



Cambridge Centre for Risk Studies
London Risk Briefings

Ebola and Pandemics

**Defining a Risk Test Scenario for managing
the business risks posed by infectious disease outbreaks**

Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

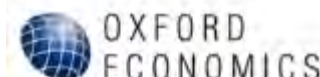
University of Cambridge Centre for Risk Studies



Research Application Partners



Collaborators



Centre for
Risk Studies

Catastrophe Modelling in Complex Systems

- The Centre for Risk Studies arises from shared interests by the participants in exploring areas of intersection between
 - Catastrophe modelling and extreme risk analytics
 - Complex systems and networks failures
- Advance the scientific understanding of how systems can be made more resilient to the threat of catastrophic failures

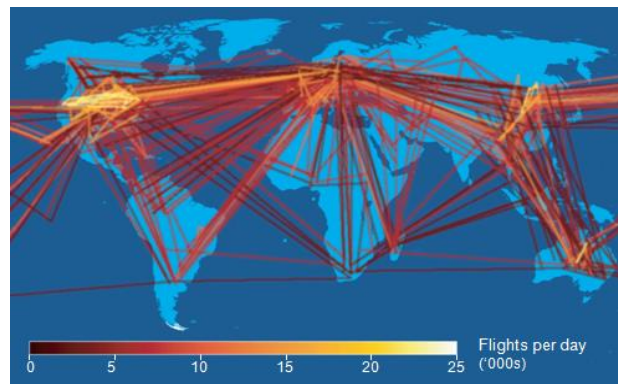
To answer questions such as:

'What would be the impact of a [War in China] on [Trade Networks] and how would this impact the [Global Economy]?

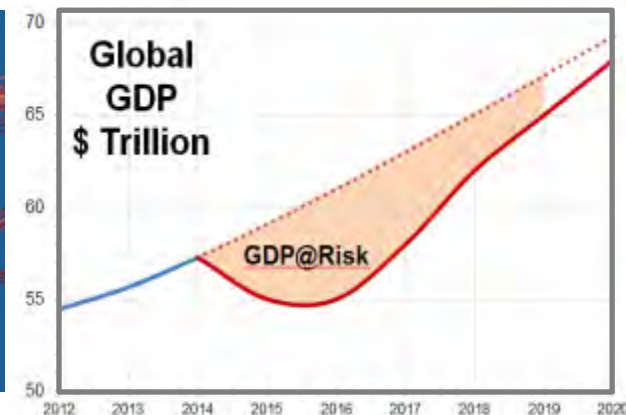
Regional Conflict



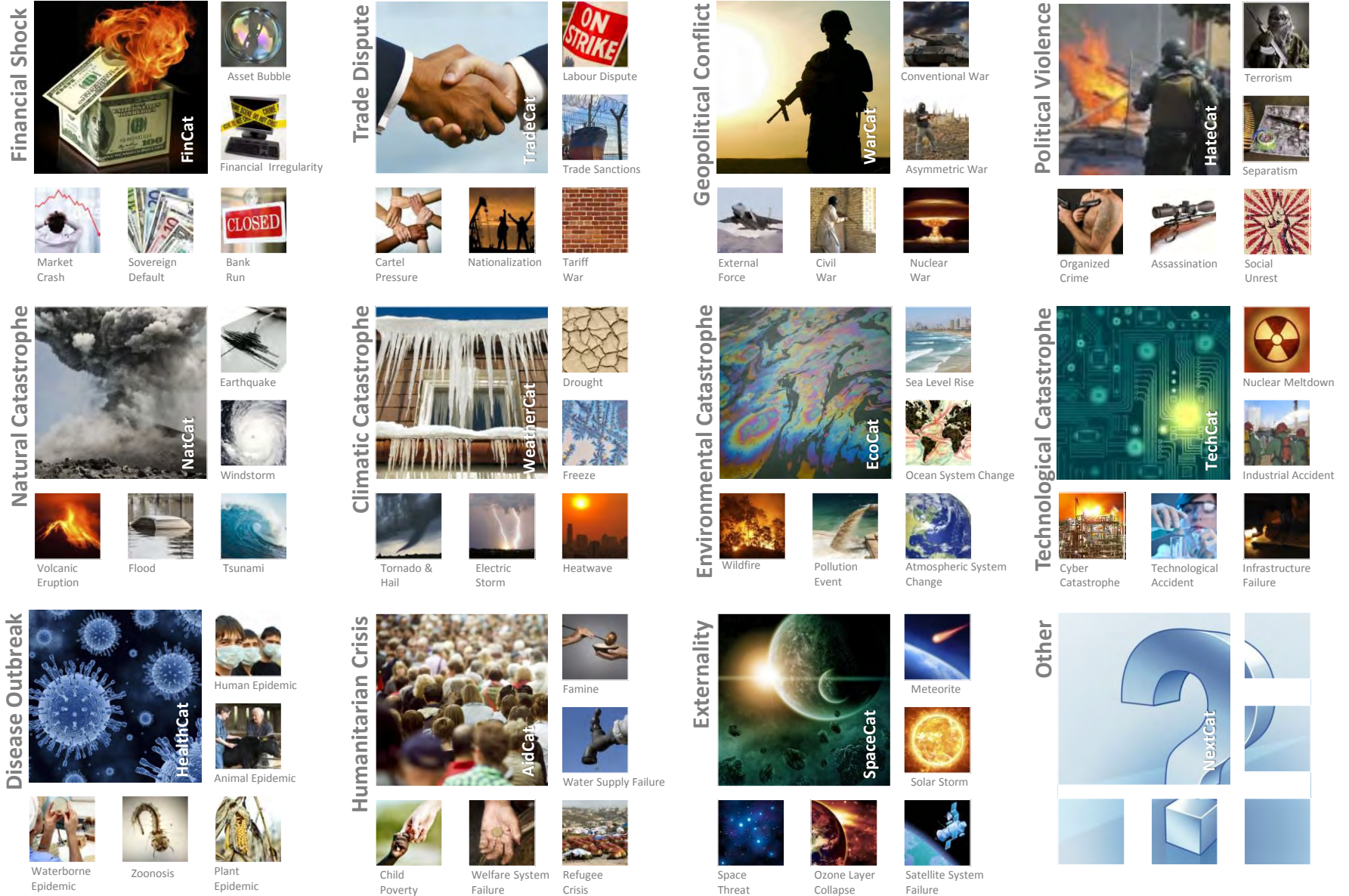
Air Travel Network



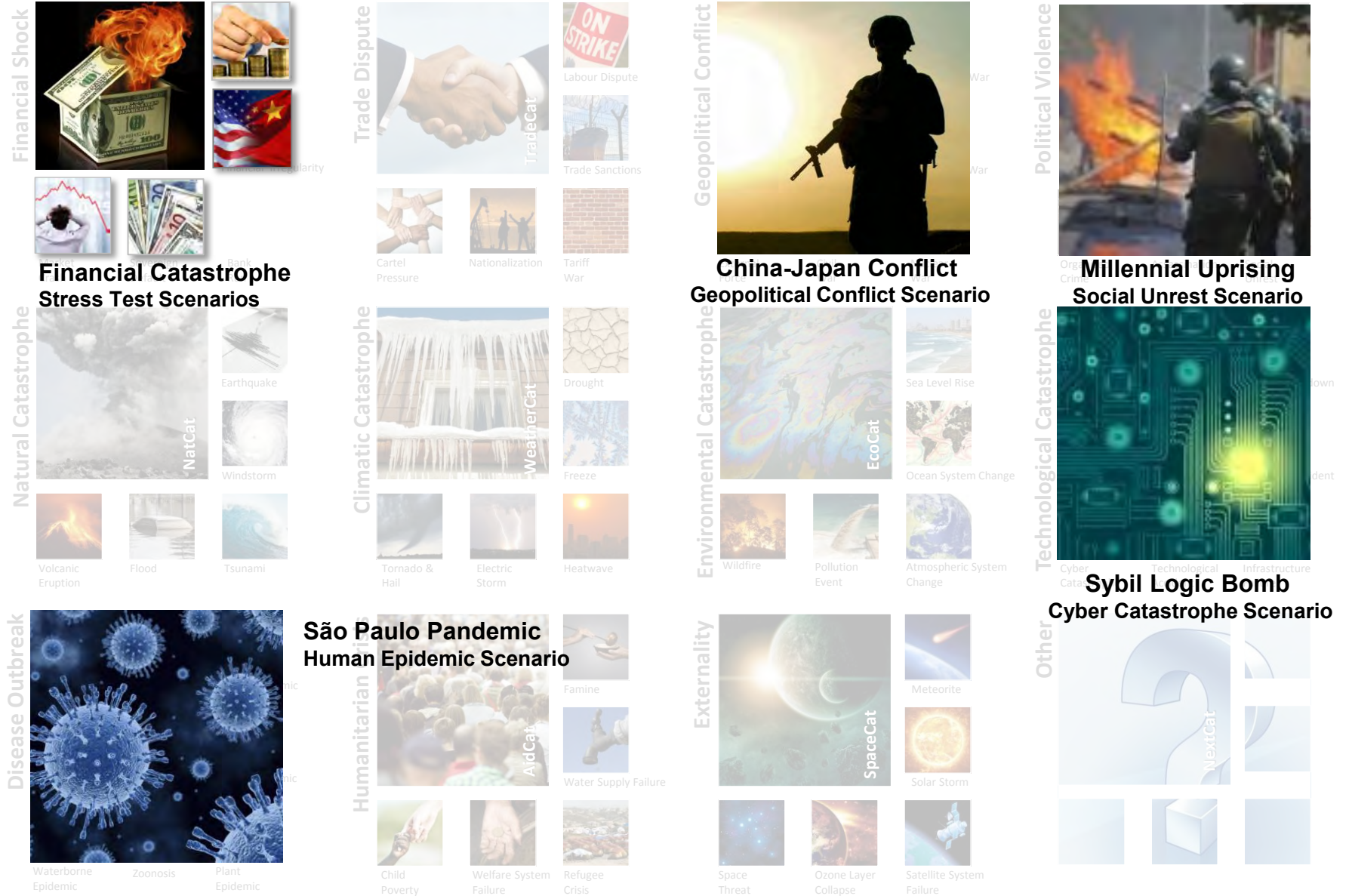
Global Economy



Cambridge Taxonomy of Threats



2013-14: Selected Scenarios from the Threat Universe



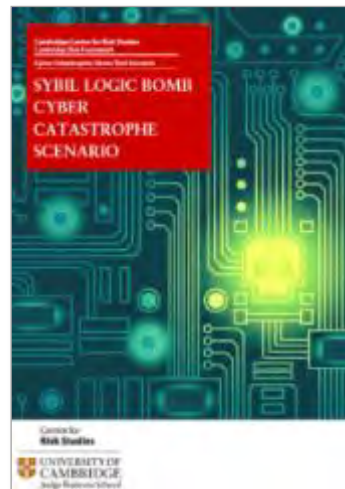
Published Reports on Stress Test Scenarios



Taxonomy of Threats



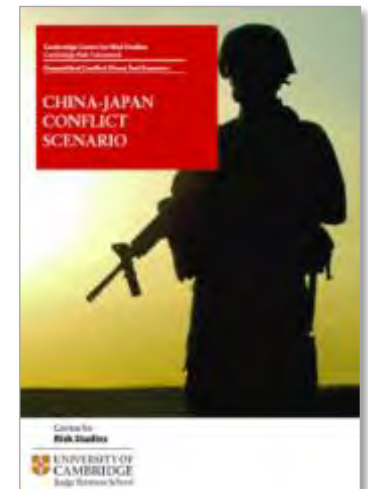
Social Unrest Stress Test Scenario



Cyber Catastrophe Stress Test Scenario



Pandemic Stress Test Scenario



Geopolitical Conflict Stress Test Scenario

Available for Download from Website:

