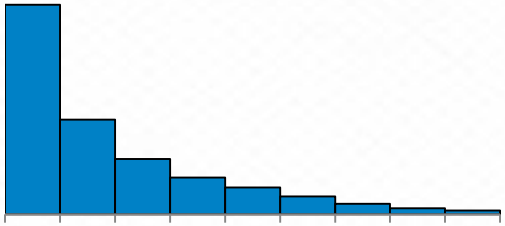
Financial Impact & Portfolio Analytics



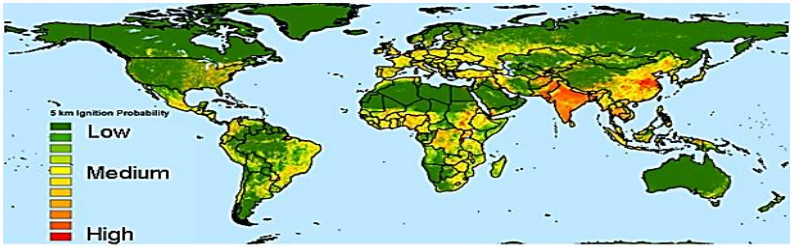
- Workers' Comp Insurance Losses
- Life Insurance Losses
- Health Insurance Losses

Event Footprint by Illness Severity and Age/Sex Cohorts

To Build a Catalog of Plausible Events, the First Step Is to Select a Set of Key Ignition Parameters

