Estimating the potential impact of the next influenza pandemic upon Wyoming

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Estimates of the potential impact of the next influenza pandemic in Wyoming

Cases: Tables 1 and 2 contain estimates of the potential impact of the next influenza pandemic in Wyoming based on 25% and 35% attack rates. The conservative estimates, labeled "1968 - type scenario," were primarily generated using rates of influenza-related illness measured during the 1960s and 1970s. The high estimates labeled "1918-type scenario" were generated using rates of influenza-related morbidity and mortality from the influenza pandemic of 1918.

Table 1: Total estimates, per health outcome, from two scenarios of potential impact of next influenza pandemic in Wyoming: Gross Attack Rate* of 25% (123,446 clinically ill)

	Moderate scenario (1968 - type)†	Severe scenario (1918 - type) †
Deaths	304	2,573
Hospitalizations§	1,363	11,375
Total hospital beds needed§	1,576	13,176
Outpatients€	64,274	54,749

*Gross attack rate = % of Wyoming population which are assumed to become clinically ill with influenza during the next pandemic.
†Source: Calculated using FluAid 2.0. See Appendix I for further details.
§ As a health outcome, the term "hospitalizations" refers to those who are hospitalized due to influenza-related illness but survive (i.e., their end health outcome is hospitalization). However, a percentage of those who will die from influenza-related illnesses are likely to die in hospital. Thus, total hospital beds required will be the sum of hospitalizations + deaths in hospital. We have assumed, for the sake of illustration that 70% of influenza-related deaths will occur in hospital.
€ Outpatient visits is calculated by (total symptomatic-deaths-hospitalizations)*% seeking care. It is assumed that approx 50% will seek care.

Table 2: Total estimates, per health outcome, from two scenarios of potential impact of next influenza pandemic in Wyoming: Gross Attack Rate* of 35% (172,824 clinically ill)

	Moderate scenario (1968 - type)†	Severe scenario (1918 - type) †
Deaths	427	3,603
Hospitalizations§	1,907	15,926
Total hospital beds needed§	2,206	18,448
Outpatients	89,984	76,648

*Gross attack rate = % of Wyoming population which are assumed to become clinically ill with influenza during the next pandemic.
†Source: Calculated using FluAid 2.0. See Appendix I for further details.
§ As a health outcome, the term "hospitalizations" refers to those who are hospitalized due to influenza-related illness but survive (i.e., their end health outcome is hospitalization). However, a percentage of those who will die from influenza-related illnesses are likely to die in hospital. Thus, total hospital beds required will be the sum of hospitalizations + deaths in hospital. We have assumed, for the sake of illustration that 70% of influenza-related deaths will occur in hospital.
€ Outpatient visits is calculated by (total symptomatic-deaths-hospitalizations)*% seeking care. It is assumed that approx 50% will seek care.

Caveats: Constructing a worst-case scenario using data from the 1918 influenza pandemic means that death-rate data were used that have a unique pattern that has not been seen since. Specifically, the death rates among men aged 20–44 years of age were about equal to those recorded among children less than 5 years old and adults aged more than 65 years. Typically, death rates among healthy adults aged 20–44 years of age are less than a quarter of the death rates among either the very young or those over 65 years of age or older.

Demand for hospital resources: Tables 3-6 illustrate the potential impact of the next influenza pandemic on Wyoming's hospital-based resources. Note that the demand for hospital beds is the sum of those hospitalized (but surviving), plus estimated deaths in hospital. For the sake of illustration, it is assumed that 70% of influenza-related deaths will occur in hospital. The assumptions and methodology used to produce the results shown in the following tables are given in Technical Appendix II.

Essentially, the tables illustrate whether or not Wyoming currently has sufficient hospital-based capacity to absorb all the patients as they become ill and seek hospital admission. Note that the capacity estimates were calculated assuming that 1224 non-ICU beds and 112 ICU beds would be available. These numbers of beds represent the total current hospital bed capacity. Because some hospital capacity must always be reserved for patients other than those ill from infectious diseases (e.g., maternity, trauma), actual current capacity to absorb pandemic influenza patients is less than the total of all hospital beds available. Adjustments to current capacity, such as opening up emergency or temporary wards, will alter capacity.