CambridgeRiskFramework.com

Network Models and Interconnected Risks

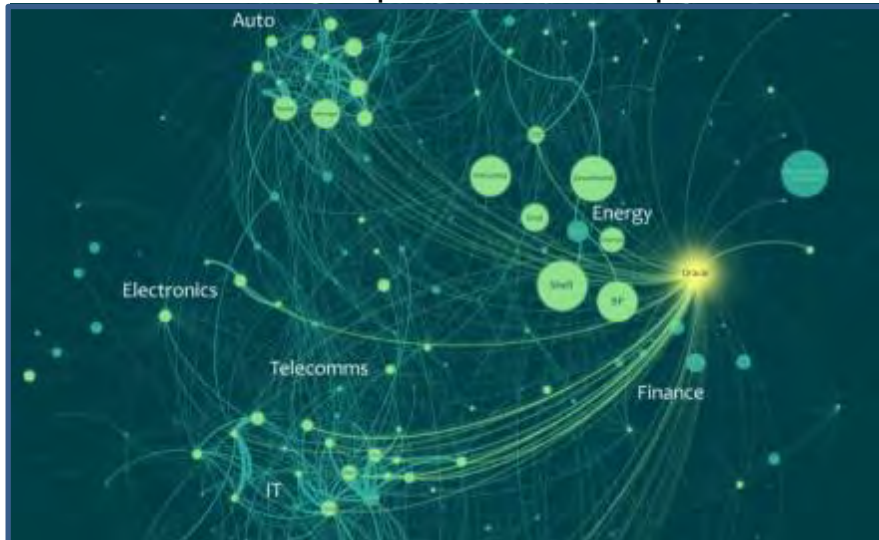
International Trading Networks



Travel Flows of People and Goods



Business Relationships between Companies



Communications and Social Media



Future London Risk Briefings



Tues 16 December – **Cyber Catastrophe Risk**



Thurs 22 January – **Social Unrest Risk**



Thurs 19 February – **Geopolitical Conflict Risk**

Registration at

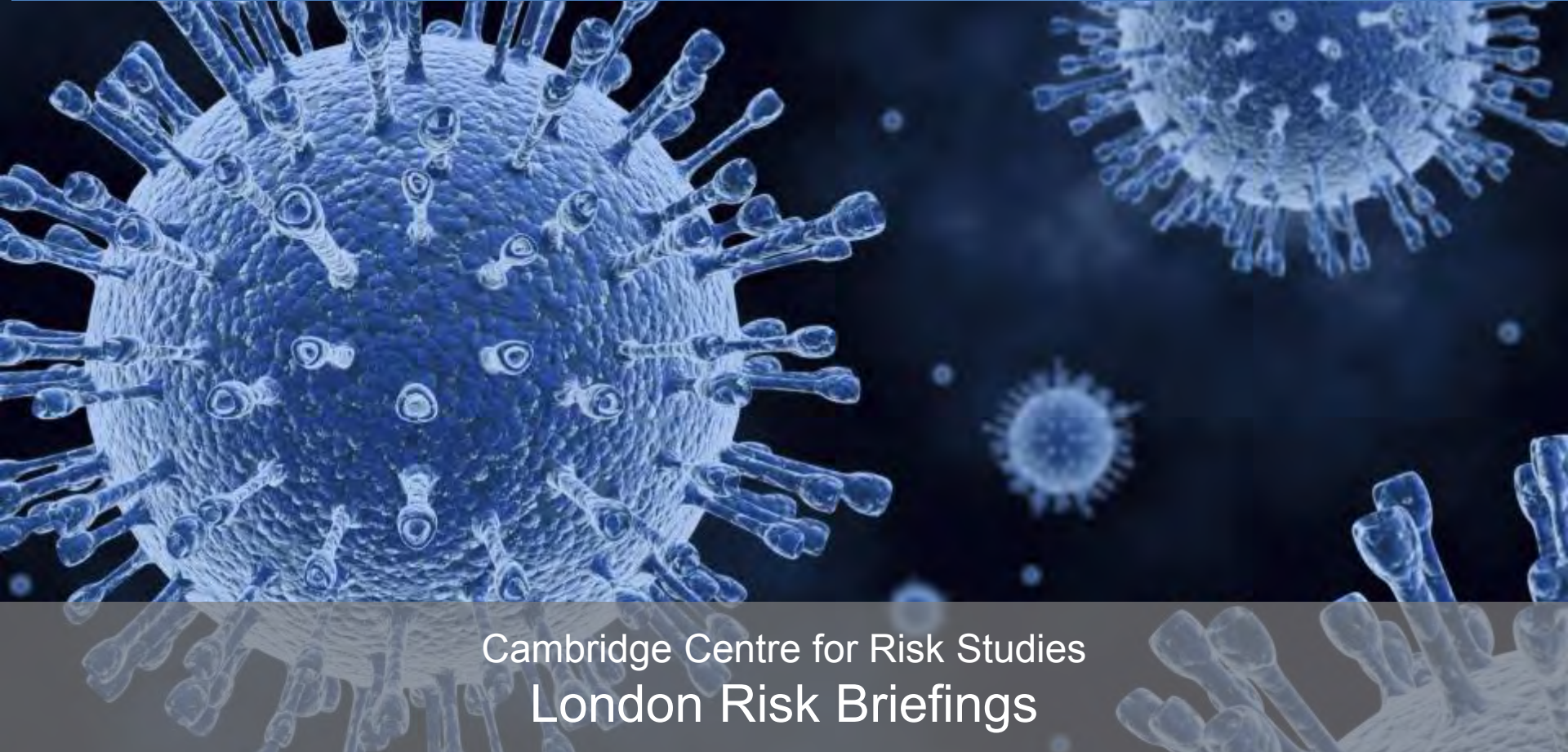
<http://www.risk.jbs.cam.ac.uk/>

Pre-Publication Bulletins on Current Events



- Centre for Risk Studies **Blog**
 - <http://www.blogs.jbs.cam.ac.uk/risk-studies-viewpoint/>
- New CRS insights broadcast on Twitter
 - Follow us **@Risk_Cambridge**
- LinkedIn Community
 - Join LinkedIn Group **Cambridge Centre for Risk Studies**
- CRS Research Platform
 - New publications and Threat Observatory
 - <http://cambridgeriskframework.com/>
- CRS Website
 - <http://www.risk.jbs.cam.ac.uk/>





Cambridge Centre for Risk Studies
London Risk Briefings

Ebola and Pandemics

Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

Dr. Andrew Coburn
CRS Team Lead, Pandemic Risk

Ebola Outbreak 2014

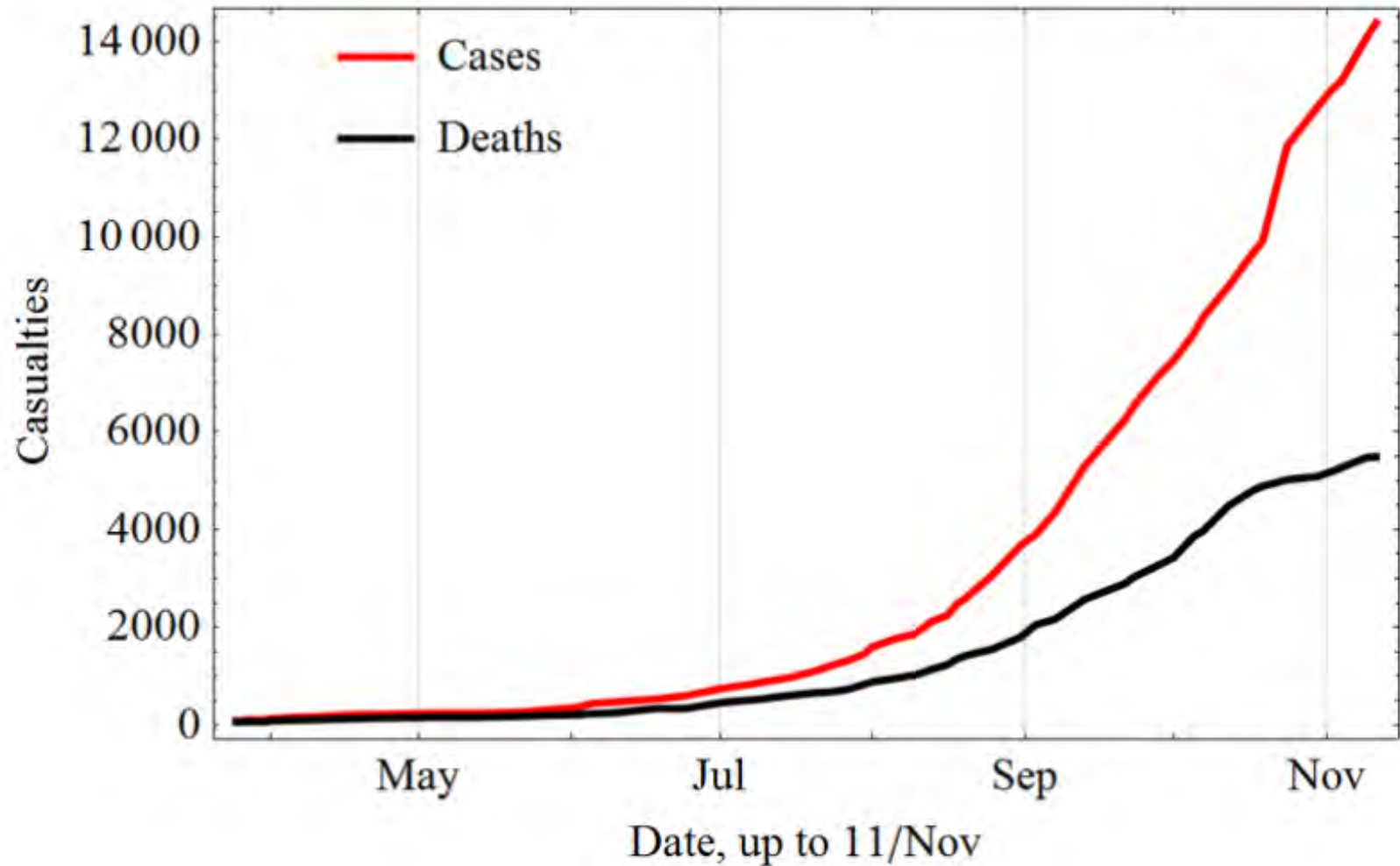


Ebola Outbreak 2014

At 20 November 2014:

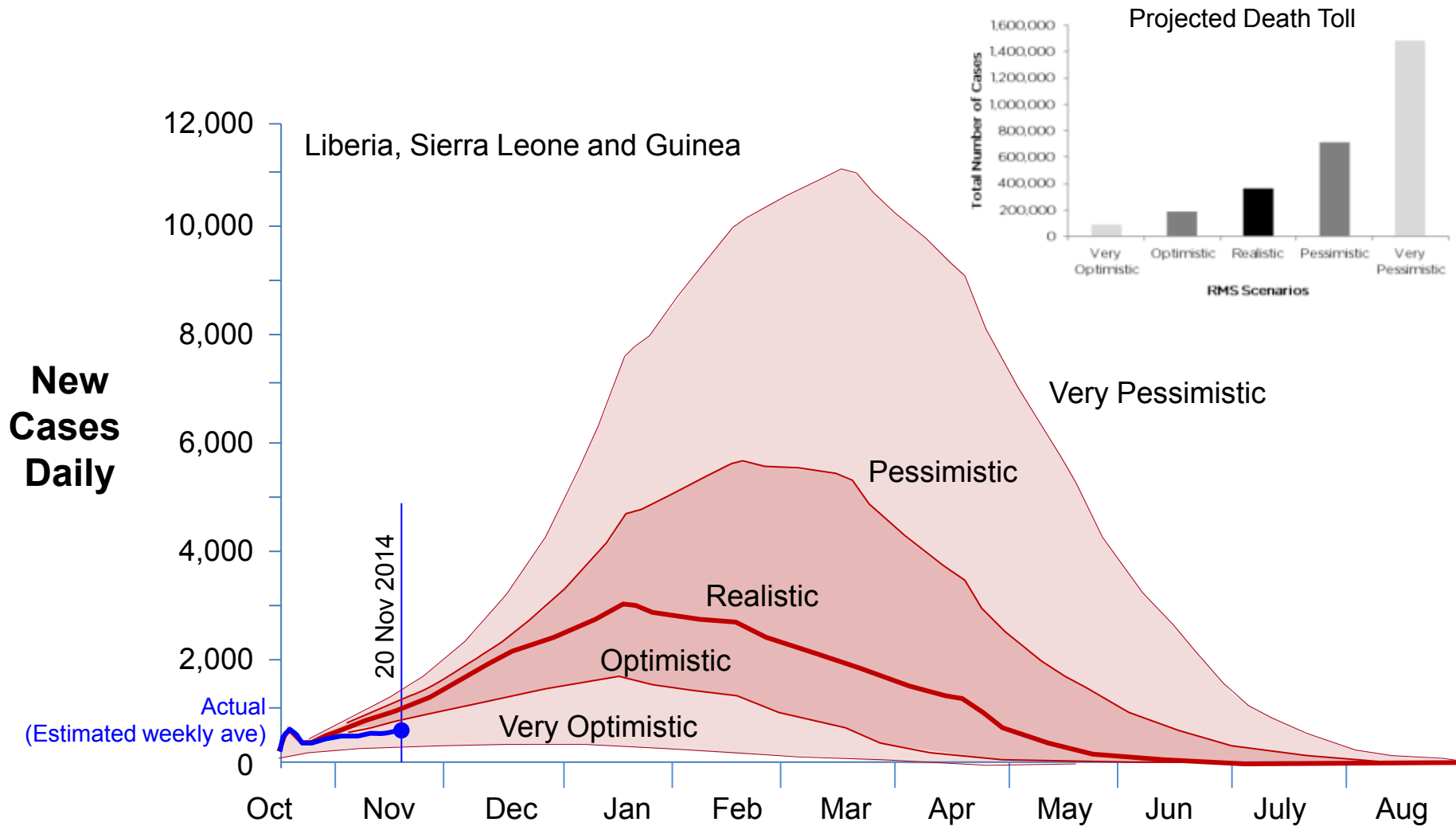
- **14,618** confirmed cases of ebola
- Estimated total infected population: **28,000 - 44,000**
- Total deaths: **5,537**
- Cases in US and Europe: **6**
- Deaths in US and Europe: **2**
- Active Outbreak: **Liberia, Sierra Leone, Guinea**
- Liberia weekly new caseloads stabilized / declining
- Now declared disease free: **Nigeria, Senegal**
- New active outbreak in **Mali** 23 October
- Freetown, capital of Sierra Leone, now infected
- Currently **100 - 300** new cases a day in West Africa

Current Status



Source: Leopoldo Martin R

How Will the Epidemic Play Out?



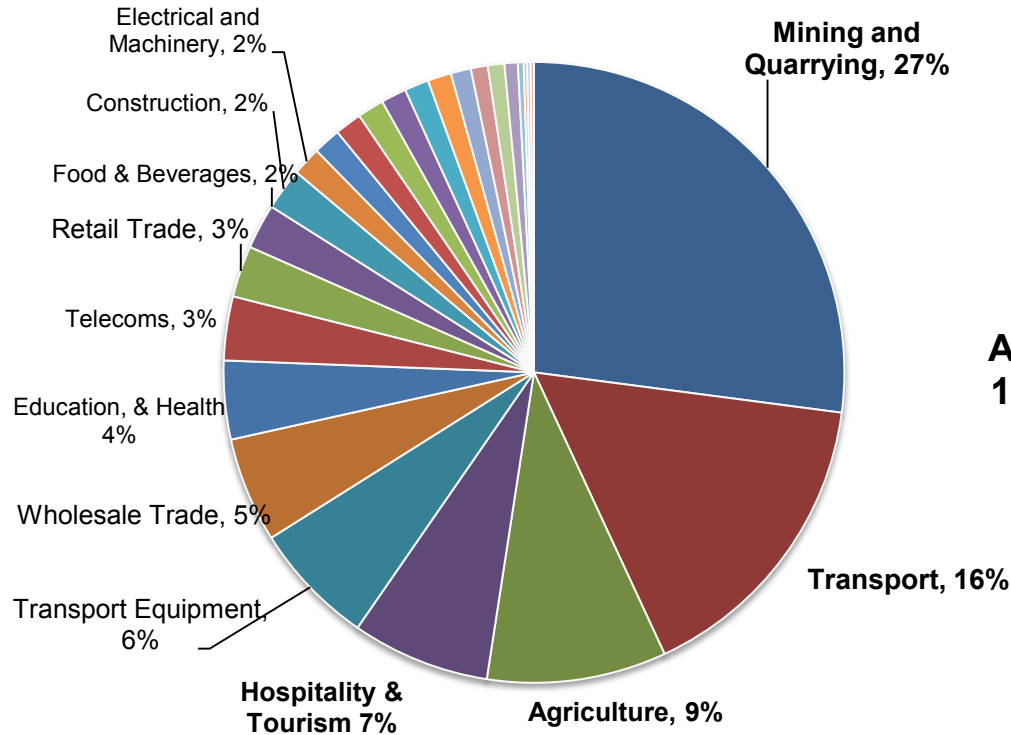
Source: RMS Ebola Event Report #2, 22 October 2014

West Africa Ebola outbreak projection using US CDC Ebola Model

Economic Impact: West Africa

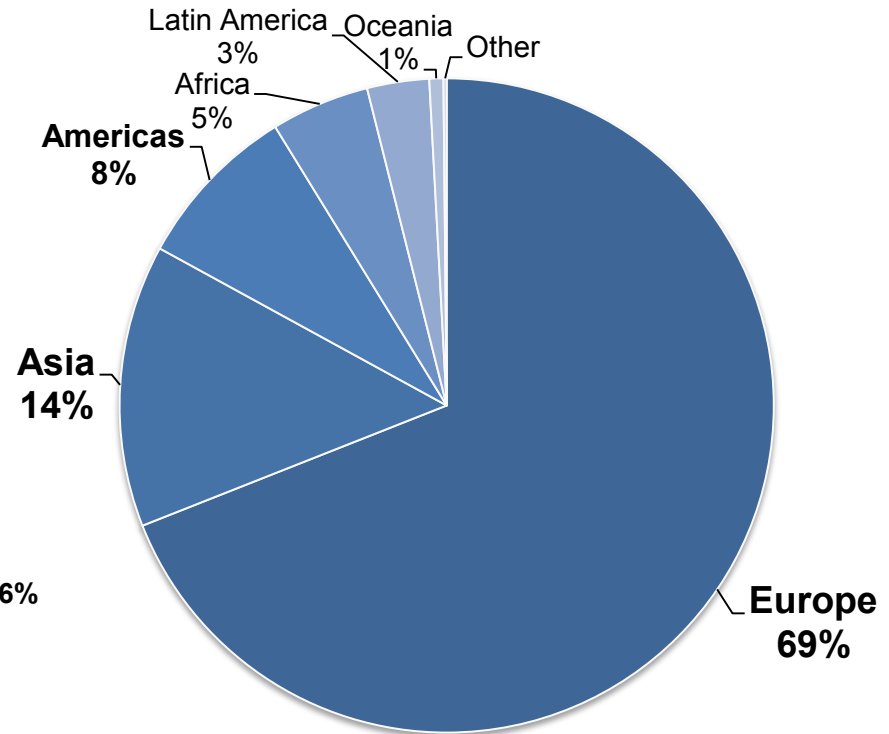
Liberia, Sierra Leone and Guinea,

Key Economic Sectors



Exports by Sector

Key Trading Markets



Export Destinations by \$ Value

World Bank estimates Ebola outbreak “could cost West Africa’s economy \$32.6 Bn”

