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Mortality Shock due to Influenza:
A Unique Modeling Challenge

Yommy Chiu - March 2014

Swiss Re

…Mortality Transitions

In a relatively low mortality environment we have started to worry about:
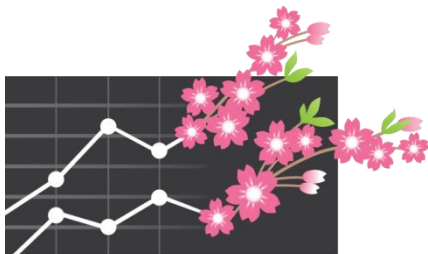
MORTALITY SHOCK ⬅➡ **MORTALITY TREND**

– usually a new disease or a new version of an existing disease

– why worry: highly traumatic, panic behaviours, economic losses

- AIDs

- drug resistant

– usually existing diseases given a boost by changing environment

– why worry: reversal of health gains, younger ages more affected, costs
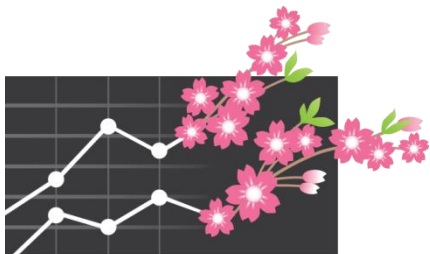
Background:
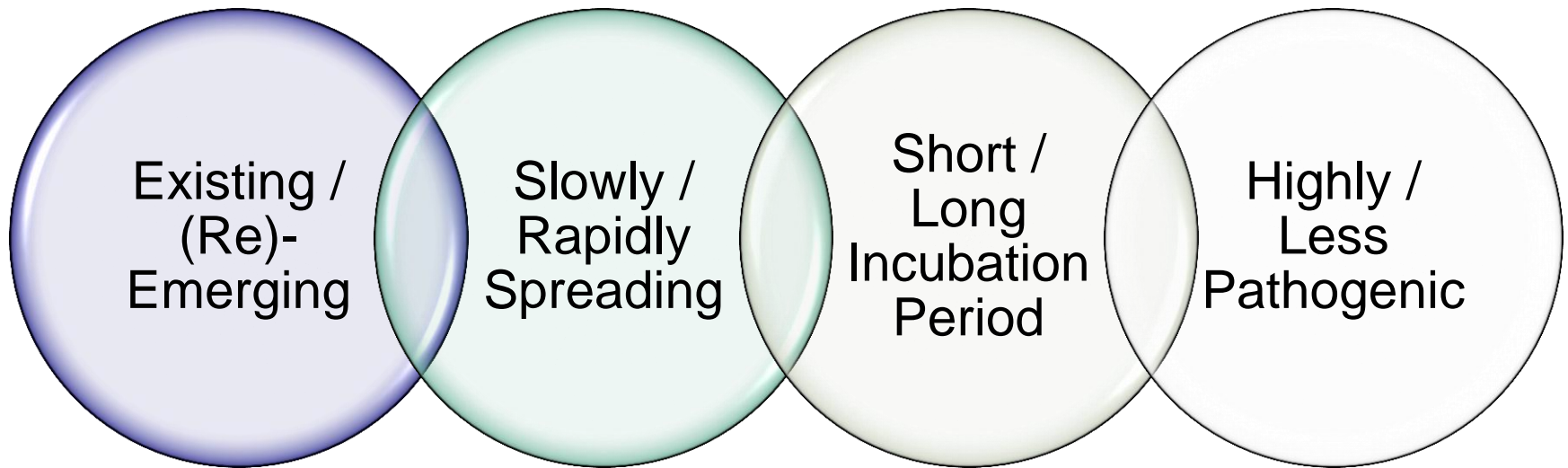# Influenza pandemics in history

