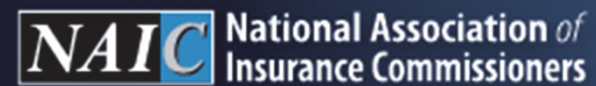


# Pandemic Modeling

*March 27, 2015*

*Presented To:*

The logo for the National Association of Insurance Commissioners (NAIC), with "NAIC" in a blue box and "National Association of Insurance Commissioners" in white text on a dark blue background.



# Topics

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- Potential Impact of a Pandemic on the U.S. Life Insurance Industry
- Potential Impact of a Pandemic on the U.S. Health Insurance Industry
- Stochastic Modeling



# Potential Impact of a Pandemic on the U.S. Life Insurance Industry



# Modeling Issues and Decisions

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- Coverage types to include
- Pandemic scenarios to be considered
  - Stochastic vs deterministic
  - Source of pandemic scenario assumptions
  - Insured vs. population mortality
- Estimating industry aggregates
- Reinsurance counterparty risk



# Coverages Included

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- Life Insurance
  - Primary impetus for study
  - Analyze individual and group separately
    - But not product types (e.g., UL vs term)
- Annuities not included
  - Payout
  - GMDB
  - Some offset to life

# Pandemic Scenarios: Stochastic vs. Deterministic

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- Stochastic: powerful
- BUT parameters?
  - Prevalence: ask epidemiologists?
  - Severity data sparse & imprecise
    - 3 flu pandemics, SARS, current avian flu
    - Prevalence & mortality estimated
- Also, can miss extreme event
- Deterministic sources available
- ✓ Decision: Deterministic

# Insured vs. Population Mortality

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- HHS scenarios for population mortality
- Correlations favoring insured mortality:
  - Socio-economic
  - Health insurance
  - Nonsmoking
  - Disease burden
- BUT 1918 flu killed healthiest
- Used results of a Delphi study to estimate



# Estimating Industry Aggregates

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- In-force by quin age
  - LIMRA Study
  - US Census Bureau
- Reinsurance ceded by quin age
  - Industry Survey + Oversight group data
- Average reserve/1000 by quin age
  - Oversight group data
- Statutory surplus & total invested assets





# Reinsurance Counterparty Risk

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- Sensitive issue for reinsurers
- Material consideration for direct writers
- Model estimates factor
- For industry aggregates, factor is ratio of:
  - Identifiable reinsurance capital; to
  - Scenario reinsurance death claims surge
  - Capped at 100%

# Scenarios – U.S. Dept. HHS

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## ■ Moderate

- Modeled using 1957
- 90 million sick
- 209,000 dead
- GDP reduced minimally

## ■ Severe

- Modeled using 1918
- 90 million sick
- 2 million dead
- GDP reduced 4.25%

## Gross Claims Total - Moderate Scenario

General population 0.7 excess deaths per 1000, "U" mortality curve

Age Range	US Census Population (1)	Percent Owning (2)	Total IL & GL Policyholders (3)	Average Face (4)	Face Amount In Force (5)
0 - 4	20,071,268	30%	6,021,380	21,500	129,459,670,000
5 - 9	19,605,572	50%	9,802,786	21,500	210,759,899,000
10 - 14	21,145,156	60%	12,687,094	21,500	272,772,521,000
15 - 19	20,729,802	65%	13,474,372	36,154	487,150,370,000
20 - 24	20,971,302	50%	10,485,652	55,000	576,710,860,000
25 - 29	19,560,906	65%	12,714,589	100,769	1,281,239,390,000
30 - 34	20,471,032	80%	16,376,826	131,250	2,149,458,440,000
35 - 39	21,052,318	90%	18,947,086	208,333	3,947,309,565,000
40 - 44	23,056,334	95%	21,903,517	213,158	4,668,907,545,000
45 - 49	22,122,629	100%	22,122,630	150,000	3,318,394,500,000
50 - 54	19,496,176	100%	19,496,176	125,000	2,437,022,000,000
55 - 59	16,489,501	90%	14,840,550	112,500	1,669,561,875,000
60 - 64	12,589,423	85%	10,701,009	90,588	969,385,520,000
65 - 69	9,956,467	80%	7,965,174	69,375	552,583,950,000
70 - 74	8,507,005	75%	6,380,254	61,667	393,449,010,000
75 - 79	7,410,757	70%	5,187,530	56,429	292,724,920,000
80 - 84	5,560,125	70%	3,892,088	45,714	177,924,025,000
85+	4,859,631	70%	3,401,742	45,714	155,508,210,000
<b>Total</b>	<b>293,655,404</b>		<b>216,400,455</b>		<b>23,690,322,270,000</b>
				<i>Average Face Amount</i>	109,474
				<i>Net Amount Inforce (billions)</i>	18,127
				<i>% Total Policyholders</i>	73.7%