8 Oct 2014

The Fear Multiplier

- Ebola kills half of the people who catch it
 - It is highly virulent and symptoms are horrific
- People's fear of catching ebola changes their behaviour
 - Some behaviour is out of proportion to the threat
- The fear of disease can have more economic impact than any direct costs of the disease itself
- Virulent diseases in the past have caused significant economic damage from the fear they engender
- Outbreaks of SARS, Polio, Asian Flu, and other diseases have had significant impacts on localized economies

The Fear Multiplier At Work



Following the death from ebola in Dallas, Texas, of Thomas Duncan, a Liberian patient, on 8 October:

- Dallas parents kept their children from going to school,
- Diners at restaurants down 5% from same period a year earlier
- Bars and clubs saw custom drop 11%
- Hotel occupancy down 7%, as people cancelled business trips to the city

Not all businesses suffered though:

- Army-Navy stores in East Texas had boom in people buying survivalist equipment e.g. water purification tablets, gas masks, and emergency fuel

SARS 2003 Impact on Retail & Tourism

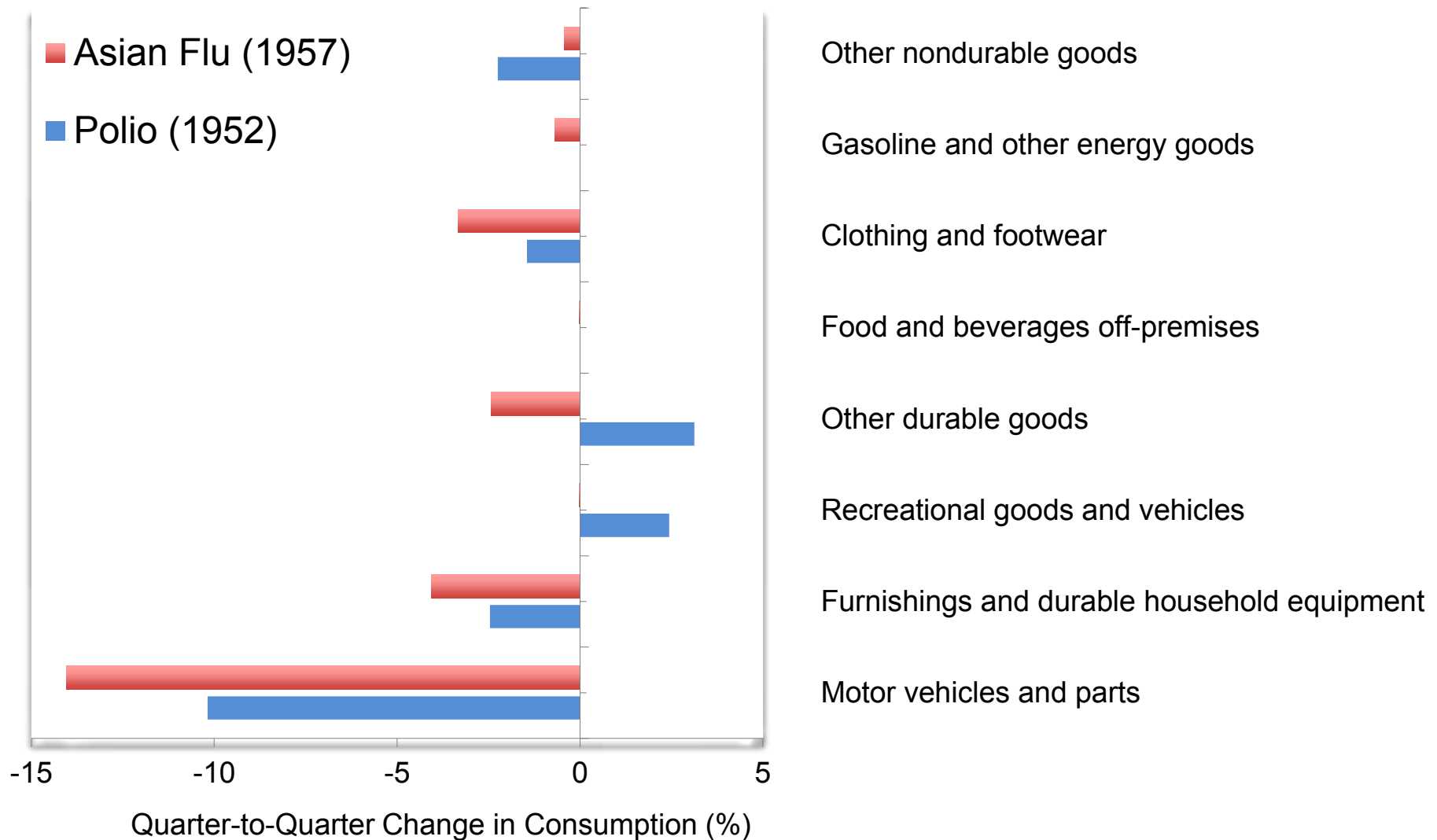
Retail in China



Tourism & Trade in Singapore



Evaporation of the Feelgood Economy



How Might the Current Ebola Epidemic Affect Us?

- Most projections now expect ebola to become endemic in West Africa
 - Eradication is becoming unlikely
- Over 200,000 people a month normally fly from the affected region to other parts of the world
 - Most of them travel to Europe as a hub to the rest of the world
 - Half of transferring travellers go to United States
- Individual cases will appear in Europe & United States
- Estimates of the number of US cases we are likely to see:
 - RMS: “US could see **15 to 130** new ebola cases” (Press Release 3 Nov 2014)
 - National School of Tropical Medicine, Texas: “between **5 and 100**”
 - David Relman, Prof. of Infectious Diseases, Stanford University: “it is quite possible that **every major (US) city will see at least a handful of cases**”

Cambridge 'Contingency' Scenario: Ebola in US and Europe

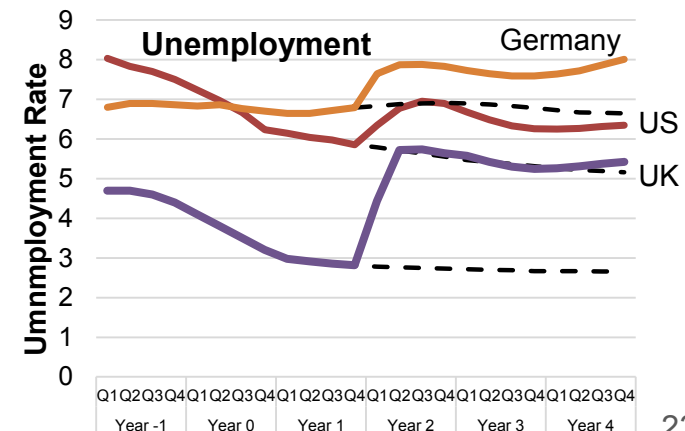
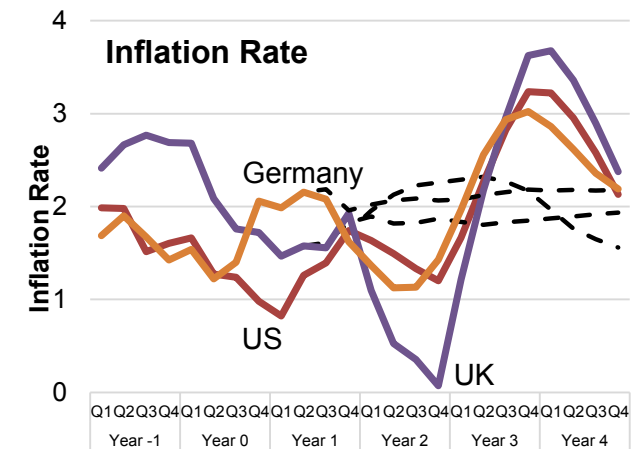
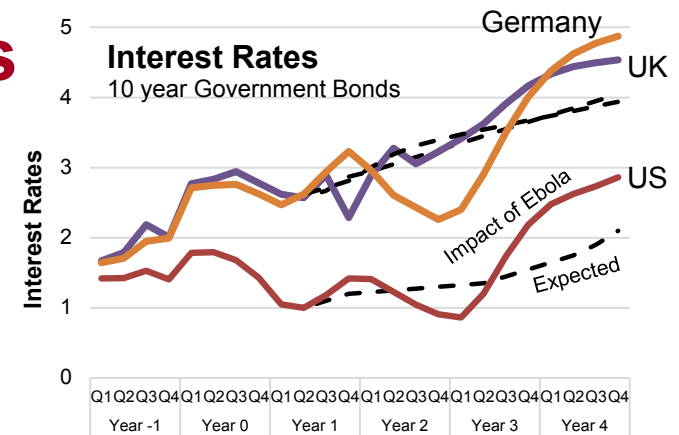
- It would be prudent for businesses to plan for contingencies around economic disruption from ebola cases in US and Europe
- This is **not** a prediction or 'expected' outcome
 - It is an analysis of the consequences of the upper bounds of published epidemiological projections
 - It is intended as a 'What If...' exploration for business preparedness planning
- The Cambridge 'Contingency' Scenario for ebola consists of:
 - Several hundreds of individual cases and clusters of cases in US and Europe
 - These occur sporadically between now and mid-year 2015
 - Most major cities have a minor outbreak or a scare
 - Each localized outbreak is quickly contained and dealt with. There is minimal contagion within US and European urban populations
 - Each outbreak causes localized panic and avoidance of public gatherings, reduction in discretionary travel, reduction in economic activity and consumption

Macroeconomic Analysis of Ebola 'Contingency' Scenario

- Ebola cases disrupt economic activities in:
 - United States – 20 major cities (accounting for a third of US national GDP)
 - UK, Germany, France, Spain, Italy – 15 major cities (accounting for a quarter of their combined GDP)
- Consumption decreases for 0.5% for 2Q
 - Similar to Polio outbreak of 1952
- Labour and participation rate drops by 5% for 2Q
 - Similar to Polio outbreak of 1952
- Tourism earnings drop 50% in Q2 and recover to 90% by Q4
 - Similar to impact of SARS 2003 on infected cities
- These economic consequences are felt by each country's trading partners and cascade through the world economy

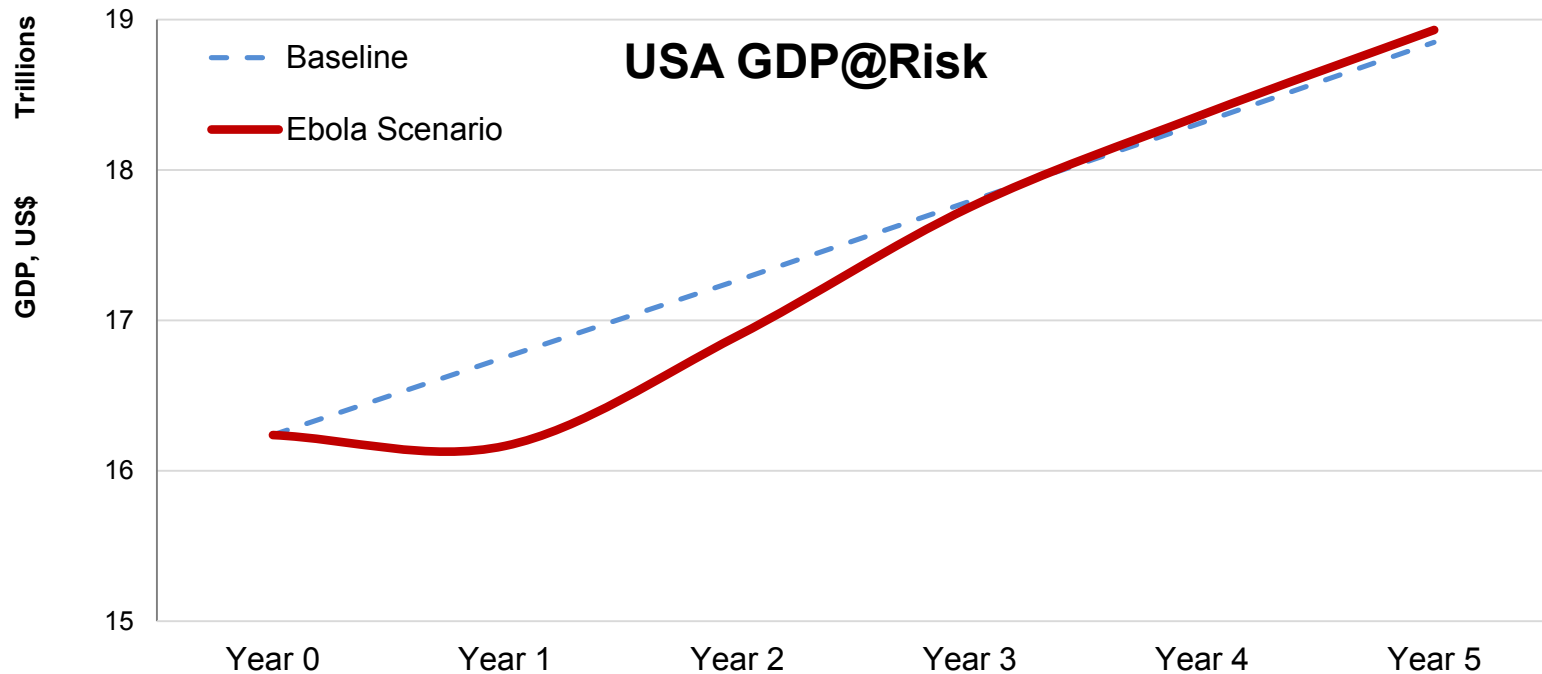
Economic Impact Consequences

- Inflation – suppression of consumer spending due to ebola triggers an initial *deflationary* phase in economy for two years, followed by an inflation boom, end of year 3
- Interest rates expected to rise as a result, adding a % point to rates in many countries
- Unemployment rates increased generally – ebola outbreak could double unemployment in UK



Ebola 'Contingency' Scenario

Would Cost the Global Economy Over a Trillion Dollars



	2015 GDP@Risk		Next 5 Years GDP@Risk	
	Total US\$	% of Total	Total US\$	% of Total
United States GDP Loss	0.30 Trillion	1.8%	0.44 Trillion	0.5%
Europe (DE, FR, UK, IT, ES)	0.24 Trillion	1.9%	0.60 Trillion	1.0%
Global GDP Loss	0.77 Trillion	1.1%	1.33 Trillion	0.4%

How Much Would it Have Cost to Have Contained it?