Table 3: Demand for hospital resources: 1968–type scenario: 25% attack rate: 8 wks duration

Pandemic Influenza Impact		Weeks									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Hospital Admission	Weekly admissions	96	160	240	305	305	204	160	96		
	Peak admissions/day				47	47					
Hospital Capacity	# of flu pts in hospital	71	118	177	224	232	204	156	103		
	% of hospital capacity	6%	10%	14%	18%	19%	17%	13%	8%		
ICU Capacity	# of flu patients in ICU	14	31	47	62	67	65	52	36		
	% of ICU capacity	13%	27%	42%	55%	60%	58%	46%	32%		
Ventilator Capacity	# of flu pts on ventilators	7	15	23	31	34	33	26	18		
	% usage of ventilators	7%	16%	24%	32%	34%	33%	26%	18%		
Deaths	# of deaths from flu			19	31	47	59	59	47	31	19
	# of flu deaths in hospital			13	22	33	42	42	33	22	13

* % capacity calculated assuming 1224 beds available and 112 ICU beds. These numbers of beds represent the total hospital bed capacity. Actual capacity to absorb pandemic influenza patients will be less than that, and thus the estimates of percentage of capacity needed are smaller than what may occur.
Source: Calculated using FluSurge 2.0 – see Appendix II for additional details

Table 4: Demand for hospital resources: 1968–type scenario: 35% attack rate: 8 wks duration

Pandemic Influenza Impact		Weeks									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Hospital Admission	Weekly admissions	135	224	337	426	426	337	224	135		
	Peak admissions/day				66	66					
Hospital Capacity	# of flu pts in hospital	99	165	247	313	325	285	219	144		
	% of hospital capacity	8%	13%	20%	26%	27%	23%	18%	12%		
ICU Capacity	# of flu patients in ICU	20	43	66	87	94	91	73	50		
	% of ICU capacity needed*	18%	38%	59%	78%	84%	82%	65%	45%		
Ventilator Capacity	# of flu pts on ventilators	10	21	33	43	47	46	36	25		
	% usage of ventilators	10%	22%	34%	44%	48%	47%	37%	26%		
Deaths	# of deaths from flu			26	44	66	83	83	66	44	26
	# of flu deaths in hospital			18	31	46	58	58	46	31	18

* % capacity calculated assuming 1224 beds available and 112 ICU beds. These numbers of beds represent the total hospital bed capacity. Actual capacity to absorb pandemic influenza patients will be less than that, and thus the estimates of percentage of capacity needed are smaller than what may occur.
Source: Calculated using FluSurge 2.0 – see Appendix II for additional details

Table 5: Demand for hospital resources: 1918–type scenario: 25% attack rate: 8 wks duration

Pandemic Influenza Impact		Weeks									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Hospital Admission	Weekly admissions	791	1,318	1,976	2,503	2,503	1,976	1,318	791		
	Peak admissions/day				390	390					
Hospital Capacity	# of flu pts in hospital	581	969	1453	1840	1905	1675	1284	843		
	% of hospital capacity	47%	79%	119%	150%	156%	137%	105%	69%		
ICU Capacity	# of flu patients in ICU	119	251	386	510	552	537	427	295		
	% of ICU capacity needed*	106%	225%	345%	455%	493%	480%	381%	263%		
Ventilator Capacity	# of flu pts on ventilators	59	126	197	255	276	269	213	147		
	% usage of ventilators	61%	128%	197%	260%	282%	274%	218%	150%		
Deaths	# of deaths from flu			154	257	386	489	489	386	257	154
	# of flu deaths in hospital			108	180	270	342	342	270	180	108

* % capacity calculated assuming 1224 beds available and 112 ICU beds. These numbers of beds represent the total hospital bed capacity. Actual capacity to absorb pandemic influenza patients will be less than that, and thus the estimates of percentage of capacity needed are smaller than what may occur.
Source: Calculated using FluSurge 2.0 – see Appendix II for additional details

Table 6: Demand for hospital resources: 1918–type scenario: 35% attack rate: 8 wks duration