1700–1900

Year(s)	Years since previous pandemic	Place of origin	Viral type
1729-1730	?	Russia?	Unknown
1732-1733	2	Russia	Unknown
1781-1782	48	Russia, China?	Unknown
1788-1789(?)	6	Russia	Unknown
1830-1831	41-48	Russia, China	Unknown
1833	2	Russia	Unknown
1836-1837	3	Russia?	Unknown
1889-1890	52-56	Russia	H2
1899-1900	9	Unkown	H3

post-1900

Year(s)	Years since previous pandemic	Place of origin or of first report	Viral type	Estimated Global Deaths	Estimated number of US Deaths	US Excess Mortality per 1000
1918-1919 (Spanish flu)	18	France, US	H1N1	40-50 mille	500,000-550,000	5.30%
1957-1958 (Asian flu)	38	China	H2N2	1-2 mille	70,000	0.41%
1968-1969 (Hong Kong flu)	10	China	H3N2	1 mille	34,000	0.17%
2009-2010	31/40	Mexico	H1N1	284,500	2,634	0.008%

Infectious diseases – factors…

Existing / (Re)-Emerging

Slowly / Rapidly Spreading

Short / Long Incubation Period

Highly / Less Pathogenic

HOW TO MODEL?

Factors complicating comparison of pandemics
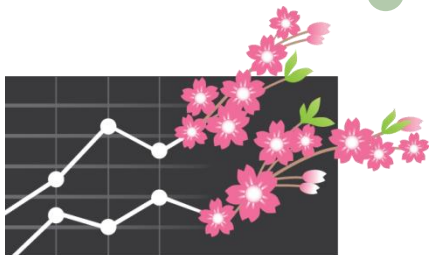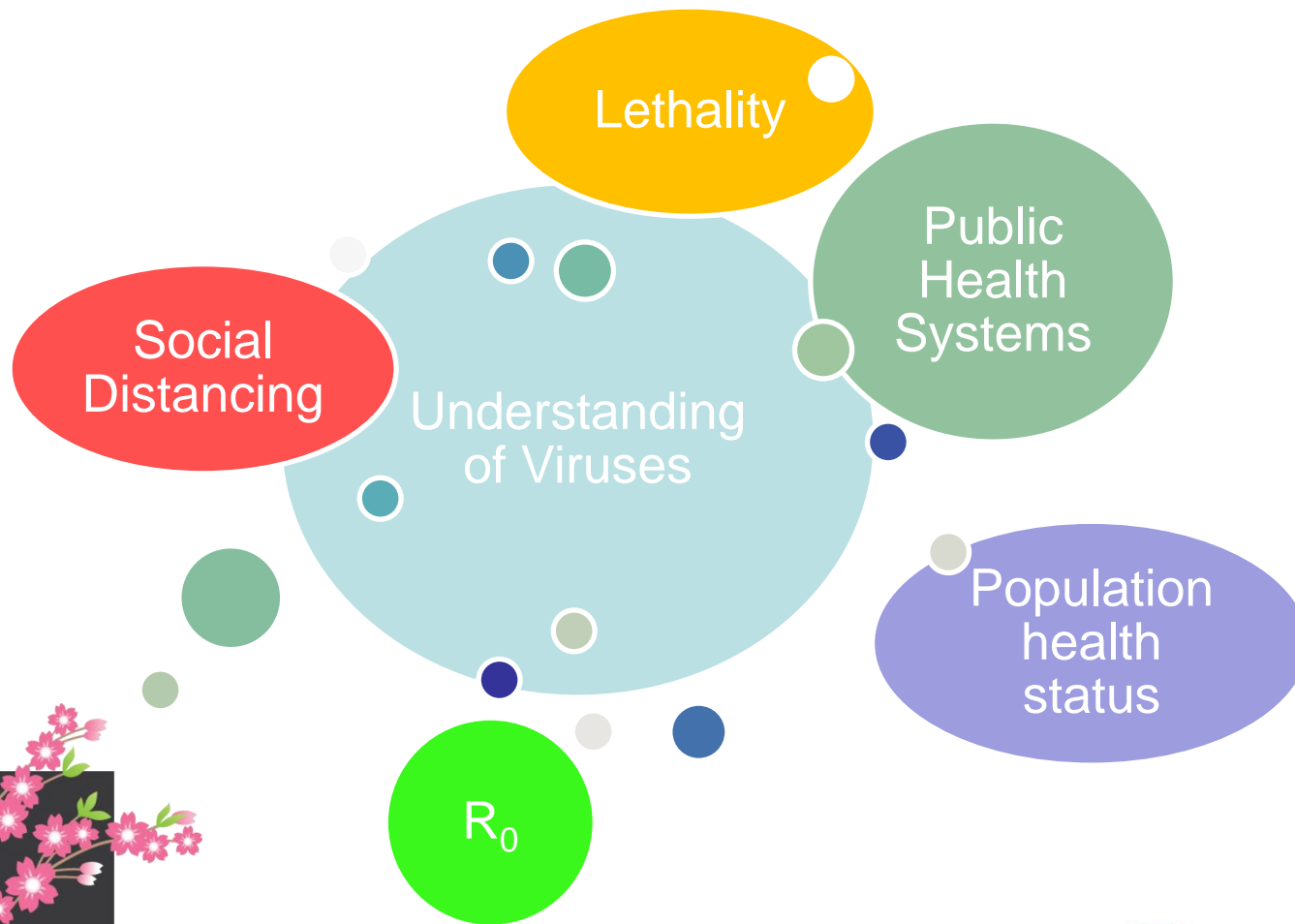
Summary of Forecasting Process