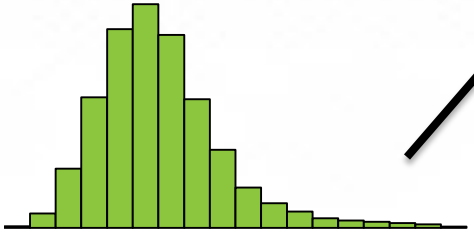


Annual Frequency

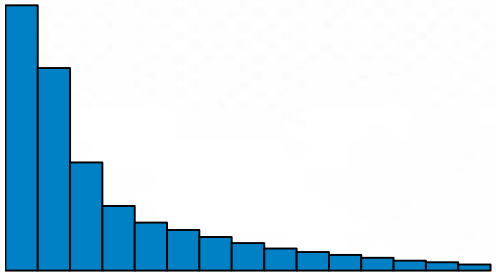


Spatial Ignition Frequency

Ignition Characteristics



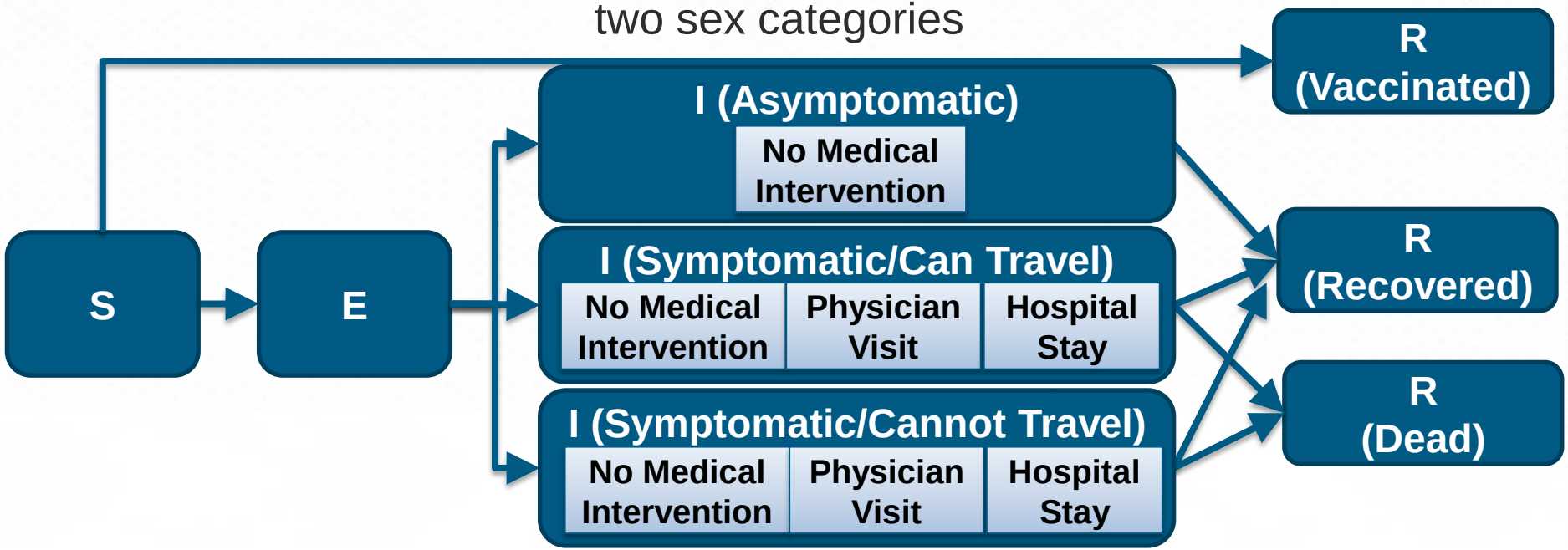
Transmissibility



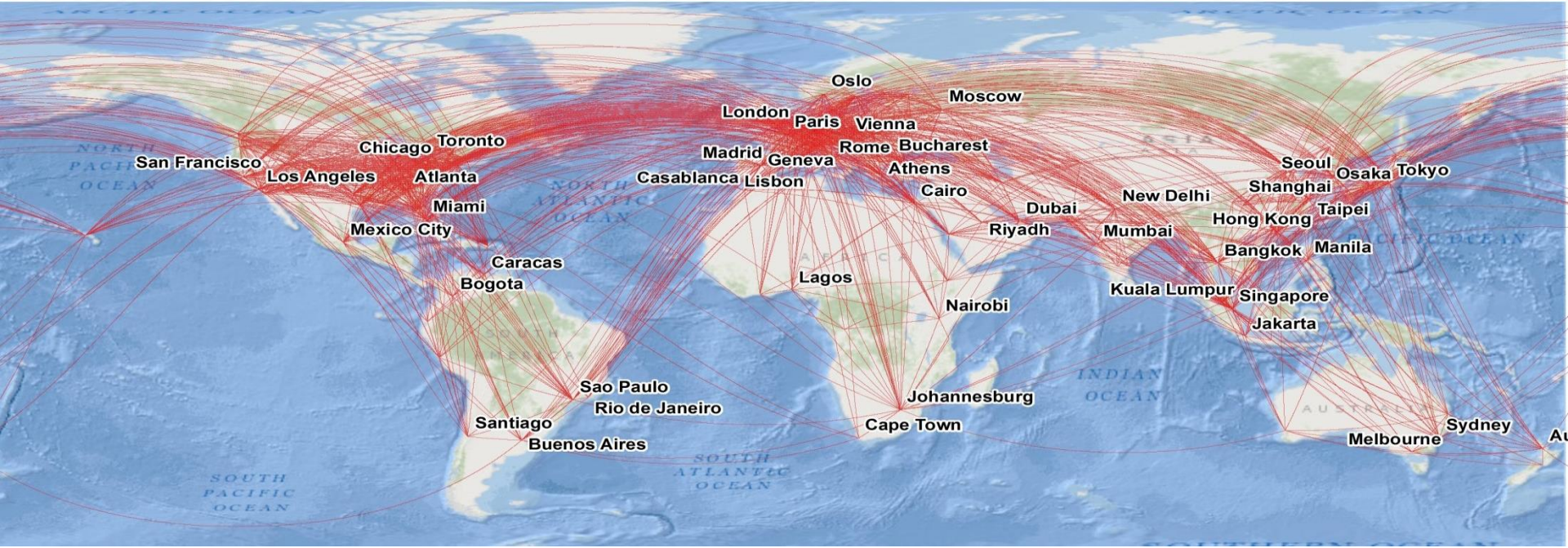
Virulence

High-Resolution Estimations Achieved via SEIR Epidemiological Model in Each Location

SEIR model operates at a daily time step with seven age groups and two sex categories