Pandemic Influenza Impact		Weeks									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Hospital Admission	Weekly admissions	1,107	1,845	2,767	3,505	3,505	2,767	1,845	1,107		
	Peak admissions/day				546	546					
Hospital Capacity	# of flu pts in hospital	814	1,356	2,034	2,577	2,668	2,345	1,798	1,180		
	% of hospital capacity	66%	111%	166%	211%	218%	192%	147%	96%		
ICU Capacity	# of flu patients in ICU	166	352	541	714	773	752	598	413		
	% of ICU capacity needed*	148%	314%	483%	638%	690%	671%	534%	368%		
Ventilator Capacity	# of flu pts on ventilators	83	176	270	357	386	376	299	206		
	% usage of ventilators	85%	180%	276%	364%	394%	384%	305%	211%		
Deaths	# of deaths from flu			216	360	540	685	685	540	360	216
	# of flu deaths in hospital			151	252	378	479	479	378	252	151

* % capacity calculated assuming 1224 beds available and 112 ICU beds. These numbers of beds represent the total hospital bed capacity. Actual capacity to absorb pandemic influenza patients will be less than that, and thus the estimates of percentage of capacity needed are smaller than what may occur.
Source: Calculated using FluSurge 2.0 – see Appendix II for additional details

Appendix I

Wyoming: Influenza Pandemic Moderate Scenario: 1968 - type
Calculating health outcomes: Methods and results

Methodology:
To calculate the potential impact on Wyoming of the next influenza impact, the software called FluAid 2.0 was used.

Population and age groups: The age groups set in FluAid were used, which are 0–18 years, 19–64 years, and 65+ years. The population of Wyoming was entered as presented in Table AI.1, below.

Table AI.1: Wyoming's population, by age:

Age group, years	Subtotal
0–18	145,346
19–64	290,743
65+	57,693
Total	493,782

Source: 200 US Census Bureau

Risk groups: A key component in estimating the potential impact of the next influenza pandemic is the proportion of Wyoming's population that, because of pre-existing medical conditions, are at high risk of influenza-related adverse health outcomes. For this exercise, FluAid's default values were used (see Table AI.2, below).

Rates of health outcomes: FluAid default rates of health outcomes (deaths, hospitalizations, outpatient visits) were used. These rates come, in most part, from U.S. data from the late 1960s and early 1970s (just after the 1968 influenza pandemic), with some rates from the 1957 influenza pandemic. See Meltzer et al. for additional details (Emerg Infect Dis 1999;5:659–671). See Table AI.2 for rates used.

Special note: Hospitalizations: The term "hospitalizations" as used in FluAid refers to final health outcome. That is, in FluAid, the term "hospitalizations" refers to those who are admitted to the hospital due to influenza-related illness but who survive. However, it is reasonable to assume that some portion of those whose ultimate influenza-related health outcome will be death will die in hospital. Those death-in-hospital cases are in addition to the FluAid calculated hospitalizations. See Appendix II for further details.

Gross clinical attack rate: The default gross clinical attack rates of 15%, 25%, and 35% were used.

Table AI.2: Input values used to calculate the potential impact on Wyoming of the next influenza pandemic: Moderate scenario: 1968 –type

High Risk percentages by age group						
Age group		**%**				
0–18 years		6.4%				
19–64 years		14.4%				
65+ years		40.0%				
Deaths: Rates by age and risk groups						
		Rates per 1,000 age and risk population				
High Risk		**Minimum**		**Most likely**		**Maximum**
0–18 years		0.126		0.22		7.65
19–64 years		0.1		2.91		5.72
65+ years		2.76		4.195		5.63
		Rates per 1,000 age and risk population				
Non High Risk		**Minimum**		**Most likely**		**Maximum**
0–18 years		0.014		0.024		0.125
19–64 years		0.025		0.037		0.09
65+ years		0.28		0.42		0.54
Hospitalizations: Rates by age and risk groups						
		Rates per 1,000 age and risk population				
High Risk		**Minimum**		**Most likely**		**Maximum**
0–18 years		2.1		2.9		9
19–64 years		0.83		2.99		5.14
65+ years		4		8.5		13
		Rates per 1,000 age and risk population				
Non High Risk		**Minimum**		**Most likely**		**Maximum**
0–18 years		0.2		0.5		2.9
19–64 years		0.18		1.465		2.75
65+ years		1.5		2.25		3
Outpatient visits: Rates by age and risk groups						
		Rates per 1,000 age and risk population				
High Risk		**Minimum**		**Most likely**		**Maximum**
0–18 years		289		346		403
19–64 years		70		109.5		149
65+ years		79		104.5		130
		Rates per 1,000 age and risk population				
Non High Risk		**Minimum**		**Most likely**		**Maximum**
0–18 years		165		197.5		230
19–64 years		40		62.5		85
65+ years		45		59.5		74