<b>Gross Claims Total - Moderate Scenario</b>					
<b><i>General population 0.7 excess deaths per 1000, "U " mortality curve</i></b>					
Population XS Deaths per 1000 (6)	Mort Ratio Insured vs Gen Pop (7)	Insured Pop XS Deaths per 1000 (8)	General Population XS Deaths (9)	Total IL & GL Policyholder XS Deaths (10)	Gross Claims (11)
1.75	57.1%	1.00	35,125	6,021	129,459,670
0.11	57.1%	0.06	2,059	588	12,645,594
0.11	57.1%	0.06	2,220	761	16,366,351
0.11	57.1%	0.06	2,177	808	29,229,022
0.11	57.1%	0.06	2,202	629	34,602,652
0.21	57.1%	0.12	4,108	1,526	153,748,727
0.21	57.1%	0.12	4,299	1,965	257,935,013
0.21	57.1%	0.12	4,421	2,274	473,677,148
0.21	57.1%	0.12	4,842	2,628	560,268,905
0.42	57.1%	0.24	9,292	5,309	796,414,680
0.63	57.1%	0.36	12,283	7,019	877,327,920
0.84	57.1%	0.48	13,851	7,123	801,389,700
1.12	57.1%	0.64	14,100	6,849	620,406,733
1.40	57.1%	0.80	13,939	6,372	442,067,160
1.75	57.1%	1.00	14,887	6,380	393,449,010
2.24	57.1%	1.28	16,600	6,640	374,687,898
2.73	57.1%	1.56	15,179	6,072	277,561,479
7.00	57.1%	4.00	34,017	13,607	622,032,840
			205,600	82,573	<b>6,873,270,501</b>
	<i>Excess deaths per 1000</i>		<b>0.70</b>	<b>0.38</b>	<b>0.29</b>
	<i>Percent less than 20</i>		<b>20.2%</b>	<b>9.9%</b>	<b>2.7%</b>
	<i>Percent 20 - 64</i>		<b>33.8%</b>	<b>42.8%</b>	<b>66.6%</b>
	<i>Percent 65+</i>		<b>46.0%</b>	<b>47.3%</b>	<b>30.7%</b>

## Gross Claims Total - Moderate Scenario

*General population 0.7 excess deaths per 1000, "V\ " mortality curve*

Population XS Deaths per 1000 (6)	Mort Ratio Insured vs Gen Pop (7)	Insured Pop XS Deaths per 1000 (8)	General Population XS Deaths (9)	Total IL & GL Policyholder XS Deaths (10)	Gross Claims (11)
1.24	57.1%	0.71	24,828	4,275	91,916,366
0.25	57.1%	0.14	4,843	1,372	29,506,386
0.25	57.1%	0.14	5,223	1,776	38,188,153
0.74	57.1%	0.42	15,382	5,659	204,603,155
1.07	57.1%	0.61	22,481	6,396	351,793,625
1.57	57.1%	0.89	30,652	11,316	1,140,303,057
1.57	57.1%	0.89	32,078	14,575	1,913,018,012
0.91	57.1%	0.52	19,094	9,852	2,052,600,974
0.74	57.1%	0.42	17,108	9,199	1,960,941,169
0.58	57.1%	0.33	12,765	7,300	1,095,070,185
0.41	57.1%	0.24	8,032	4,679	584,885,280
0.33	57.1%	0.19	5,442	2,820	317,216,756
0.25	57.1%	0.14	3,110	1,498	135,713,973
0.17	57.1%	0.09	1,643	717	49,732,556
0.17	57.1%	0.09	1,404	574	35,410,411
0.08	57.1%	0.05	608	259	14,636,246
0.08	57.1%	0.05	456	195	8,896,201
0.08	57.1%	0.05	398	170	7,775,411
			205,546	82,635	<b>10,032,207,914</b>
	<i>Excess deaths per 1000</i>		<b>0.70</b>	<b>0.38</b>	<b>0.42</b>
	<i>Percent less than 20</i>		<b>24.5%</b>	<b>15.8%</b>	<b>3.6%</b>
	<i>Percent 20 - 64</i>		<b>73.3%</b>	<b>81.9%</b>	<b>95.2%</b>
	<i>Percent 65+</i>		<b>2.2%</b>	<b>2.3%</b>	<b>1.2%</b>