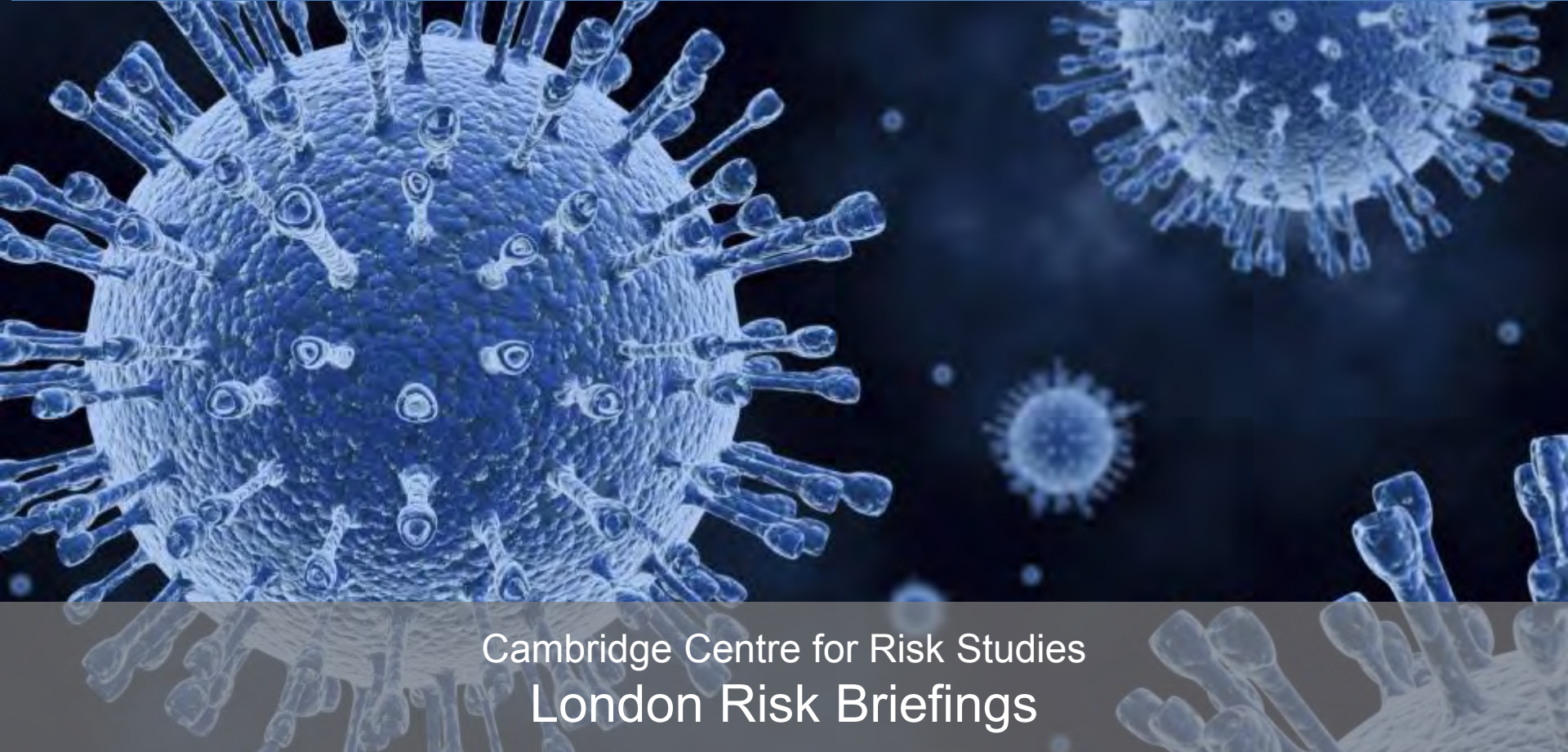
World Health Organization Cost Estimates to Contain Ebola Outbreak
Appeal to National Governments for Assistance

Date	Cost Estimate Appeal
April 2014	\$4.8 million
July 2014	\$100 million
August 2014	\$500 million
October 2014	\$1 Billion

- By 15 October, only \$257m had been received, with another \$162m pledged
 - Only a third of the resources needed
- The opportunity to eradicate the disease has been lost through inability of international community to fund the early eradication of a threat in a external location

What Should Your Ebola Contingency Plans Be?

- Information and communication to employees and counterparties
 - Be proactive with reassurance: put the risk into perspective
- Expect disruption to processes, suppliers, and markets
 - Have business continuity plans ready
 - Expect absenteeism – have overlapping coverage of essential tasks
- Prioritize protection of workforce
 - Ensure work practices are safe for employees
 - Ebola is spread by close physical contact, not airborne infection: Ensure protection measures reinforce education not myth
- Implement higher tolerance of credit risk from counterparties
- Be ready to switch to conservative investment strategies for asset portfolio resilience
- Give generously to ebola containment charities



Cambridge Centre for Risk Studies
London Risk Briefings

São Paulo Pandemic Virus Scenario

Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

Ebola is Just the Most Recent 'Emergent Disease'

Historical Infectious Disease Pandemics

Date	Name	Cause
2012	Middle East Respiratory Syndrome Coronavirus	MERS-CoV
2002	Severe Acute Respiratory Syndrome	SARS
1981-today	Acquired Immunodeficiency Syndrome	HIV/AIDS
1918-1922	Russian Typhus Epidemic	Typhus
1855-1959	Third Pandemic	Bubonic plague
1962-1966	El Tor Cholera Pandemic	Cholera
1899-1923	Sixth Cholera Pandemic	Cholera
1881-1896	Fifth Cholera Pandemic	Cholera
1863-1875	Fourth Cholera Pandemic	Cholera
1846-1863	Third Cholera Pandemic	Cholera
1826-1837	Second Cholera Pandemic	Cholera
1816-1824	Asiatic Cholera Pandemic	Cholera
1793;	Yellow fever, U.S.	Yellow fever
1690-1878		
1775-1782	North American smallpox	Smallpox
1679	Great plague of Vienna	
1665-1666	Great plague of London	
1629-1631	Italian plague/ Great Plague of Milan	Bubonic plague
16th C	Spread of smallpox thru colonization	Smallpox
1500-1800	Epidemics throughout Europe	Multiple
1577-1579	Following Black Assize	
1489	Spanish Siege of Moorish Granada	Typhus
1347-1350	Black Death	Bubonic plague
639	Plague of Emmaus/Amwas	Bubonic plague?
541-750	Plague of Justinian	Bubonic plague
251-266	Plague of Cyprian	Smallpox or measles?
165-180	Antonine Plague	Smallpox or measles?
430 BC	Plague of Athens	Typhoid/Plague/ Measles?

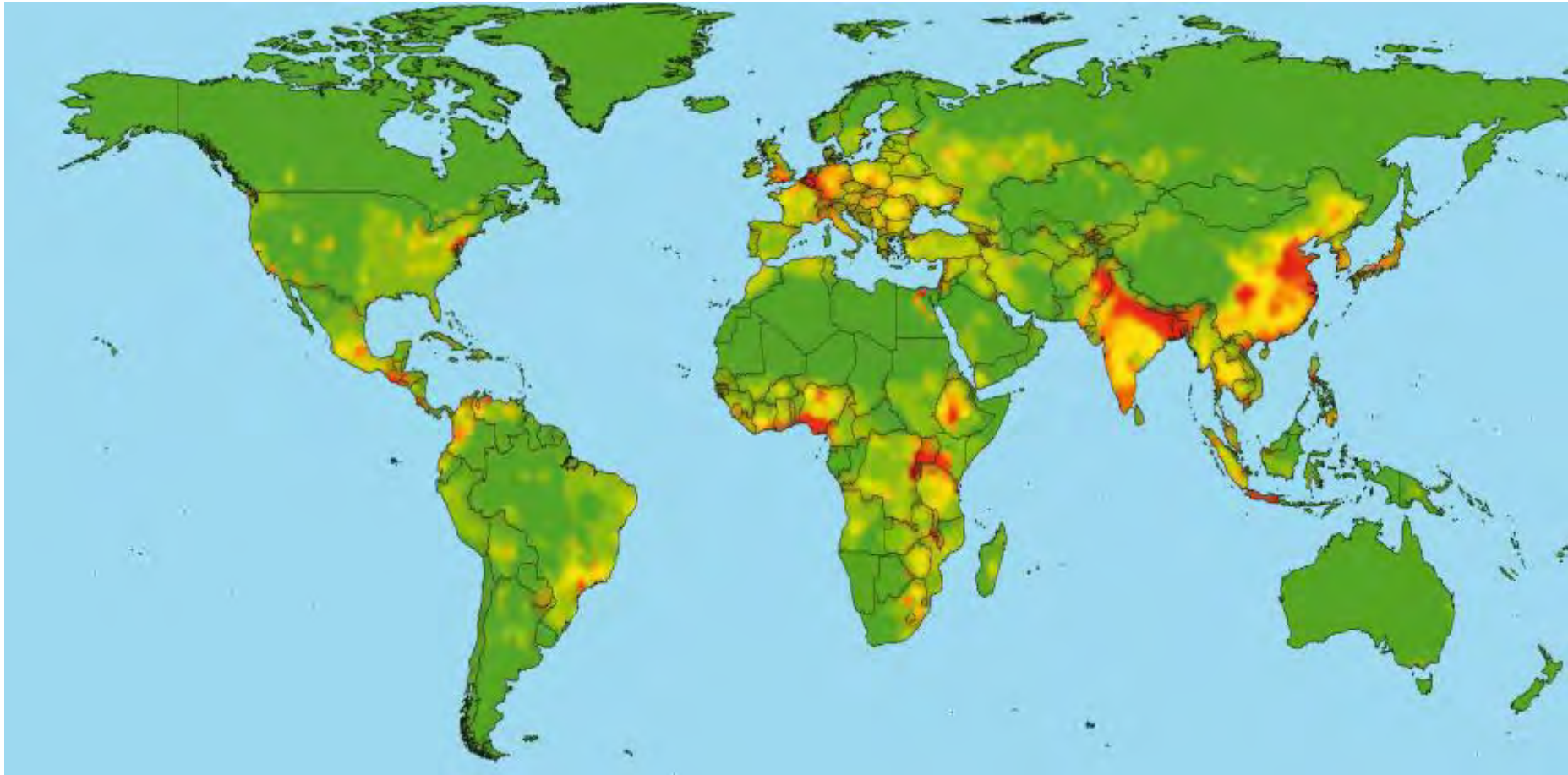
Historical Influenza Pandemics

Date	Notes	Influenza Strain
2009	Mexican Swine Flu	H1N1
1977-1978	Russian Flu 'benign' pandemic, possibly caused by a lab release	H1N1
1968	Hong Kong Flu	H3N2
1957-1958	Asian Flu Pandemic	H2N2
1918-1919	Spanish Flu 'The Great Influenza'	H1N1
1889-1893	Russian Flu	H3N8 or H2N2
1830-1848	Four influenza epidemics occurring almost continuously 1830 to 1848, possibly originating in China	
1788-1790	Initiated a pandemic era, of heightened global influenza activity for almost 20 years	
1780-1782	Began in Southeast Asia and spread to Russia and eastward into Europe	
1761-1762	Begun in Americas and spread to Europe and around the globe. First pandemic to be scientifically studied.	
1729-1730, 1732-1733	First detected in Russia	
1580	Swept over the entire globe, spreading east to west from Asia	
1557-1558	Asia origin. Highly fatal, and associated with severe complications	
1510	First recognizable pandemic. Invaded Europe from Africa.	

Where Will the Next Emergent Disease Come From?