Source: Default values in FluAid 2.0, available at: http://www.dhhs.gov/nvpo/pandemics/

Results: The complete results produced by FluAid for a 1968-type scenario are presented below.

Table AI.3: Potential impact on Wyoming of the next influenza pandemic: 1968-type scenario.

Population: Numbers and distribution by age and risk group						
Risk groups		**0-18 yrs**	**19-64 yrs**	**65+ yrs**	**Totals**	**% total**
Non-high risk*		136,044	248,877	34,616	419,537	85
High risk*		9,302	41,866	23,077	74,245	15
	Totals	145,346	290,743	57,693	493,782	100

Note: High risk refers to pre-existing medical conditions (e.g., asthma, diabetes, heart and lung conditions) that increase risk of influenza-related adverse health outcome.

Deaths: By age group										
		Gross attack rate						**Distribution of deaths by risk group**		
Age groups		**15%**		**25%**		**35%**			**% high risk**	**% all deaths**
0-18 yrs	most likely	2		4		5		0-18 yrs	0	1
19-64 yrs	most likely	91		152		212		19-64 yrs	42	48
65+ yrs	most likely	95		158		221		65+ yrs	41	51
TOTALS	most likely	188		314		438		Totals	83	100

Hospitalizations:* By age group										
		Gross attack rate						**Distribution of hospitalizations by risk group**		
Age groups		**15%**		**25%**		**35%**			**% high risk**	**% all hospital**
0-18 yrs	most likely	41		68		95		0-18 yrs	1	5
19-64 yrs	most likely	537		896		1,254		19-64 yrs	10	65
65+ yrs	most likely	252		420		589		65+ yrs	19	30
TOTALS	most likely	830		1,384		1,938		Totals	30	100

Outpatients: By age group										
		Gross attack rate						**Distribution of outpatients by risk group**		
Age group		**15%**		**25%**		**35%**			**% high risk**	**% all outpatient**
0-18 yrs	most likely	12,895		21,491		30,087		0-18 yrs	3	32
19-64 yrs	most likely	22,433		37,389		52,344		19-64 yrs	8	56
65+ yrs	most likely	4,478		7,464		10,450		65+ yrs	5	11
TOTALS	most likely	39,806		66,344		92,881		Totals	16	99

*The term "hospitalizations" refers to those who are admitted to hospital due to influenza-related illness, but who survive. However, it is reasonable to assume that some portion of those whose ultimate influenza-related health outcome will be death will die in hospital. Those death-in-hospital cases are in addition to the FluAid calculated hospitalizations. See Appendix II for further details.

Wyoming: Influenza Pandemic Severe Scenario: 1918- type scenario
Calculating health outcomes: Methods and results

Caveats in estimating a 1918-type scenario
While there are a number of sources recording the death rates due to the 1918 pandemic, such sources typically don't record rates by risk group (risk of adverse health outcomes due to pre-existing health conditions). However, when faced with having to allocate potentially limited resources, such as vaccines, policy makers may well wish to know the death rates and number of deaths by both age and risk group.

Further, any use of 1918-based death rates implicitly assumes that a user is accepting the pattern of deaths experienced in 1918. This pattern includes a notably higher-than-normal death rate among otherwise healthy 20-40 year olds (see review by Taubenberger JK, Morens DM. Emerg Infect Dis 2006;12:15–22). Such a death rate among this age group has not been experienced since the 1918 pandemic (either in later pandemics or during non-pandemic years).