## Total Net Life Insurance Claims - Moderate Scenario

*General population 0.7 excess deaths per 1000, "U" mortality curve*

Age Range	Gross Claims (1)	Reserve Release (2)	Reinsurance Credit (3)	Net Claims Before Taxes (4)	Tax Rate (5)	Net Claims After Taxes (6)
0 - 4	129,459,670	663,680	6,249,006	122,546,984	35%	79,655,539
5 - 9	12,645,594	138,348	553,612	11,953,634	35%	7,769,862
10 - 14	16,366,351	313,800	642,068	15,410,483	35%	10,016,814
15 - 19	29,229,022	1,267,049	762,671	27,199,303	35%	17,679,547
20 - 24	34,602,652	1,643,825	1,860,894	31,097,932	35%	20,213,656
25 - 29	153,748,727	1,565,037	28,657,825	123,525,865	35%	80,291,812
30 - 34	257,935,013	2,658,814	47,472,270	207,803,928	35%	135,072,553
35 - 39	473,677,148	5,415,058	97,296,060	370,966,029	35%	241,127,919
40 - 44	560,268,905	10,691,741	117,344,948	432,232,217	35%	280,950,941
45 - 49	796,414,680	21,842,102	211,512,048	563,060,530	35%	365,989,345
50 - 54	877,327,920	25,194,403	295,572,714	556,560,803	35%	361,764,522
55 - 59	801,389,700	30,966,486	272,742,116	497,681,098	35%	323,492,714
60 - 64	620,406,733	35,254,699	230,018,452	355,133,583	35%	230,836,829
65 - 69	442,067,160	54,871,344	149,094,317	238,101,499	35%	154,765,974
70 - 74	393,449,010	92,007,888	127,087,510	174,353,612	35%	113,329,848
75 - 79	374,687,898	118,848,364	107,831,289	148,008,245	35%	96,205,360
80 - 84	277,561,479	124,389,072	41,811,660	111,360,746	35%	72,384,485
85+	622,032,840	353,366,218	64,444,683	204,221,939	35%	132,744,261
<b>Total</b>	<b>6,873,270,501</b>	<b>881,097,928</b>	<b>1,800,954,143</b>	<b>4,191,218,431</b>		<b>2,724,291,980</b>

# Pandemic Claims as % of Surplus

<b>U.S. Direct Life Insurance Industry</b>			
<b>Estimated Net Claims</b>			
<i>(Billions of Dollars)</i>			
		Moderate Scenario	Severe Scenario
	Individual	\$ 1.3	\$ 34.3
	Group	1.5	30.0
	<b>Total</b>	<b>2.8</b>	<b>64.3</b>
	2005 Claims	\$ 107.6	\$ 107.6
	% Claims	2.6%	59.8%
	2005 Surplus	\$ 255.7	\$ 255.7
	% Surplus	1.1%	25.1%
	2005 RBC	\$ 62.5	\$ 62.5
	% of RBC	4.5%	102.9%



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# Potential Impact of a Pandemic on the U.S. Health Insurance Industry





# Summary

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- Assumption development
- Impact on providers
- Impact on insurers
- Impact on self insured plans
- Other issues