- Influenza Surveillance
- Flu prescription Drug Sales

Data

- Time Series
- Compartmental

Predictive Model

- Peak Time
- Peak Height
- Magnitude

Event Forecast

Forecast Evaluation and Response

- Accuracy
- Interventions
- Response Allocation & Planning
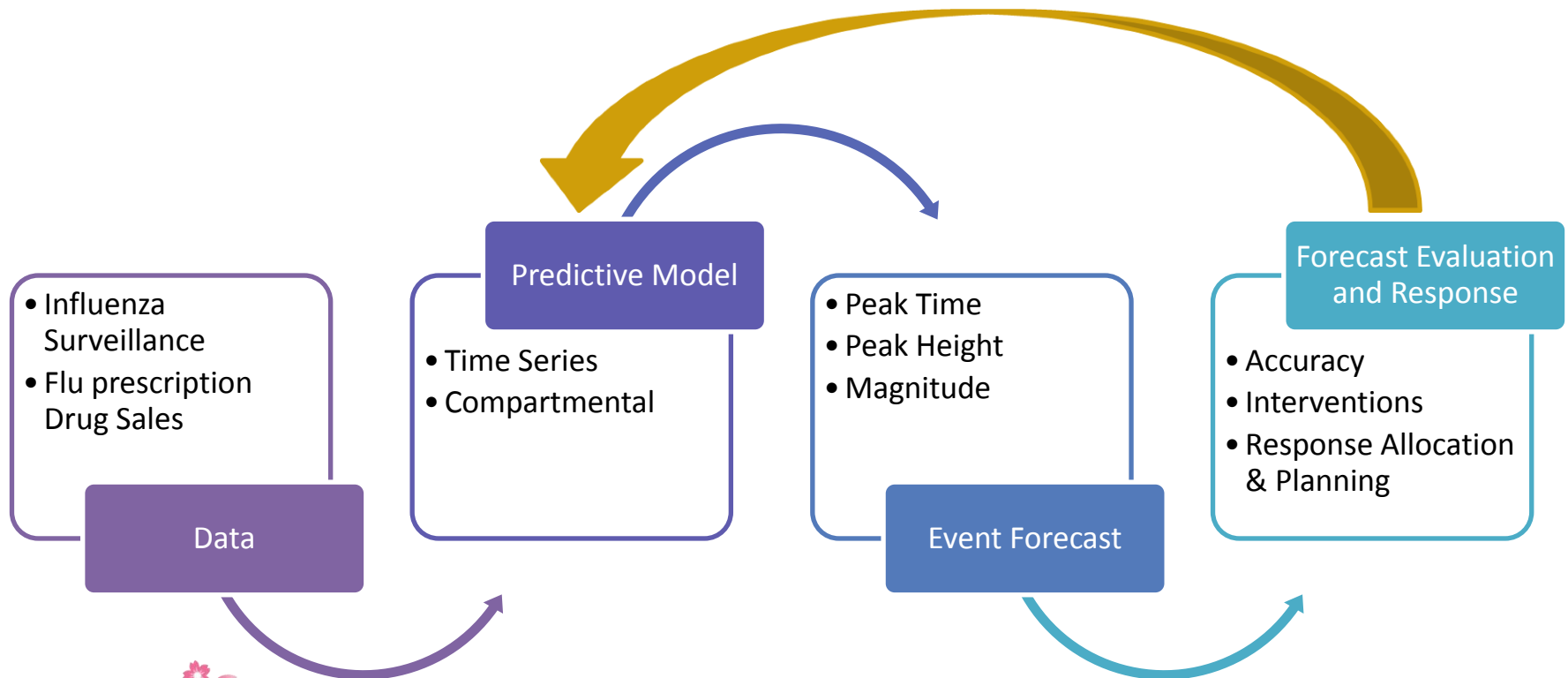
Nsoesie et al., 2013; A systematic review of studies on forecasting the dynamics of influenza outbreaks