Methodology

Population and age groups: The same population and age groups were used as were used in calculating the 1968-type scenario.

Risk groups: FluAid's default values were used (see Table AI.2, above).

Health outcomes rates
Need for a scaling factor: The easiest way to produce estimates of potential impact of the next influenza pandemic assuming a 1918-type scenario is to use FluAid (as described in producing 1968-type estimates), but altering FluAid's default rates of health outcomes with a scaling factor. A user would essentially multiply FluAid's default rates of death (which represent a 1968-type scenario) by a scaling factor to get rates of death for a 1918-type scenario.

Calculating a scaling factor: To calculate a scaling factor that can be used to scale-up FluAid default death rates from a 1968-type scenario to produce a 1918-type scenario requires estimating deaths under both scenarios for the same population. Then, by comparing the number of deaths, the scaling factor can be readily calculated. The endnotes to this appendix contain the details of the calculations made.

Scaling factor to use: From the comparison of estimated deaths from a 1968- type scenario and a 1918-type scenario, the age-weighted average scaling factor is 8.22 (see endnotes for details as to how this was calculated). This is the factor by which to multiply the FluAid default (1968-type scenario) death rates so as to obtain estimates of deaths under a 1918-type scenario.

Death rates to estimate a 1918-type scenario: Table AI.4 presents the results of multiplying FluAid's 1968-type scenario default death rates (see Table AI.2) by the scaling factor.

Rates of hospitalizations to estimate a 1918- type scenario: There are little or no data from the 1918 influenza pandemic regarding hospitalization rates or rates of outpatient visits. And, even if such data existed, it is questionable if it would be relevant in society today. The context of a hospitalization has changed greatly in the past 100 years. Improved hospital-based technology and better trained hospital-based staff (of all types) has resulted in different set of outcomes and different expectations associated with hospitalizations. Overall, because of the changes in technology, there may be a different set of reasons (or a different "trigger point") that will cause a patient to go to a hospital seeking admission. Similar problems exist for rates of outpatient visits.

Because there are little or no data regarding rates of hospitalizations during the 1918 influenza pandemic, it was assumed (and it is only an assumption) that the same differences in death rates between the 1968-type scenario and the 1918-type scenario (i.e., the scaling factor) would also apply to differences in rates of hospitalizations. That is, if death rates in the 1918-type scenario were approximately 8 times greater, on average, than the death rates in the 1968-type scenario, then it was assumed that the same differences existed in hospitalization rates. Again, this is just an assumption and there are no data to support the idea that such an assumption would be "reasonable." Table AI.4 presents FluAid's default rates of hospitalization multiplied by a scaling factor of 8.22 (the same scaling factor used to produce 1918-type rates of death).

Rates of outpatient visits: There are no data concerning the rates of outpatient visits in 1918. And, similar to the discussion concerning rates of hospitalization for a 1918-type scenario, even if data on rates of outpatient visits in 1918 existed, it is questionable if such data would be relevant in society today (for example, many physicians made house calls in 1918—a practice that all but disappeared by the late 20th century). The context of an outpatient visit has changed greatly in the past 100 years.

However, because of the already high rates of outpatient visits in the 1968-type scenario (see Table AI.2), calculating outpatient visits for a 1918-type scenario using a scaling factor of 8.22 (used to produce the rates of death and hospitalizations in Table AI.4) would result in too many outpatients being calculated (often more outpatients than actual symptomatic cases). Therefore, I could not use a methodology similar to that used to calculate the hospitalizations for the 1918-type scenario.

Therefore, to calculate outpatient visits for a 1918-type scenario, the following methodology was used:

First, the total number of symptomatic cases, by age group, was calculated:

> For example, for age group 0–18 years: Total symptomatic cases = Total population × gross clinical attack rate of 25% × percent of total population aged 0–18 years.
>
> Repeat the above calculation for other age groups.

Second, the total number of outpatients plus those ill but requiring no medical care was calculated as follows:

> For a given age group: The total number of outpatients + ill no medical care = total symptomatic cases – deaths – hospitalizations.

Third, it was assumed that 50% of the total number of outpatients + ill no medical care patients would seek medical care.