# Exposure

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- United States
- Private Payers
  - Insured and Self-Insured
- Major Medical Only
  - No LTD, STD, LTC



# Modeling Approach

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- How many covered individuals get sick
  - Morbidity
  - Age distribution
  - Impact of selection
- What type of care they receive
  - Severity of illness
  - Provider level & capacity
- Estimate the cost of services
- Distribute costs to payers



# Levels of Care

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- Three in the literature
  - Self - Care
  - Outpatient
  - Hospitalization
- Distribution varies by scenario
- Additional level contemplated in severe
  - Alternative Care Facility



# Waves and Surge Duration

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## ■ Waves

- Pandemics have different wave patterns
- Attack rate is sum of all waves

## ■ Surge Duration

- Like waves, duration varies
- Will interact with system capacity
- Conservative (and simplifying) approach is to assume all in one year

# Pandemic Scenarios – US Dept. HHS

Characteristic	Moderate (1957-like)	Severe(1918-like)
Illness	90 million (30%)	90 million (30%)
Outpatient	45 million (50%)	45 million (50%)
<b>Hospitalization</b>	<b>865,000</b>	<b>9,900,000</b>
ICU care	128,750	1,485,000
<b>Mechanical Ventilation</b>	<b>64,975</b>	<b>742,500</b>
Deaths	209,000	1,903,000



# U.S. System Capacity

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- 975,000 beds
  - Worldwide nursing shortage
  - Reduction in acute beds
- 105,000 mechanical ventilators
  - 100,000 in use during normal flu season
  - National stockpile has 5,000
- 110,000 flu hospitalizations per year



# Provider Assumptions – Hospital

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- Capacity Constraints
  - Staffed Beds
  - Average Length of Stay
- Cost Estimate
  - Acute Respiratory Distress Syndrome (ARDS)
  - SARS
  - Drug resistant pneumonia
  - Influenza
- Length of Stay Depends on Scenario
  - Moderate LOS may be longer, cost more than severe





# Alternative Care Facilities

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- Surge Capacity in Severe Scenario
- Every Locale Will Handle Differently
  - Nursing rather than acute care
  - Step down from hospital / convalescent
- No Precedent – How to Model?
  - Assume unbilled rejected by POG
  - Assume average bill between outpatient and hospital rate



# Displacement

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- Every \$1 spent on pandemic care crowds out elective care
- Conventional wisdom in a natural disaster is claims go down with little or no “make up”
  - Health infrastructure damaged
  - People busy surviving
- Pandemic tougher to pin down
  - Conventional wisdom is decrease in short term

## Total System Estimated Gross Costs as of 2010

		Gross Cost as of 2003 (Millions)		
		Seasonal	Moderate	Severe
(1)	Outpatient	\$ 3,146	\$ 13,270	\$ 10,354
(2)	Hospital	5,442	16,921	111,066
(3)	Death	1,932	12,132	105,171
(4)	Gross Cost	10,519	42,324	226,592
(5)	ACF Cost Allocation	\$ -	\$ -	\$ 2,172
(6)	Deferred Elective Care Allocation	\$ -	\$ 11,649	\$ 48,115
(7)	Net 2003 Payer Cost	\$ 10,519	\$ 30,674	\$ 180,649
(8)	Inflation 2003–2010	60.6%	60.6%	60.6%
(9)	<b>2010 Gross Cost</b>	\$ 16,892	\$ 49,256	\$ 290,082
(10)	<i>Diff. from Seasonal</i>		\$ 32,365	\$ 240,826
(11)	% of National Health Expenditures	0.6%	1.9%	11.2%
(12)	Deaths	42,005	213,045	1,944,149
(13)	Hospitalizations	298,226	889,388	7,912,135



# Insurer Considerations

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- Cash Flow
  - Providers
  - Insurers
- Pricing and Reserving
  - IBNR
  - Adequacy
- Renewal Options
  - Will actuaries be able to sign off?
  - Will companies be able to pull out?
- Professional and Regulatory Implications