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Overview of Methodology

INPUTS: key factors accounted for in Swiss Re's model

OUTPUT: excess mortality

Ability to spread

Ability to cause death

Inception variables & calibrations
(e.g. lethality age profile, % symptomatic, contagiousness)

simulated pandemics

Key Result

Simulations sorted to examine excess mortality that would be expected from a pandemic of a specific severity probability

Interventions
- behavioural – mixing, travel restrictions
- antibiotics
- antivirals
- vaccines

Demographic Characteristics
- Global population data
- Daily contacts by age
- Travel Patterns

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Modelling results:

Insured-age excess mortality due to pandemic influenza
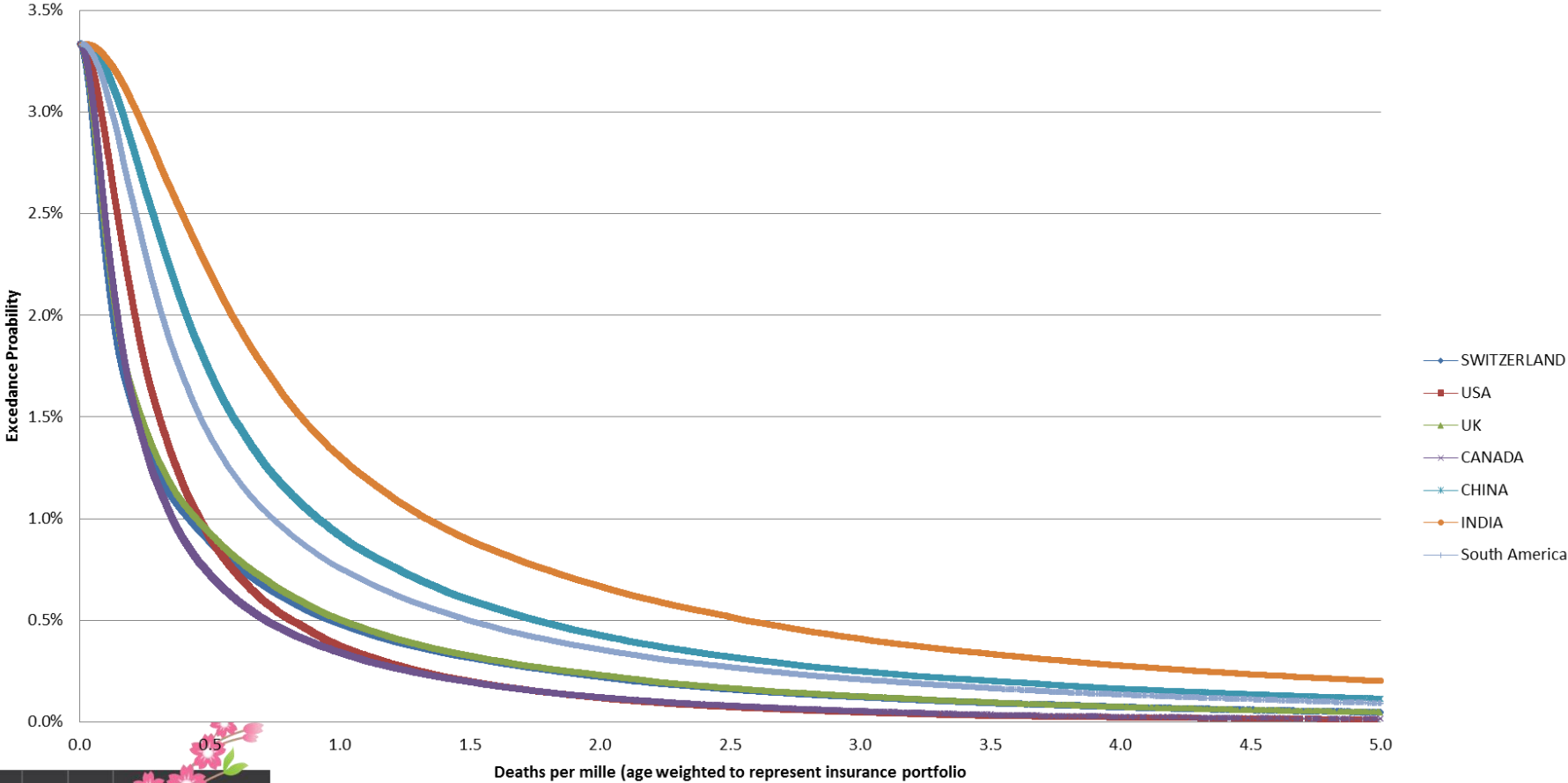
Modelling Results:
Flu outcomes to seasonal flu