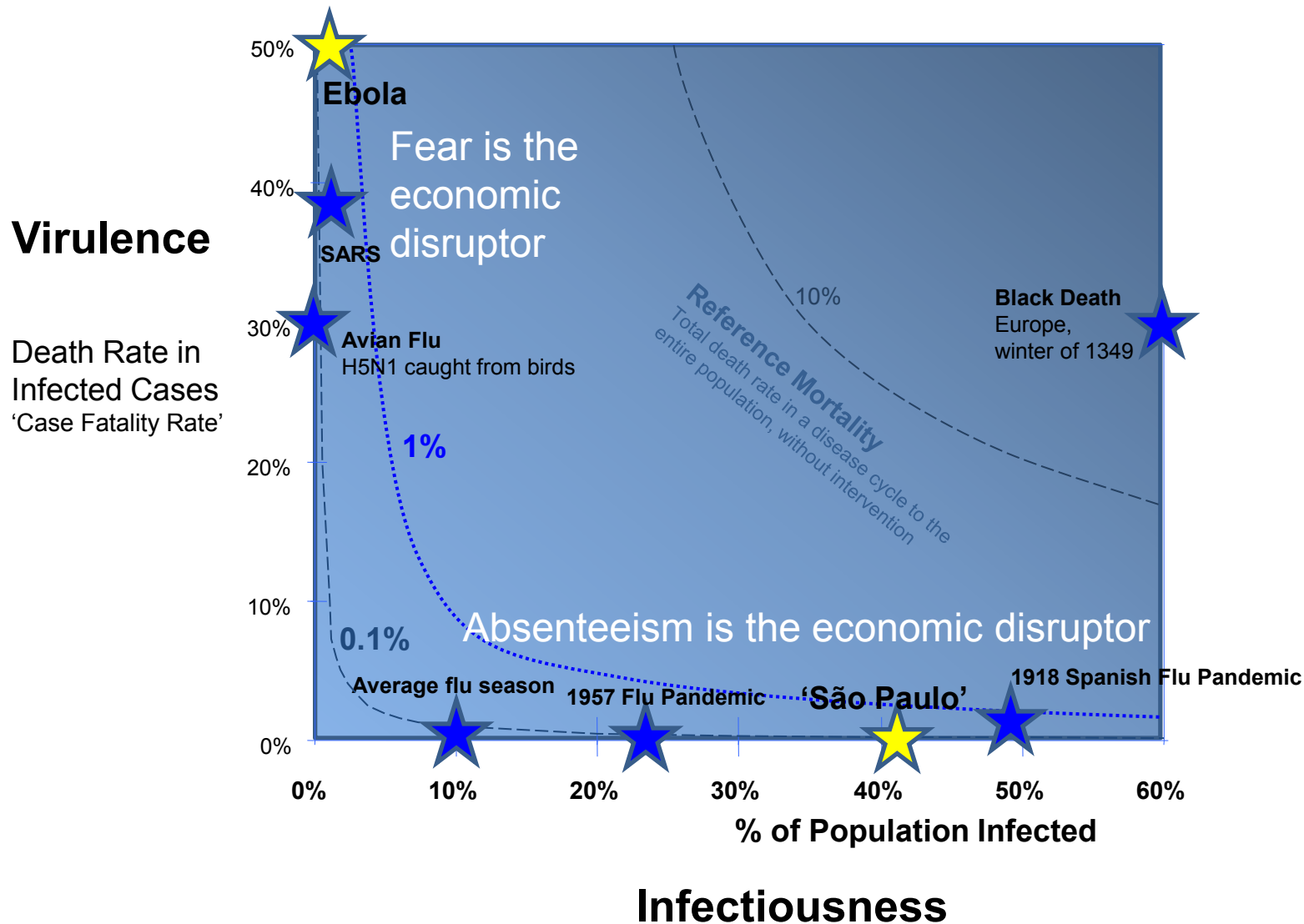
Emerging Infectious Disease Risk Map

Zoonotic Sources

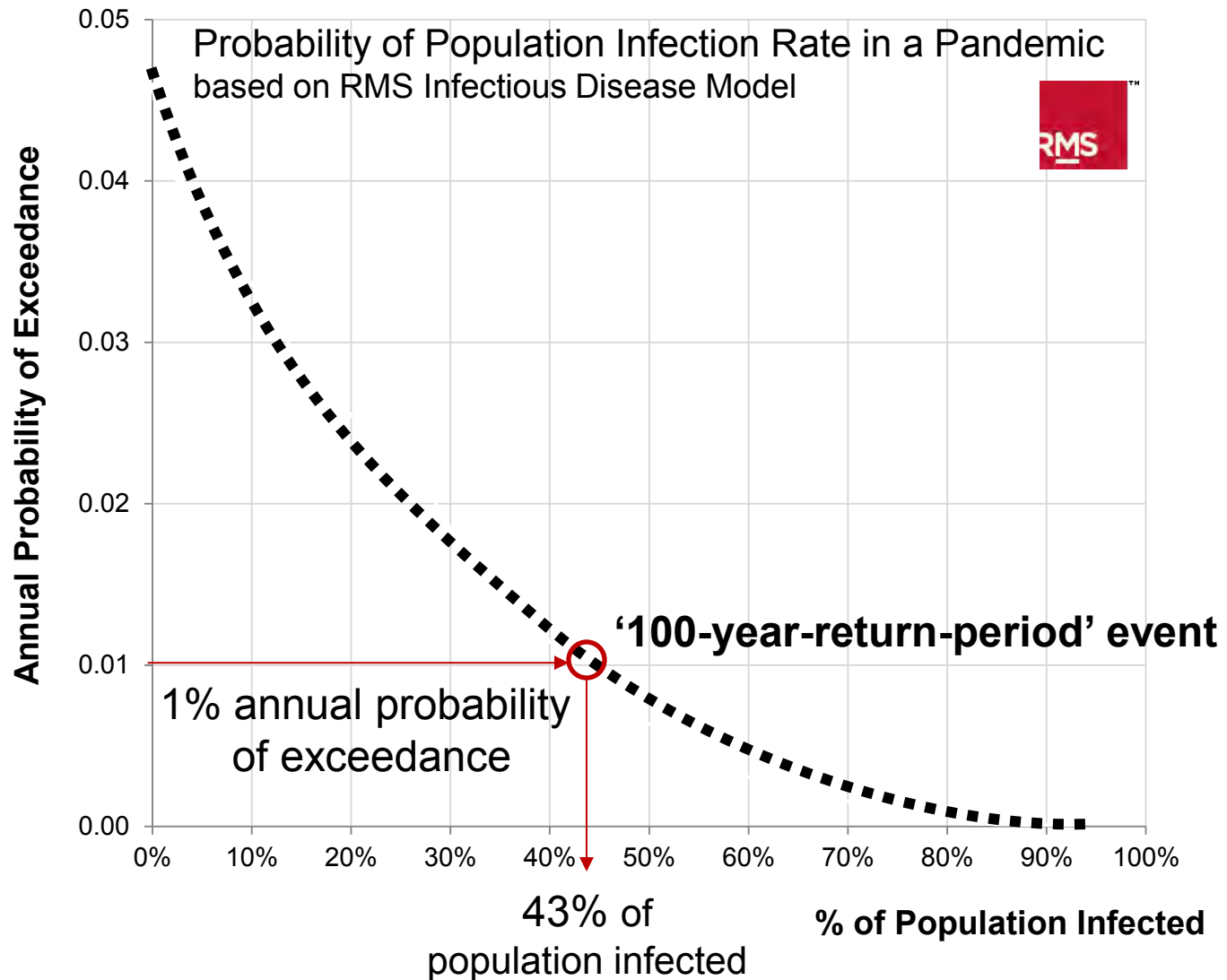


Source Data: Global distribution of the relative risk of an EID event, from 'Global trends in emerging infectious diseases' Jones et al., (2007); Study by Institute of Zoology, UK, Consortium for Conservation Medicine, New York.

Diseases: Infectiousness vs Virulence



Selecting the Scenario



An Outbreak of Mystery Illness in Brazil Poultry Farmers

CASSANDRA.com

[Sign up](#) [Log in](#)

[Hypothetical News](#)

[TV & Video](#)

[International](#)

[Business](#)

[Sport](#)

[Entertainment](#)

Virus warning for Brazil

Mystery virus spreads as government warn citizens to avoid Brazil

Wednesday, Nov 12

Sao Paulo (1048 GMT – 0648 BRT) -
The UK Foreign & Commonwealth
Office and US State Department have
issued a travel advisory warning for
Brazil following an outbreak of an
unidentified deadly virus.

Brazilian government officials have
condemned the moves, calling them a
"reckless, irresponsible and expensive
overreaction", but UK officials point to



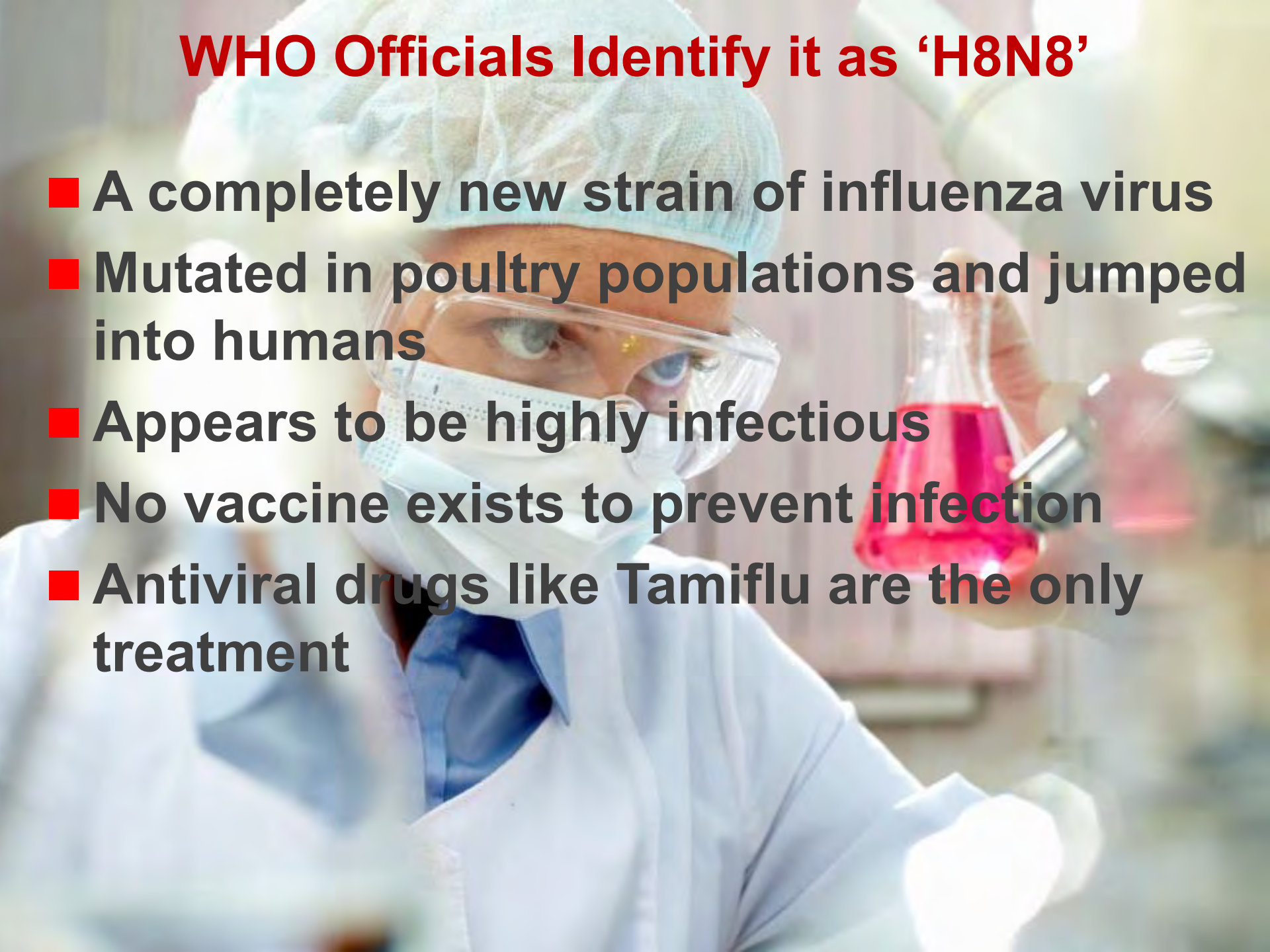
**WHO specialists arrive in Brazil to
investigate the mystery virus that
has caused over 100 deaths.**

The Mystery Virus Kills Many of its Initial Victims

- Over 100 deaths are reported in 10 days
- Many deaths are in teenagers and young adults
- Case Fatality Rate estimates are wildly variable (nobody knows how many people are infected)
- Some reports suggest that 10% of people who catch the virus die
- Contact tracing of infected contacts puts 8,000 people into quarantine in São Paulo

WHO Officials Identify it as 'H8N8'

- A completely new strain of influenza virus
- Mutated in poultry populations and jumped into humans
- Appears to be highly infectious
- No vaccine exists to prevent infection
- Antiviral drugs like Tamiflu are the only treatment



Stockmarkets React

- Fear of a potential pandemic hits trading
- Latin American currencies are badly hit
- Flight to quality – emerging markets punished
- Airline stocks decline
- Healthcare providers stocks go up

Sick Travellers Spread the Infection Worldwide

CASSANDRA.com

Sign up Log in

Hypothetical News

TV & Video

International

Business

Sport

Entertainment

Sao Paulo Virus sweeps across globe

Cases of the deadly new virus reported in US and Europe

Thursday, Nov 27

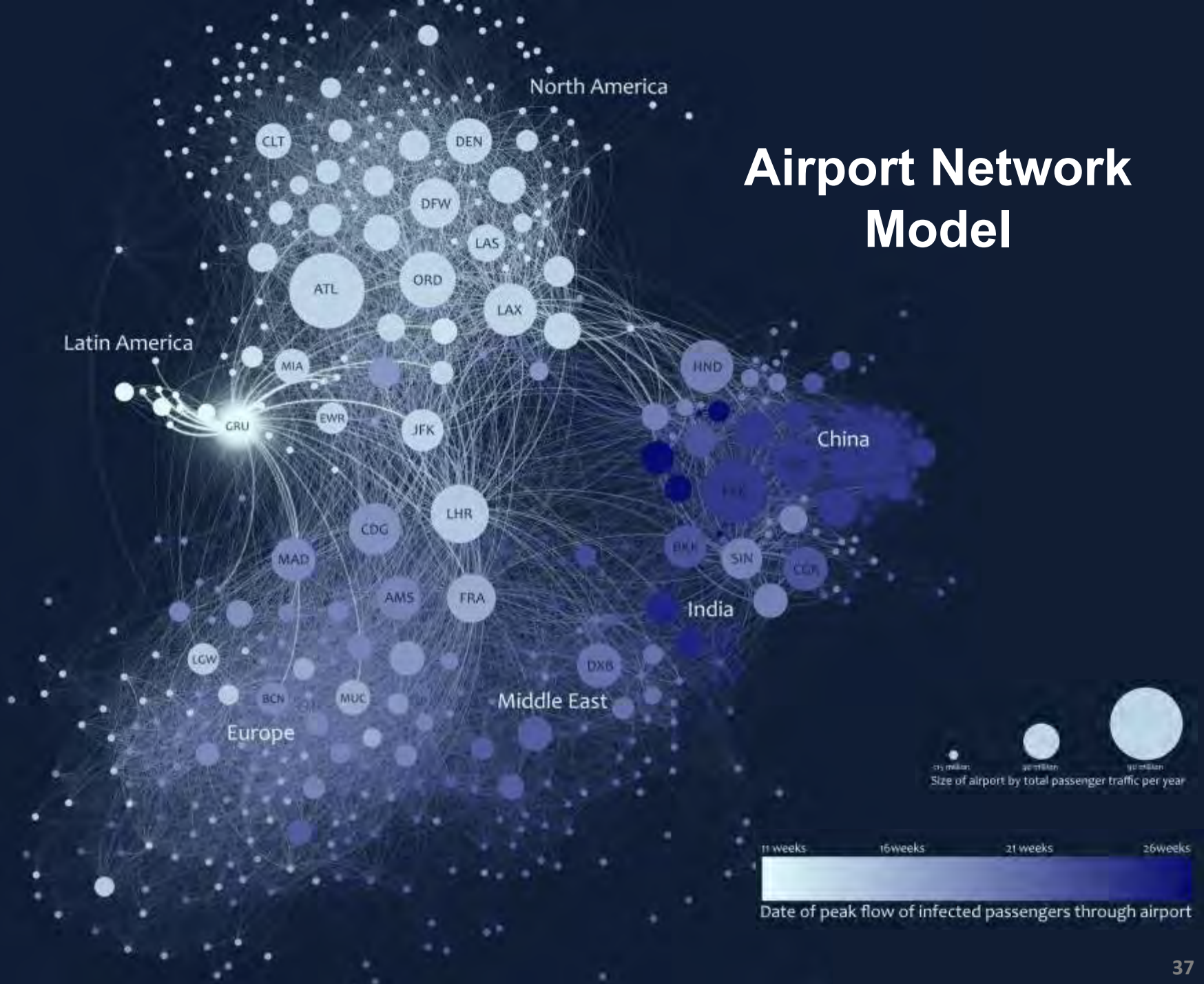
Atlanta, US (1454 GMT – 0954 EST) – Fear is gripping the world as hospitals struggle to cope with increasing numbers of sick people. Researchers at the CDC are “making progress” in identifying the genetic characteristics of the Sao Paulo Flu Virus.

Much is still unknown about Sao Paulo Virus, although health officials have stated it is one of the most infectious

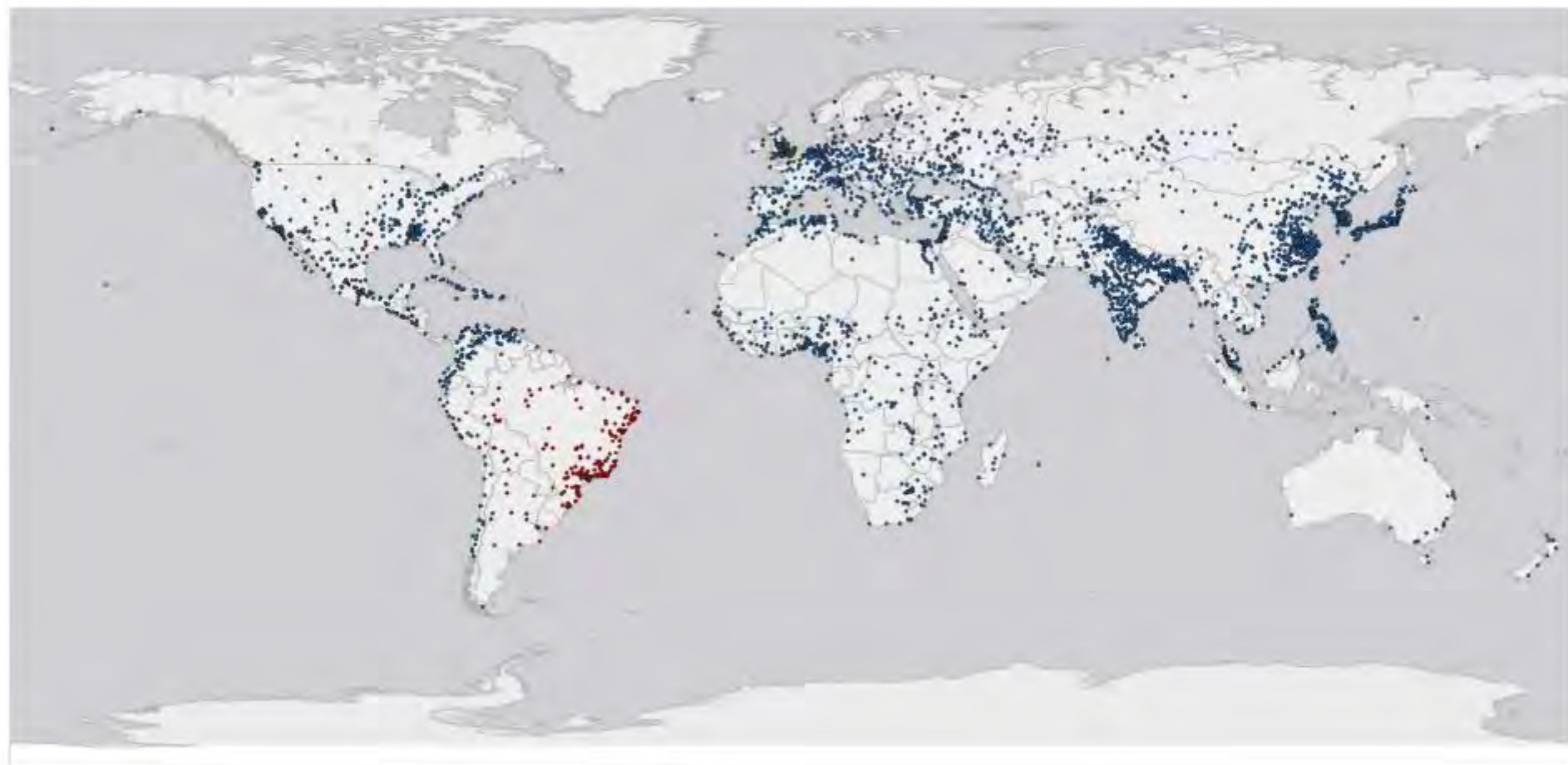


Business and tourism is trying to continue as usual but economists say productivity is down by a significant amount.