Gross clinical attack rate: The same gross clinical attack rates were used as used in estimating the 1968-type scenario.

Table AI.4: Input values used to calculate the potential impact on Wyoming of the next influenza pandemic: Severe scenario: 1918- type

High Risk percentages by age group			
Age group	**%**		
0-18 yrs	6.40%		
19-64 yrs	14.40%		
65+ yrs	40.00%		
Deaths: Rates by age and risk groups			
		Rates per 1,000 age and risk population	
High Risk	**Minimum**	**Most likely**	**Maximum**
0-18 yrs	1.036	1.808	62.883
19-64 yrs	0.822	23.920	47.018
65+ yrs	22.687	34.483	46.279
		Rates per 1,000 age and risk population	
Non High Risk	**Minimum**	**Most likely**	**Maximum**
0-18 yrs	0.115	0.197	1.028
19-64 yrs	0.206	0.304	0.740
65+ yrs	2.302	3.452	4.439
Hospitalizations: Rates by age and risk groups			
		Rates per 1,000 age and risk population	
High Risk	**Minimum**	**Most likely**	**Maximum**
0-18 yrs	17.262	23.838	73.980
19-64 yrs	6.823	24.578	42.251
65+ yrs	32.880	69.870	106.86
		Rates per 1,000 age and risk population	
Non High Risk	**Minimum**	**Most likely**	**Maximum**
0-18 yrs	1.644	4.110	23.838
19-64 yrs	1.480	12.042	22.605
65+ yrs	12.330	18.495	24.66
Outpatient visits: Rates by age and risk groups			
FluAid was not used to calculate the numbers of outpatients. See above text of this Appendix for further details			

Source: These rates were calculated by multiplying FluAid's default rates (see Table AI.2) by a weighted average scaling factor of 8.22. See text in this appendix for further details.

Results: The complete results produced by FluAid for a 1918-type scenario are presented below.

Table AI.5: Potential impact on Wyoming of the next influenza pandemic: 1918- type scenario.

Population: Numbers and distribution by age and risk group										
Risk groups		**0-18 yrs**	**19-64 yrs**	**65+ yrs**	**Totals**	**% total**				
Non-high risk*		136,044	248,877	34,616	419,537	85				
High risk*		9,302	41,866	23,077	74,245	15				
	Totals	145,346	290,743	57,693	493,782	100				
Note: High risk refers to pre-existing medical conditions (e.g., asthma, diabetes, heart and lung conditions) that increase risk of influenza-related adverse health outcome.										
Deaths: By age group										
		Gross attack rate						**Distribution of deaths by risk group**		
Age groups		**15%**		**25%**		**35%**			**% high risk**	**% all deaths**
0-18 yrs	most likely	19		31		44		0-18 yrs	0	1
19-64 yrs	most likely	748		1,246		1,745		19-64 yrs	42	48
65+ yrs	most likely	778		1,296		1,814		65+ yrs	41	50
TOTALS	most likely	1,545		2,573		3,603		Totals	83	99
Hospitalizations:* By age group								**Distribution of hospitalizations by risk group**		
		Gross attack rate								
Age groups		**15%**		**25%**		**35%**			**% high risk**	**% all hospital**
0-18 yrs	most likely	335		558		781		0-18 yrs	1	5
19-64 yrs	most likely	4,417		7,362		10,307		19-64 yrs	10	65
65+ yrs	most likely	2,073		3,455		4,838		65+ yrs	19	30
TOTALS	most likely	6,825		11,375		15,926		Totals	30	100

* The term "hospitalizations" refers to those who are admitted to hospital due to influenza-related illness, but who survive. However, it is reasonable to assume that some portion of those whose ultimate influenza-related health outcome will be death will die in hospital. Those death-in-hospital cases are in addition to the FluAid calculated hospitalizations. See Appendix II for further details.

Endnote: Calculating a scaling factor to convert 1968-type death rates to those suitable to calculate a 1918-type scenario

These set of endnotes provide an explanation of the calculations used to produce the scaling factor of 8.22. This scaling factor is used to convert the FluAid default, 1968-type death and hospitalization rates, into death and hospitalization rates for a 1918-type scenario.