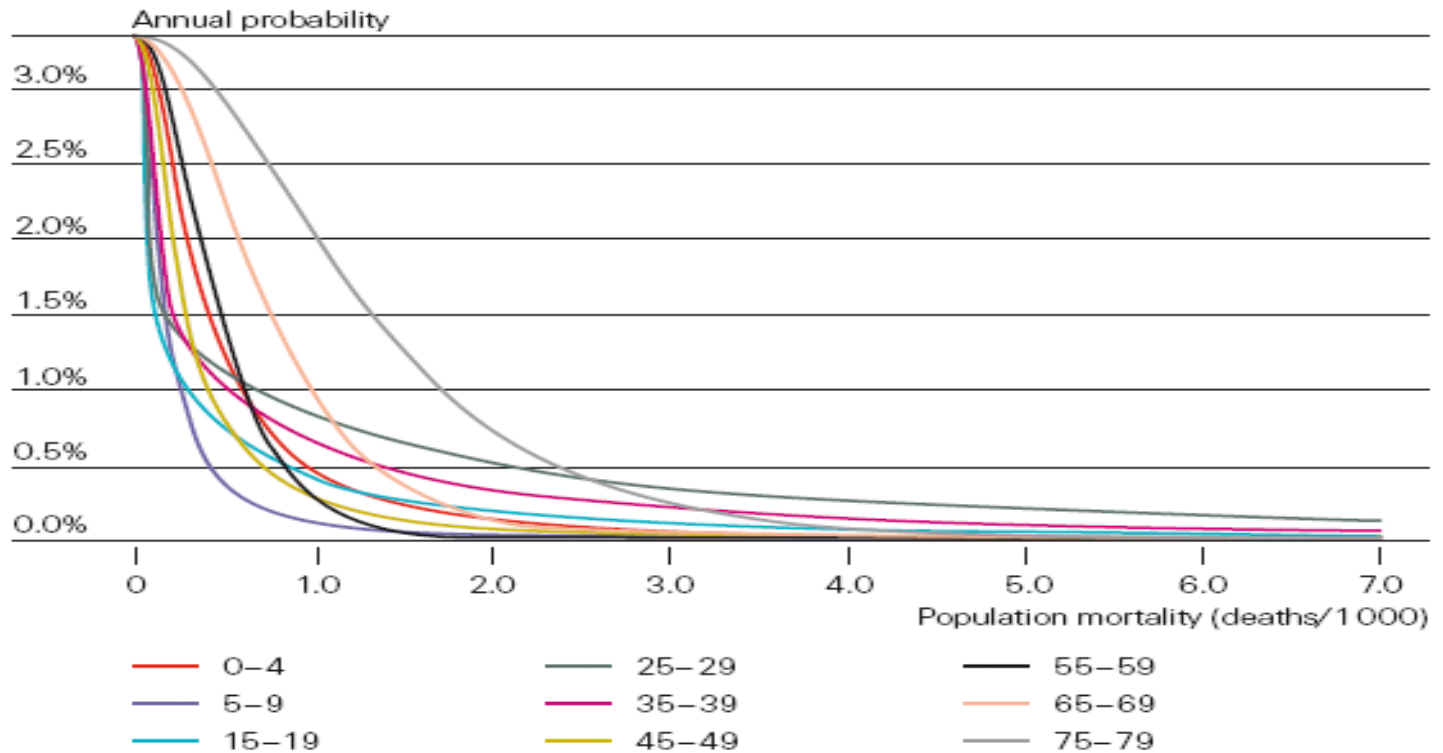US age-specific excess mortality due to pandemic influenza, selected age groups