Airport Network Model



São Paulo Pandemic Spread - Start



Week

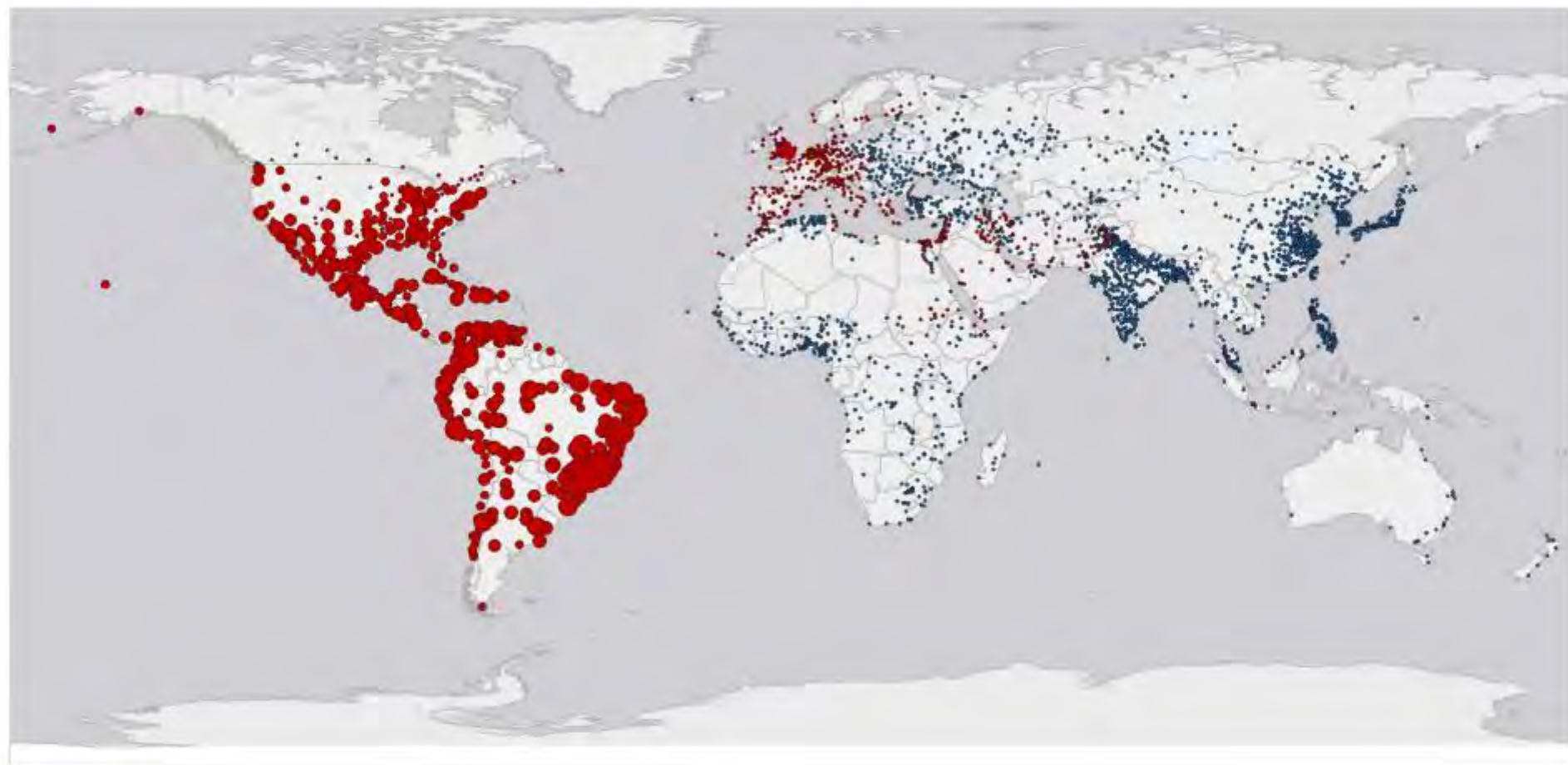
3

Number of People Infected in City



Copyright: ©2013 Esri. DeLorme. NAVTE

São Paulo Pandemic Spread - Middle



Week

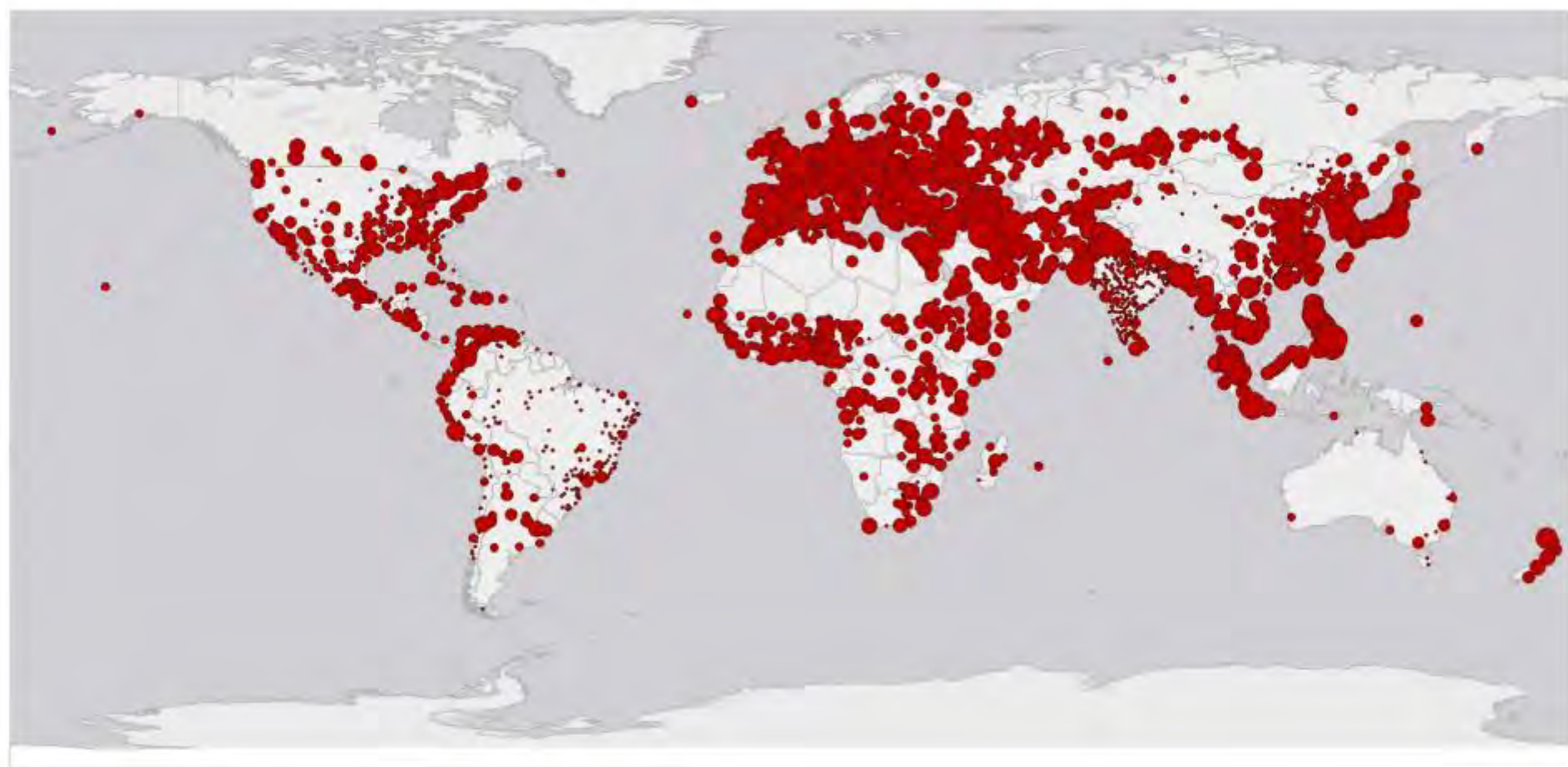
10

Number of People Infected in City



Copyright: ©2013 Esri. DeLorme. NAVTE

São Paulo Pandemic Spread - Advanced



Week

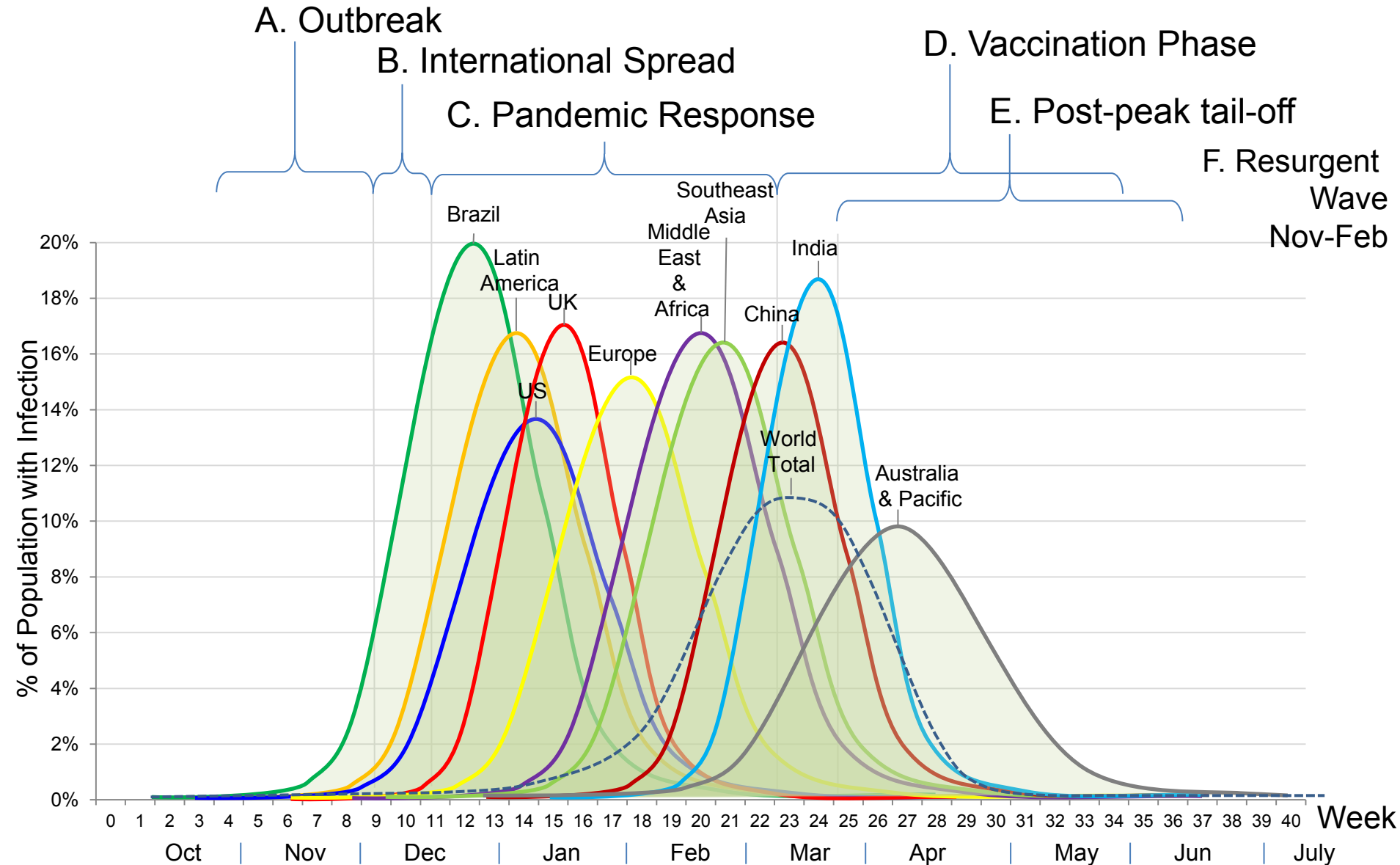
18

Number of People Infected in City



Copyright: ©2013 Esri, DeLorme, NAVTE

Pandemic Scenario Timeline



Schools Are Closed as Part of Pandemic Response Plans

CASSANDRA.com

Sign up Log in

Hypothetical News

TV & Video

International

Business

Sport

Entertainment

**BREAKING
NEWS**

WHO declares global pandemic

Some countries declare martial law to contain the outbreak

Tuesday, Dec 23

Geneva (1723 GMT – 1123 CDT) -
The WHO finally declared a global pandemic, requiring governments around the world to shut down public areas and prioritise medical attention

Critics argue that this announcement is coming weeks later than it should have done causing tens of thousands of unnecessary deaths and millions of extra infections.