Step 1: Calculating clinical cases by age group for 1918-type scenario

The weighted average scaling factor was calculated by first multiplying the total population (Table E1) by a set gross clinical attack rate (e.g., 15%) and then distributing the total cases by age, using the distributions given in Table E2 (e.g., For 0–18 years; 288.367 million × 0.15 × 0.476 = 20.58 million cases). For the entire population, at a 15% gross clinical attack rate, this gives total of approximately 43 million cases (Table E3). Note that the source of distribution of cases by age (Table E2) provides slightly different age categories. It is assumed that using slightly different age categories does not alter the distribution of cases (e.g., using 0–18 years instead of 0–14 years does not alter the 47.6% of all cases accruing in that age group as shown in Table E2).

Table E1: U.S. population, by age, 2002

Age group, years	Millions
0–18	81.022
19–64	160.132
65+	47.213
Total	288.367

Source: Statistical Abstract of the United States: 2003: Table No. 11 (page 13).

Table E2: Distribution of cases by age for 1918-type scenario

Age group, years	% of cases
0–14	47.6
15–65	48.9
65+	3.5

Source: Figure 3, Frost WH. Public Health Reports 1920;35:584–597.

Table E3: Calculated total number of clinical cases: 15% attack rate

Age group, years	Clinical cases (millions), Gross clinical attack rate 15%
0–18	20.588114
19–64	21.165153
65+	1.501783
Total	43.255050

Source: Calculated by multiplying the total number of cases in the entire population (Table E1), assuming a 15% gross clinical attack rate.

Step 2: Calculating deaths by age group for 1918-type scenario
The number of cases per age group (Table E3) is then multiplied by average age-specific case fatality rates experienced in the 1918 influenza pandemic in the United States (Table E4). It is assumed that using slightly different age categories does not alter the case fatality rates. For example, for the age group 0–18 years, the following formula is used: 20.59 million clinical cases (Table E3) x average case fatality rate of 0.96% (Table E4) = 197,645 deaths (20.59 × 0.0096 = 197,645).

Table E4: 1918: U.S. case fatality rates

Case fatality rates from 1918 U.S. data			
Gender weighted average case fatality rates			
Locales*	0-14yrs	15-65yrs	65+yrs
Locales 1	1.3%	2.6%	4.4%
Locales 2	0.7%	1.3%	1.9%
Locales 3	0.9%	3.5%	6.4%
Averages	0.96%	2.46%	4.21%

* Locales, all in United States
1 New London, Baltimore, Maryland (minor communities)
2 Macon, Spartanburg, San Antonio, Augusta, Des Moines, Little Rock, Louisville
3 San Francisco
Source: Figure 7, Frost WH. Public Health Reports, 1920; 35:584-597

Step 3: Calculate deaths for 1968-type scenario
The model from Meltzer et al. (Emerg Infect Dis 1999;5:659–671) was then re-run, using the 2002 estimates of the U.S. population (Table E1). Specifically, the model was re-run using the distribution of cases for Scenario B developed by Meltzer et al. (see the online-only Appendix II, available at: http://www.cdc.gov/ncidod/eid/vol5no5/melt_back.htm). For Scenario B in Meltzer et al., the cases were distributed as follows: 0–19 years— 46%; 20–64 years—46.7%; 65+ years—7.3% (see Table 2 in Meltzer et al., Appendix II). The reason why Scenario B from Meltzer et al. was used is that, of the two scenarios presented in Meltzer et al., the distribution of cases in Scenario B most closely matches those measured in 1918 (Table E2).

Step 4: Calculate the scaling factor from 1968-type to 1918-type pandemic deaths for 1968-type scenario
With the two sets of estimates of deaths (calculated for a U.S. population as at 2002, assuming a 15% gross clinical attack rate), the scaling factor is then calculated as follows:

> For given age group: Scaling factor = (deaths in 1918-type scenario)/ (deaths in 1968-type scenario).

A global scaling factor is calculated as follows:

> Global scaling factor = (all deaths in 1918-type scenario)/(all deaths in 1968-type scenario).

Results:
Table E5 provides estimates of deaths, for a U.S, population as at 2002, for a 1968-type pandemic and a 1918-type pandemic.