# Self - Insured Plans

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- Attempt similar methodology
  - No annual statements
  - Reasonable data sources?
- Less rigorous approaches
  - “Sample” plan (10,000 lives) and gross up?
- Reinsurance more important consideration
- Self insurers need to understand extent of risk



# Why Self Insured Matters

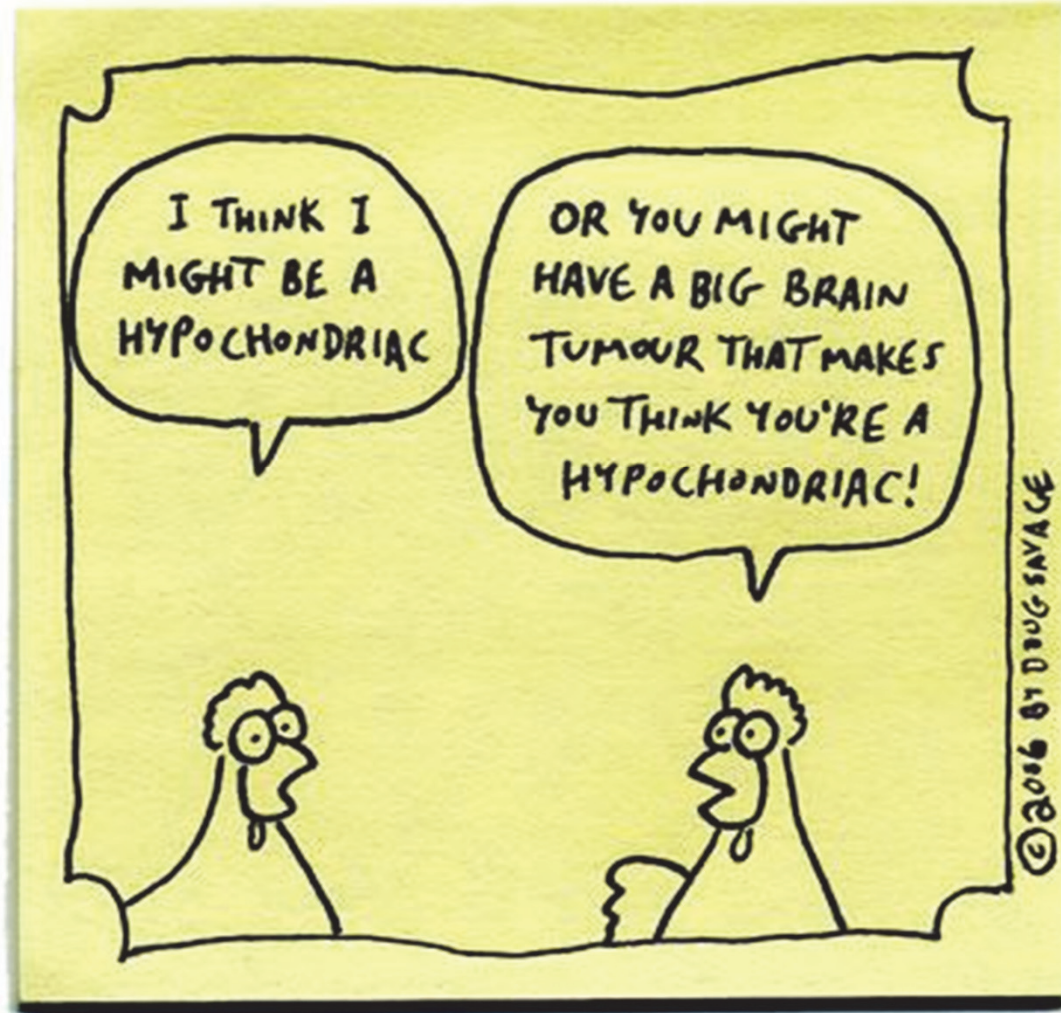
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- What is the exposure?
- Reinsurance impact
  - Acute cost likely less than specific
  - Aggregate cover more on smaller groups
- ERM Double - Whammy
  - Business Continuity
  - Cash Flow Issues
  - Supply Chain

# Questions / Comments

## *Savage Chickens*

by Doug Savage



[www.savagechickens.com](http://www.savagechickens.com)