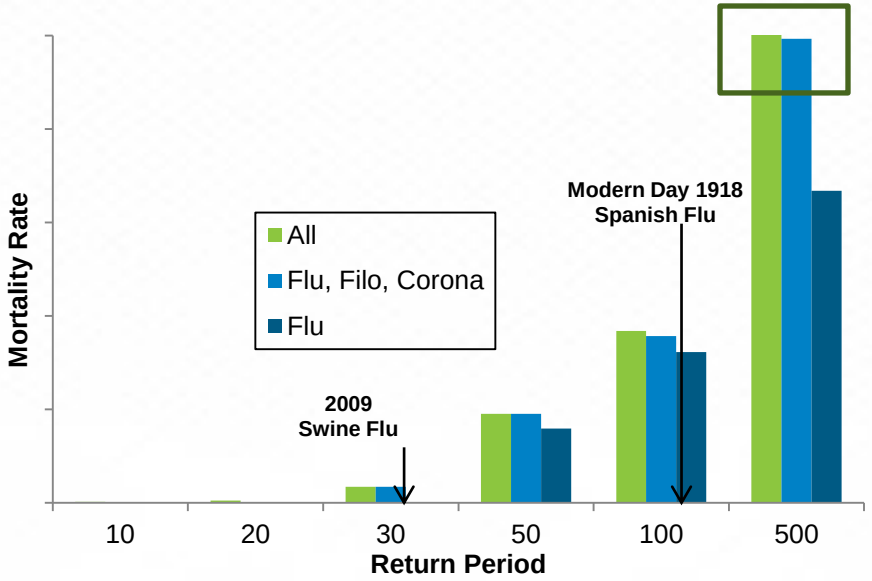


Explicit Modeling of Population Movement Drives Geographic Spread of Disease

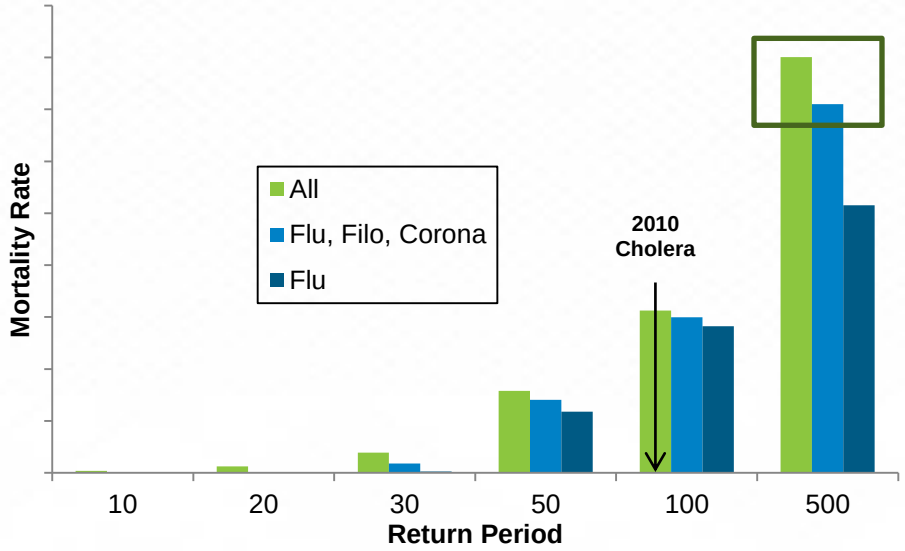


Total Mortality for Select Return Periods Vary Geographically, by Covered Disease

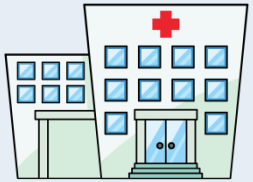
Australia, Canada, France, Germany, Japan, United Kingdom, United States



Greater Antilles



AIR Healthcare Utilization Model Quantifies Inpatient/Outpatient Uptake and Insurance Claims

Hospital 	**Clinic** 
 **ER**	 **Pharma**

- Estimate loss due to hospitalization, clinic visit, ER visit, and pharmaceutical claim during flu pandemics
- Estimates based on correlated severity functions derived from observed healthcare utilization
- Specific to age, sex, and location

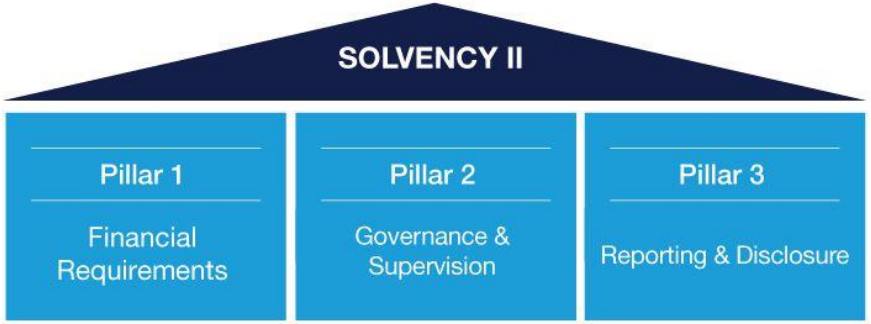
Solvency II – Catastrophe Risk

Stress Test

- 1.5 deaths per million
- Limitations
  - Based on flu-only analysis from Swiss Re
  - Doesn't include underwriting adjustments for: age, sex, income, co-morbid statuses, and duration