Mexican army drafted in to contain virus outbreak in Mexico City

Thus far, casualties have been much lower in the west, where anti-viral

Healthcare Resources Are Overwhelmed



UK

Normal GP consultations per week:

4,672,200

Pandemic demand in peak week:

3,778,900

Total Hospital Beds in UK:

136,486

Normal Occupancy Level:

86%

Pandemic Hospital Bed Demand:

312,000

Total Intensive Care beds in UK:

3,770

Normal Occupancy Level:

85%

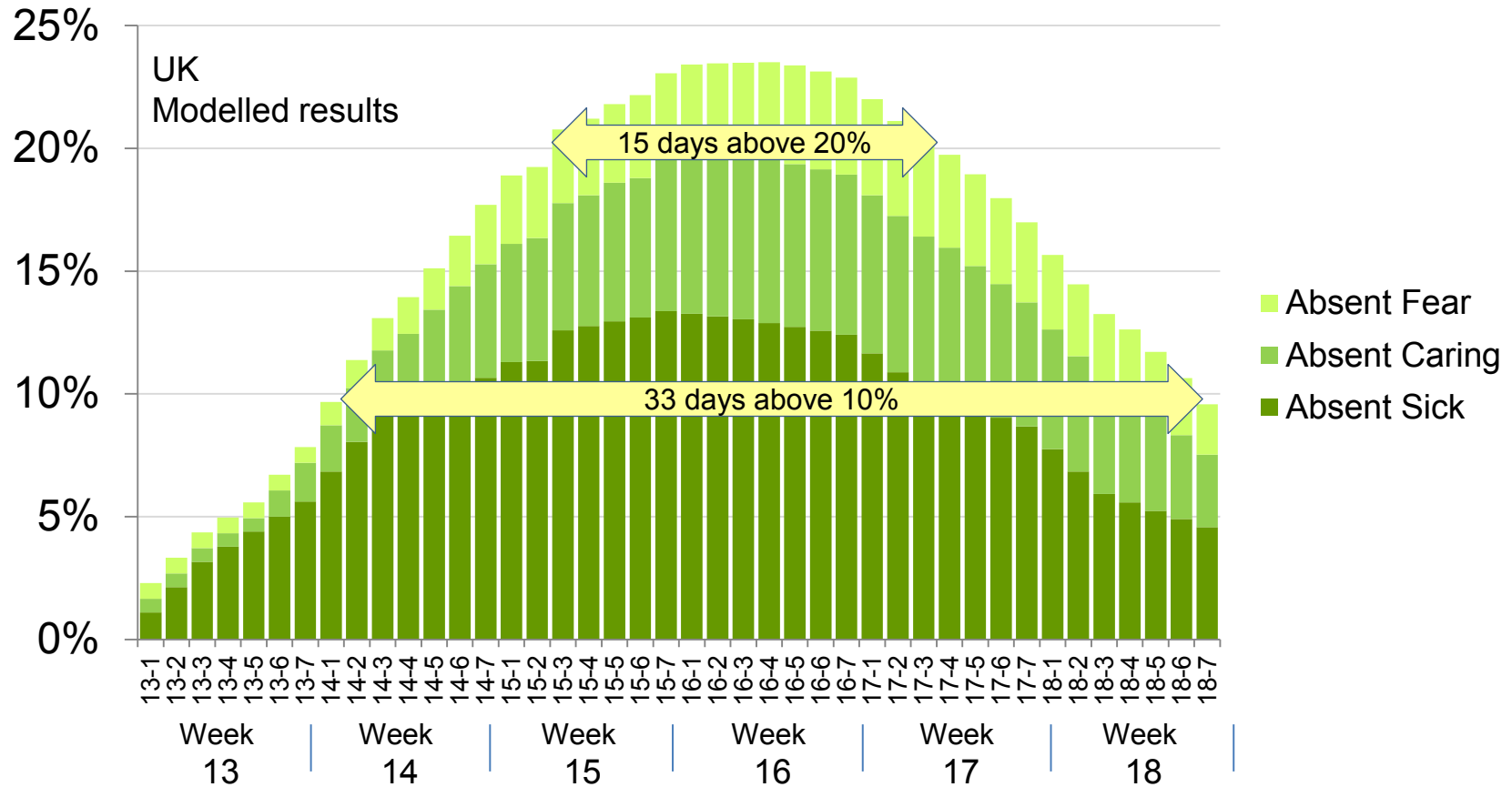
Pandemic Intensive Care Bed Demand:

58,000

Sickness Levels Increase in the Workplace

- Absenteeism comes from illness, caring for dependents, and fear of becoming infected
- At absenteeism levels above 10%, productivity drops off disproportionately
- At 20% absenteeism, many businesses cannot operate and are likely to suspend operations
- Managers may take precautionary measures to close offices pre-emptively before staff are ill
- Companies that deal with general public are more at risk
- Highest risk are healthcare providers

Average Absenteeism in Workforce



Around 1 in 8 organizations will be hit by infection rates of **twice the national average** in their workforce
(Around 1 in 50 will have 3x the national average)

Vaccine Arrives!

CASSANDRA.com

Sign up Log in

Hypothetical News

TV & Video

International

Business

Sport

Entertainment

Vaccinations begin for Sao Paolo Virus

Pharmaceutical companies struggle to meet demand for new drug

Wednesday, March 30

London, England (1029 GMT) - The NHS unveiled its vaccination plan today, prioritizing health workers and the most vulnerable people to receive the first wave of vaccines. The UK death toll has already reached 40,000 but authorities believe that the worst may already be over.

Despite long queues and some angry exchanges, most countries are managing the vaccination process in a



Chicken eggs are used to create the vaccination for the Sao Paolo Virus, also known as H8N8.

In the UK, optimism is beginning to

11/03/2011

Getting Back to Business



CASSANDRA.com

[Sign up](#) [Log in](#)

[Hypothetical News](#)

[TV & Video](#)

[International](#)

[Business](#)

[Sport](#)

[Entertainment](#)

‘Open for business’ as Sao Paolo fades

WHO: “Infection rates are slowing but there is still a threat”

Tuesday, April 5

New York (1438 GMT – 0938 EST) -

The head of the WHO rang the opening bell on the NYSE with gusto this morning. It was a signal that the city is open for business, but not without caution.

The threat of Sao Paolo Virus still lingers on the streets of New York, as it does on most of the world's cosmopolitan hubs. Their multicultural blend of everything created a



Facemasks are required on the NYC and London transport systems

The return to normal has been inconsistent though, with several

Headline Death Toll

- Worldwide: 19 million deaths
- United States: 425,000 deaths
- UK: 70,000 deaths

Global Life Insurance Industry Exposure Database

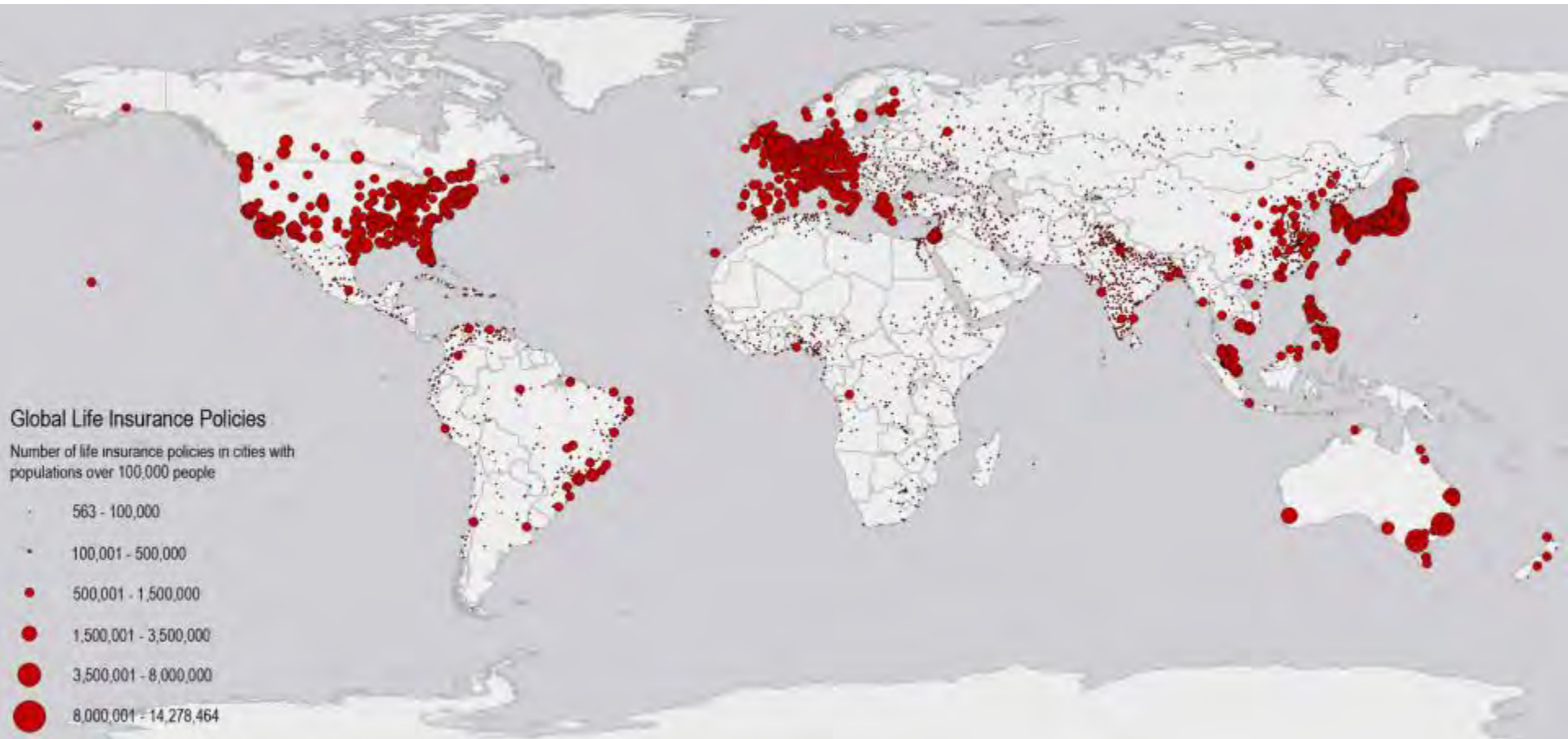


Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

A joint development project between
Axco and the Centre for Risk Studies



- \$2.4 Trillion of Life Insurance Premium worldwide
- 1.2 Billion Life Insurance policies
- Total aggregate value of life cover: \$78 Trillion

Total Payout by the Life & Health Insurance Industry

	Total Payout	Loss Ratio (% of annual PI)
Life Insurance Payouts	\$99.2 Bn	4.0%
Personal Accident & Health	\$92.7 Bn	9.2%
Total	\$191.9 Bn	5.5%

- Average Annual Life Insurance Payout approx \$940 Bn
- Life Insurance pandemic payout represents about 11% excess

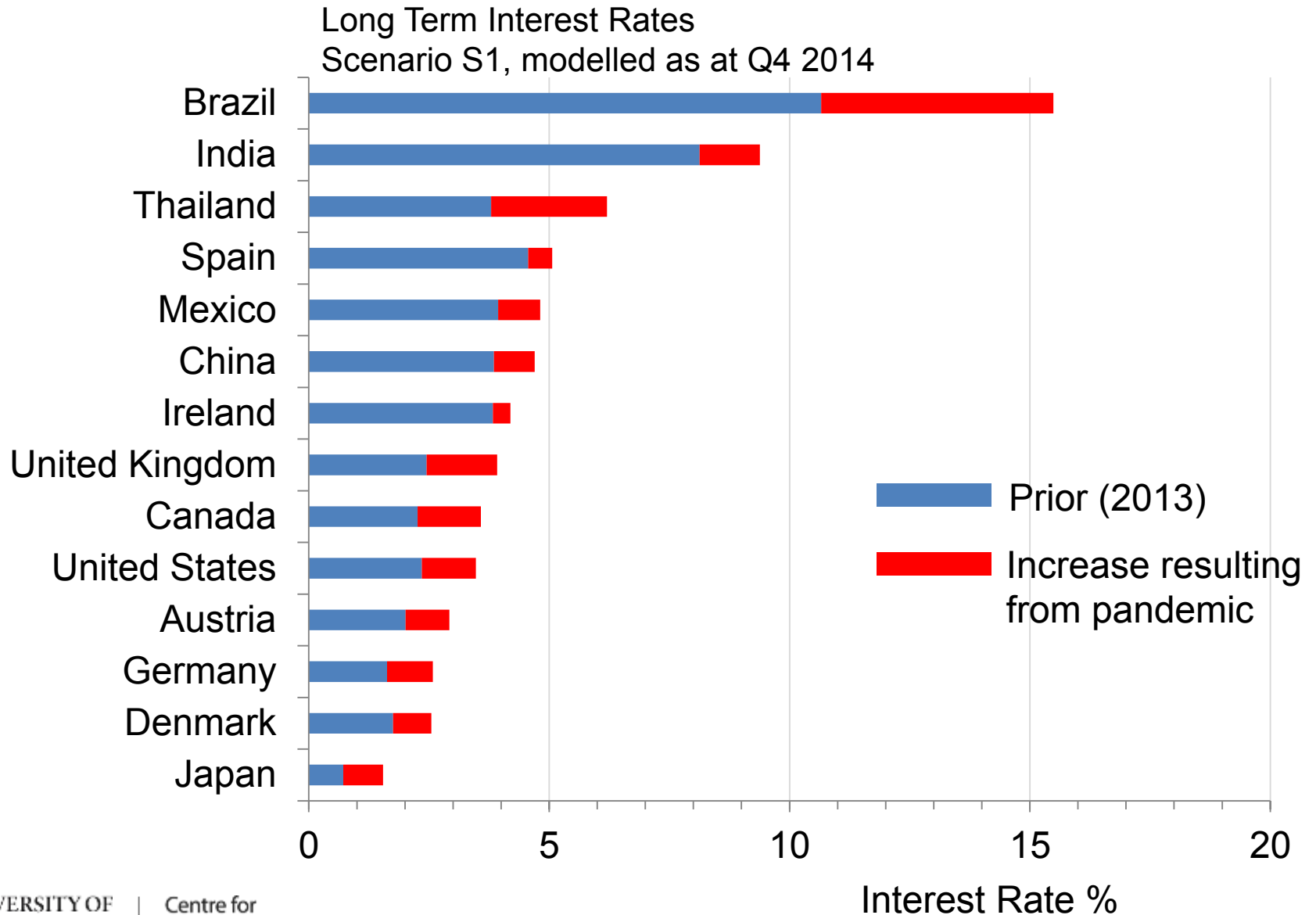
Insurance Claims on Other Business Lines

- **Life insurance death benefits**
 - Excess mortality from infection
- **Healthcare insurance**
 - Increased numbers of people wanting treatments
- **Accident & Health coverages**
 - Reimbursement for illness treatment
- **Government (Local Authority) liability**
 - Deaths that might be blamed on local authority decision-making
- **Healthcare liability**
 - Deaths that may be blamed on medical malpractice
- **Event cancellation insurance**
 - Public gatherings cancelled by public health officials
- **Biotech product liability**
 - Vaccine deficiencies (possible waiver from government authorities)
- **Management Liability**
 - Major business losses deemed attributable to poor pandemic response decision-making by senior management
- **Property loss**
 - Increased incidence of fire, water escape damage in buildings left unoccupied during office closures
- **Agriculture**
 - Losses from untended crops and unfed animals as a result of sick farm workers
- **Contingent BI**
 - Named suppliers unable to meet obligations due to illness
- **Civil Authority BI**
 - Possible prevention of business operations (e.g. restaurants) by public health act
- **Auto Insurance**
 - **Decrease** in claims from lower car usage during pandemic progress
- **Annuity & Pensions**
 - **Decrease** in liabilities from premature deaths of annuitants