As described in this Appendix, the global scale-up factor (8.22) is used to multiply FluAid's default (1968-type) death and hospitalization rates. This scaling up allows FluAid to be used to estimate a 1918-type scenario.

Table E5: Calculating a scaling factor using estimated deaths from two influenza pandemic scenarios (assuming a 15% gross clinical attack rate)

	Deaths: Thousands 15% gross clinical attack rate		
Age groups	**1968-type**	**1918-type**	**Scale-up FACTOR**
0–19 yrs	18.95118	226.7852	11.96681
20–60 yrs	72.79716	644.9231	8.859179
60+ yrs	24.06332	80.74335	3.355454
Totals	115.8117	952.4516	8.224143

Source: Estimates of deaths for 1968-tyep scenario calculated using Scenario B of model presented in Meltzer et al. (Emerg Infect Dis 1999;5:659–671). See text in endnote for more. Estimates of death for 1918-type scenario calculated as described in text of this endnote.

Appendix II:
Calculating the demand for hospital resources in Wyoming associated with the next influenza pandemic: Two scenarios

Methodology

To calculate the potential impact of the next influenza pandemic upon Wyoming's hospital resources, I used FluSurge 2.0 (available at: http://www.dhhs.gov/nvpo/pandemics/). The methodology is similar for both the 1968- type and 1918- type scenarios.

Table AII.1: Assumptions used for both scenarios to calculate demand for hospital-based resources over duration of pandemic

Total licensed non-ICU beds*	1224
Total licensed ICU beds:	112
Total number of ventilators:	98

*This number represents the total number of hospital beds in Wyoming. The actual number of beds available for pandemic influenza patients will be some proportion of this.

1968-type scenario

Population by age groups: The same population presented in Appendix I, table AI.1 was used.

Number of total licensed non-ICU beds: The number of beds available is listed in Table AII.1. For the purposes of this exercise, it was assumed that 100% of beds are available and staffed.

Total licensed ICU beds: The number of beds available is listed in Table AII.1. For the purposes of this exercise, it was assumed that 100% of beds are available and staffed.

Total number of ventilators: The number of ventilators available is listed in Table AII.1. For the purposes of this exercise, it was assumed that 100% of ventilators are available.

Duration and attack rate: Assumed 8 weeks duration and calculated for both 25% and 35% attack rates.

Assumptions used in FluSurge: Table AII.2 lists the default assumptions in used in FluSurge

Table AII.2: Assumptions used for both scenarios to calculate demand for hospital-based resources over duration of pandemic

	Input assumptions	Unit	Values
No. 1	Average length of non-ICU hospital stay for influenza-related illness	days	5
No. 2	Average length of ICU stay for influenza-related illness	days	10
No. 3	Average length of ventilator usage for influenza-related illness	days	10
No. 4	Average proportion of admitted influenza patients will need ICU care	Proportion	0.15
No. 5	Average proportion of admitted influenza patients will need ventilators	Proportion	0.075
No. 6	Average proportion of influenza deaths assumed to be hospitalized	Proportion	0.7
No. 7	Daily percentage increase in cases arriving compared to previous day	Percent	5

1918-type scenario
Using FluSurge to produce estimates of potential impact on demand for hospital-based resources for a 1918-type scenario is very similar as using FluSurge to produce estimates for a 1968-type scenario. The number of non-ICU beds, ICU beds, and other data should be the same as those used to estimate the impact for the 1968-type scenario.

Number of total deaths and hospitalizations: Table AII.3 presents the number of deaths and hospitalizations used in FluSurge to estimate the impact of a 1918-type scenario on hospital-based resources for 25% and 35% attack rates.

Table AII.3: Total hospitalizations used to calculate impact of 1918-type pandemic on hospital-based resources

Health outcomes	Gross attack rate 25%* Severe scenario (1918-type) †	Gross attack rate 35%* Severe scenario (1918-type) †
Deaths	2,573	3,603
Hospitalizations	11,375	15,926
Total hospital beds needed: Hospitalizations + deaths-in-hospital (70% of deaths)	13,176	18,448

Source: See Draft Report and Appendix I.