Chart source: see Pandemic influenza: A 21st Century model for mortality shocks

Modelling results: sensitivity analysis

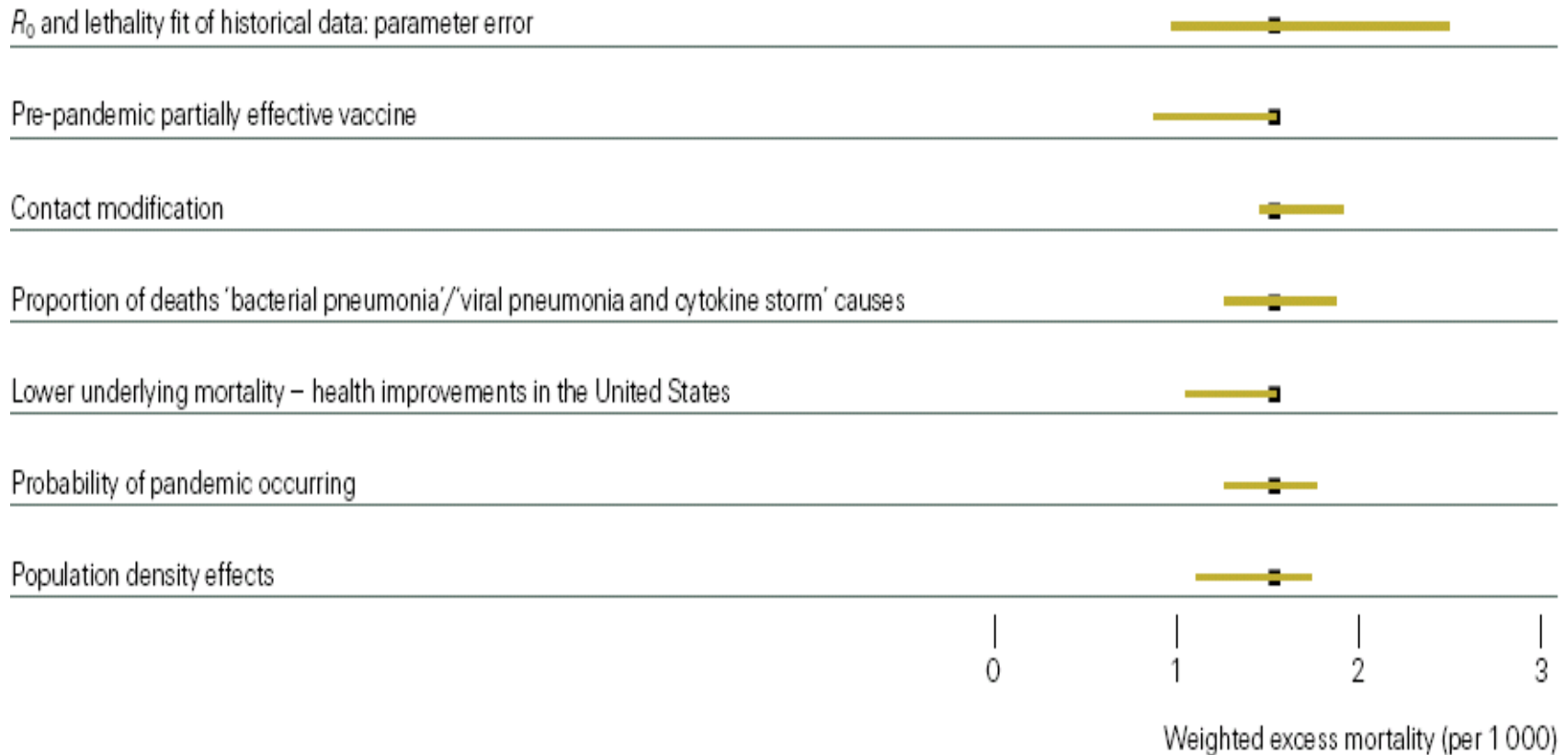Sensitivity of outcome, according to selected population, to plausible changes in variables

Weighted excess mortality (per 1 000)

Chart source: see Pandemic influenza: A 21st Century model for mortality shocks

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Thank you

contact: Yommy_Chiu@swissre.com

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