Stochastic Modeling

- Includes all the information as in the stress test
- Allows for dynamic modeling of the correlations across other risks – lapse, market, longevity, etc.



CATRADER® 18.0 Release Includes Pandemic Morbidity and Mortality Analysis

- Mortality and life insurance loss by:
  - Age
  - Sex
  - Location
  - Disease

Influenza	Filoviruses	Coronaviruses
Cholera	Crimean-Congo Hemorrhagic Fever	Lassa Fever
Meningitis	Plague	Rift Valley Fever

AIR Offers Consulting Services for Tailored Solutions

Sub-national specificity available for detailed analytics

- City
- Municipality

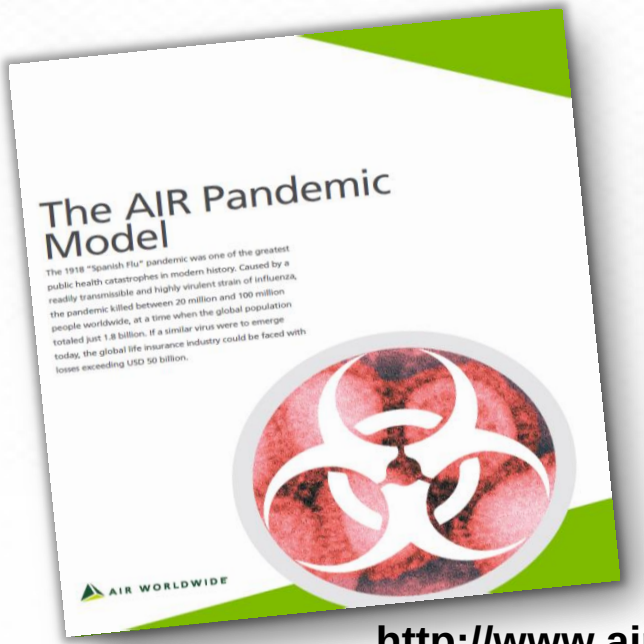
Additional underwriting characteristic analysis

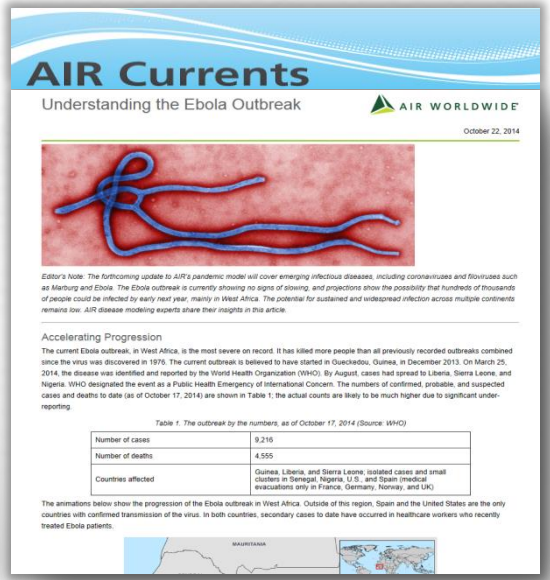
- Socioeconomic status
- Smoking status
- Prior health status

Summary

- The changing world impacts our infectious disease risk
- Multiple financial tools exist to mitigate this risk
- The AIR Pandemic Model has several key features:
  - Global in scope, high granularity
  - Captures temporal progression of events
  - Extensively validated using available data
  - Explicitly modeled diseases
- Utilize the AIR Pandemic Model to enable a more robust understanding and management of pandemic risk

Additional Reading





http://www.air-worldwide.com/Models/Life-and-Health/

http://www.air-worldwide.com/blog/

http://www.air-worldwide.com/Publications/AIR-Currents/

For More Information

Contact AIR for more information about software and consulting solutions to help manage pandemic risk:

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