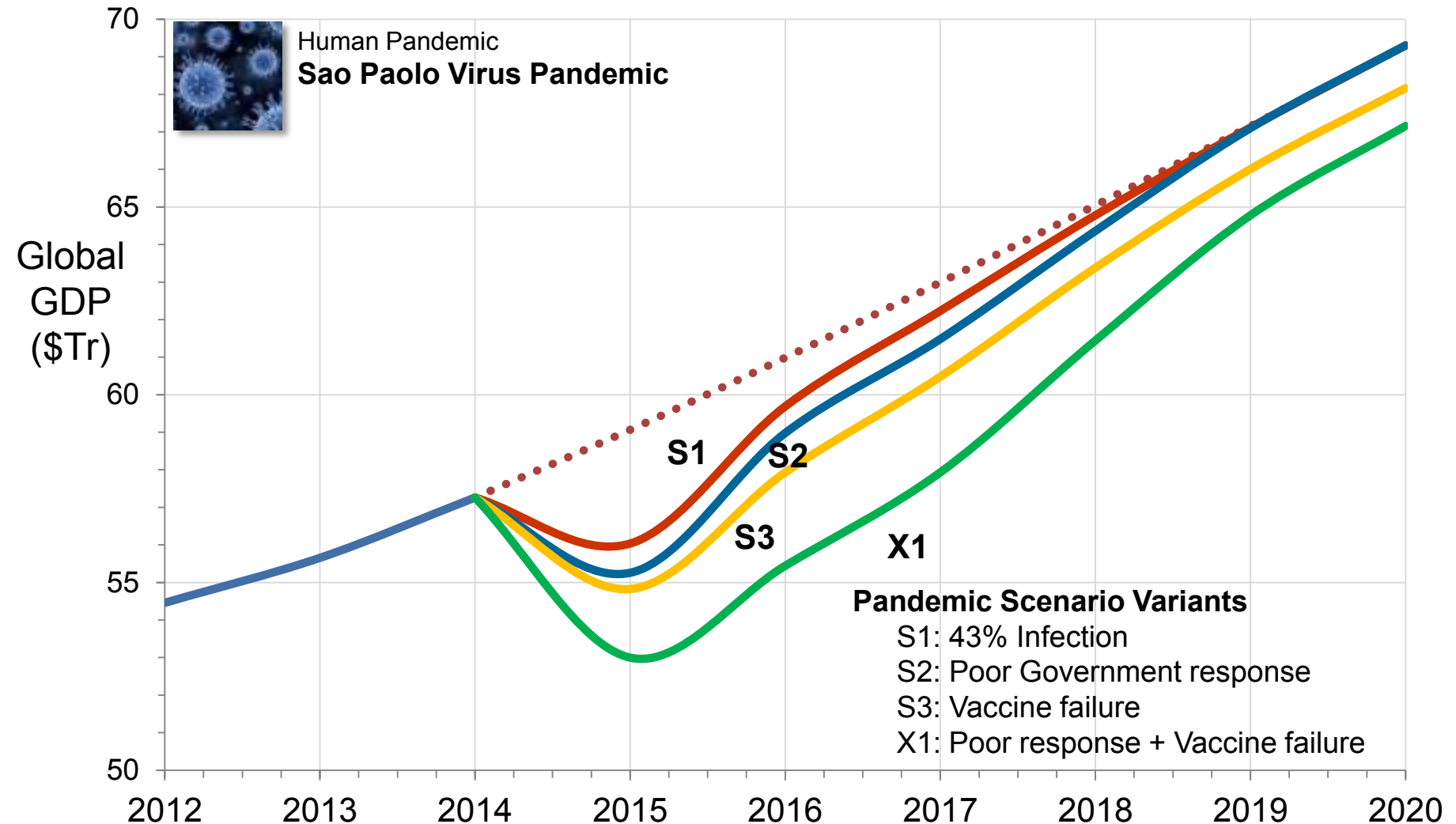
Key Macroeconomic Effects of Pandemic

- Reduction in 'Labour Participation' through absenteeism and office closures
- Consumer spending appetite is suppressed
 - Final Consumption reduces – some is deferred
- Increases unemployment and 'Output Gap'
 - UK unemployment increases from 6% to 13%
- Government expenditure increases (healthcare and emergency response measures)
- Sectoral impacts include heavy impact on discretionary economy, such as tourism and travel

Interest Rate Changes



Global GDP Impact of Scenario and Variants



Impact of the Pandemic Scenario and Variants

Scenario Variant	Infection Rate	Global Death Toll	Duration of Wave	GDP@Risk
S1: Standard Scenario	43%	19 million	7 months	\$7 Trillion
S2: Poor government response	43%	22 million	8 months	\$10 Trillion
S3: Vaccine failure	43%	24 million	9 months	\$14 Trillion
X1: Poor gov response & vaccine failure	43%	25 million	12 months	\$23 Trillion

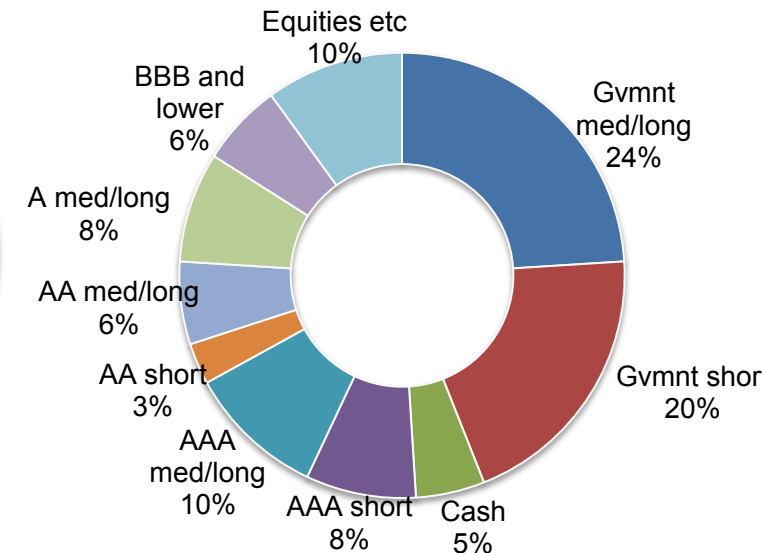
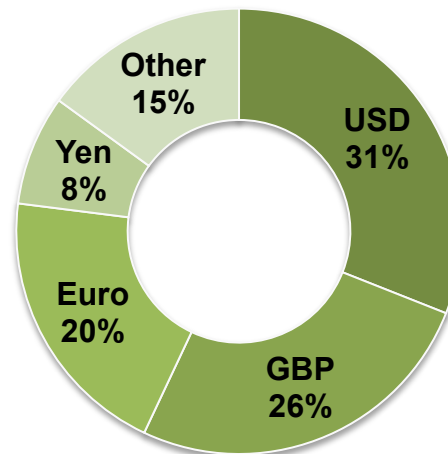
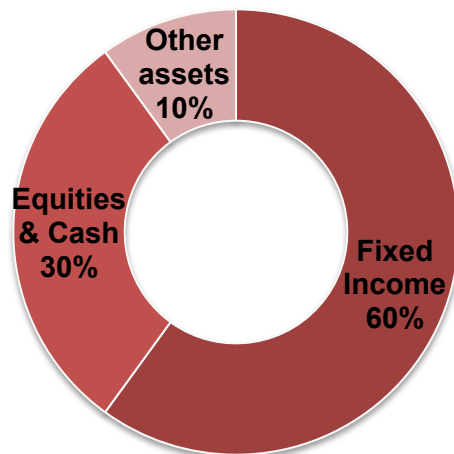
2007-2012 Great Financial Crisis	\$18 Trillion
Great Financial Crisis as if at 2014	\$20 Trillion

Hypothetical Investment Portfolio of an Insurance Company

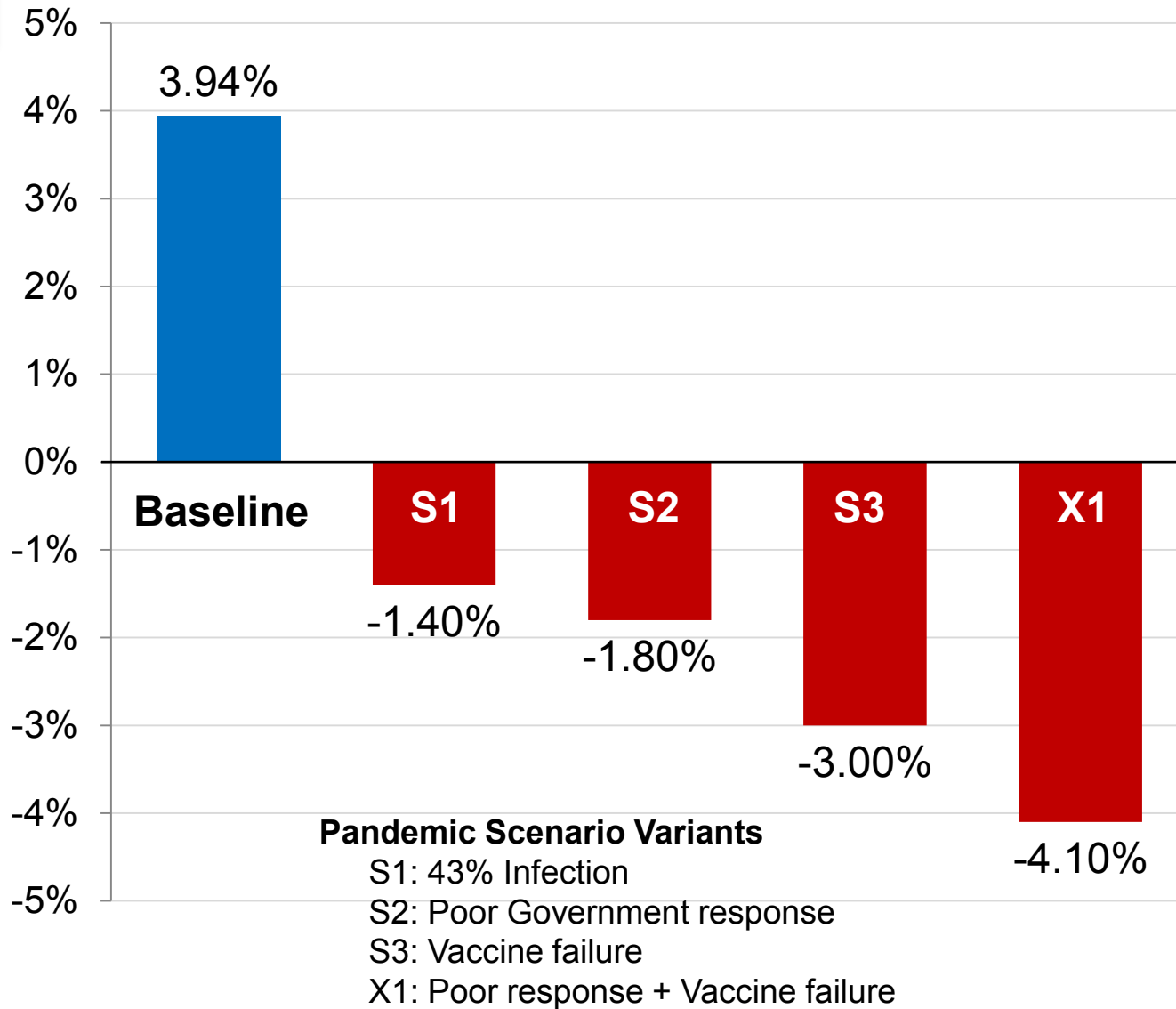
Portfolio structure						
	USD	GBP	Euro	Yen	Other	Total
Government med/long	8%	7%	5%	2%	2%	24%
Government short	6%	5%	4%	2%	3%	20%
Cash	2%	1%	1%		1%	5%
AAA short	2%	2%	2%	1%	1%	8%
AAA med/long	4%	3%	1%	1%	1%	10%
AA short	1%	1%	1%			3%
AA med/long	2%	1%	1%		2%	6%
A short						0%
A med/long	2%	2%	2%	2%		8%
BBB and lower	2%	2%	1%		1%	6%
Equities etc	2%	2%	2%		4%	10%
Total	31%	26%	20%	8%	15%	

Focus on

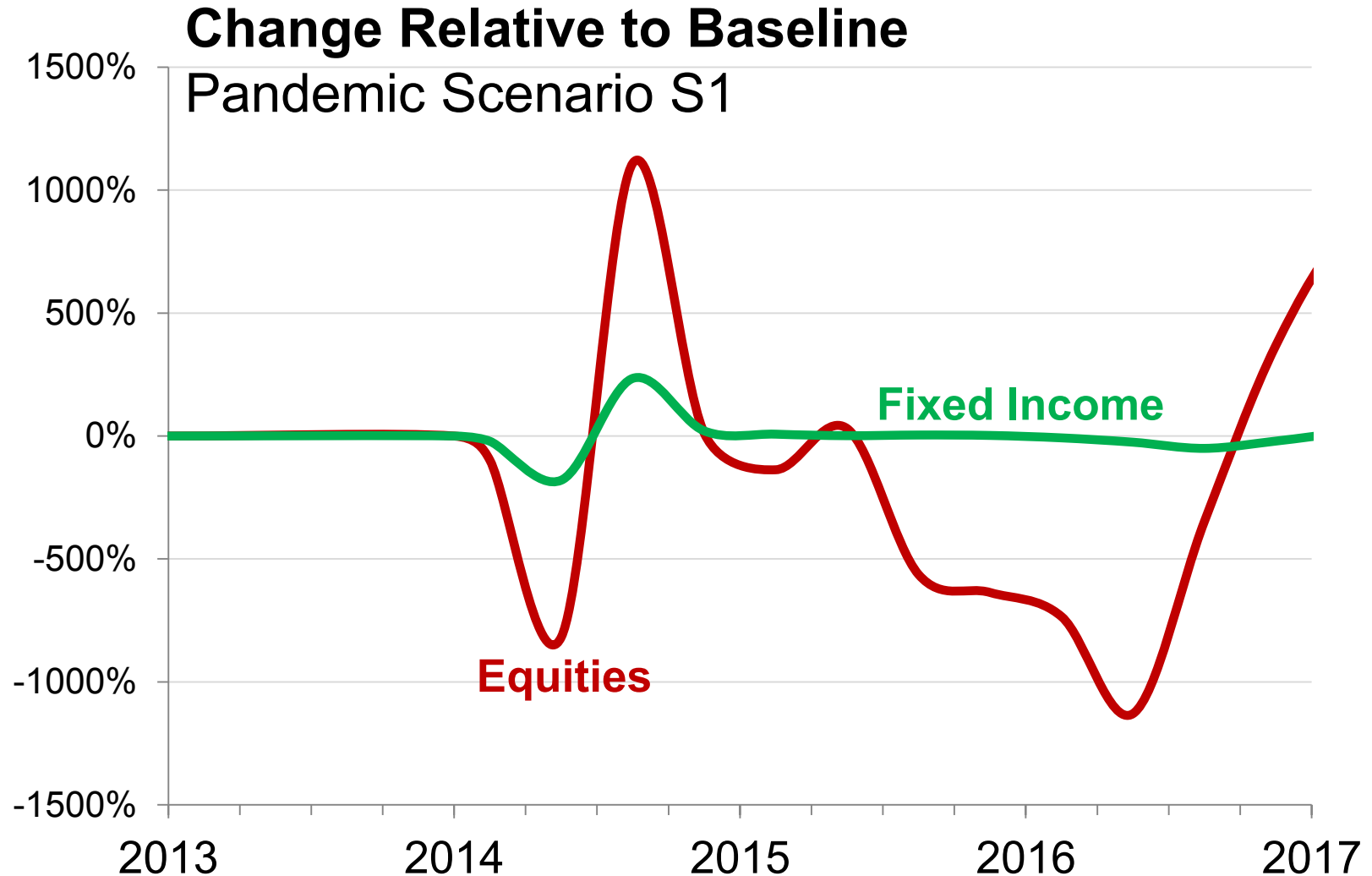
- high quality
- fixed income



Pandemic Impact on Investment Portfolios



Fixed Income vs Equities





Stress Test Scenario - Conclusions

São Paulo Virus Pandemic

Exploring the issues of insurance risk from a human disease threat

- Debilitation of the population is the key societal issue during a pandemic of high infectiousness
 - Death toll significant, but major social impact is absenteeism
 - Workforce absenteeism may be too high for many companies to stay operational
- Duration of debilitation is lengthy – multiple months in individual countries and 8-9 months globally
- It affects everything
- Economic impact will be significant

São Paulo Pandemic Scenario Report



Pandemic Stress Test Scenario

Available for Download from Website:
CambridgeRiskFramework.com



Tues 16 December – **Cyber Catastrophe Risk**

Registration at

<http://www.risk.jbs.cam.ac.uk/>

Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School