Influenza

Influenza is not a reportable disease in Louisiana. However, novel strains and influenza deaths in children be reported to the state health department. Cases of influenza like illness (ILI) are monitored through sentinel sites as a proxy measure of influenza activity.

Influenza is a viral infection of the lungs characterized by fever, cough and severe muscle aches. In younger adults and children, influenza causes debilitating, short-term illness. In elderly and high risk individuals, it is a major cause of disability and death (often as a result of secondary infection of the lungs by bacteria).

Individuals at high risk of complications are:

- aged six months to four years, or 65 and older
- pregnant women
- residents of chronic-care facilities
- those who are in long-term aspirin therapy
- those who have chronic pulmonary (including asthma), cardiovascular (except hypertension), renal, hepatic, hematological or metabolic disorders (including diabetes)
- those who are immunosuppressed (immunosuppression caused by meds or by HIV)
- those who are morbidly obese (body-mass index >40)

Influenza Sentinel Surveillance Program

It is estimated that between 450,000 and 900,000 Louisiana residents become infected with influenza each year. Because influenza infections are so common, the reporting system could not rely on the passive case reporting of confirmed cases as done with most infectious diseases. Estimating the number of individual flu cases in the United States is very challenging because:

1-many people with flu don't seek medical care and

2-only a small number of those that do seek care are tested

3-More people who are hospitalized or die of flu-related causes are tested and reported, but under-reporting of hospitalizations and deaths occurs as well.

For this reason the Centers for Disease Control and Prevention (CDC) monitors influenza activity levels and trends and virus characteristics through a nationwide surveillance system and uses statistical modeling to estimate the burden of flu illness (including hospitalizations and deaths) in the United States.

Reporting is done on **suspected cases from sentinel sites**. These sentinel surveillance sites are physicians' offices and hospital emergency departments. Currently, there are about 60 sites participating in the influenza sentinel surveillance system.

Suspected cases are called "Influenza-Like Illnesses" or ILI. To meet the definition of ILI, a case must:

1. have a fever (≥100°F),
2. and have upper respiratory tract infection symptoms (cough, sore throat),
3. and no other obvious cause for this infection.

The numbers of ILI and denominator data (number of visits to the facility) are reported weekly by the sentinel facilities to the Office of Public Health (OPH). Cases are categorized into four age groups (in years): newborn to four; five to 24; 25 to 49; 50 to 64; 65 and older. For physicians, the denominator is the number of patients seen that week; for hospitals, it is the weekly total of all emergency department visits.

Influenza season begins between October and December each year and ends between December and March. The duration of influenza season varies between nine and 17 weeks. The intensity of the season (defined as the proportion of patient visits due to ILI in the physicians' offices) ranges from 2% to 10% (Figure 1, Table 1).

Figure 1: Seasonal distribution of influenza – Louisiana, 2006-2011

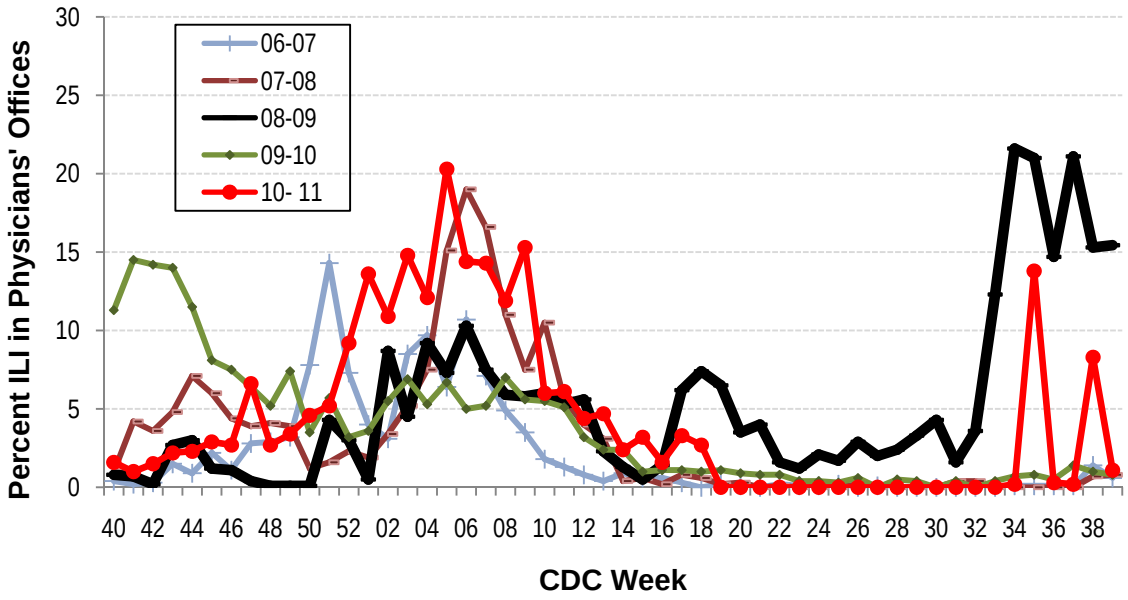


Table 1: Seasonal Distribution of Influenza-Like Illnesses as percentage of visits among sentinel sites – Louisiana, 1999-2011

Percent ILI / Visits Emergency Dept & Physicians' office
0-0.9
1-1.9
2-2.9
3-3.9
4-4.9
5-9.9
10+

Wk	Month	98-99	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
40	Oct	0.8	0.2	0.2	1.0		0.0	0.0	1.0	0.8	0.9	7.1	2.4
41		0.9	0.2	0.3	1.0	1.2	0.1	0.0	1.4	1.5	0.8	9.1	2.0
42		1.0	0.1	0.7	1.0	0.9	0.5	0.0	0.7	1.4	0.6	9.5	2.6
43		1.0	0.1	0.4	1.0	3.3	0.2	0.1	1.7	1.6	0.7	6.9	2.1
44	Nov	1.0	0.3	0.8	1.2	2.7	0.2	0.1	1.5	2.3	1.4	7.0	3.0
45		1.2	0.3	0.7	1.3	5.2	0.2	0.2	2.0	2.1	1.4	5.3	2.2
46		1.2	0.2	0.6	1.2	3.7	0.1	0.3	1.6	2.1	1.3	5.3	2.8
47		1.3	0.4	0.4	1.0	1.5	0.0	0.2	2.2	2.5	1.2	5.3	3.2
48	Dec	1.4	0.3	0.2	0.5	1.9	0.8	0.6	2.2	2.0	2.2	4.5	2.9
49		1.4	0.3	0.4	0.7	1.4	0.0	0.7	2.9	3.0	1.2	5.3	2.6
50		1.5	1.6	0.5	1.0	1.9	0.1	1.1	6.0	2.1	1.4	3.5	3.6
51		1.5	1.4	0.5	1.2	0.5	0.0	0.6	8.3	2.5	2.0	4.6	3.6
52		1.5	2.6	2.1	0.5	0.9	0.4	0.9	5.7	3.1	3.2	5.0	5.6
01	Jan	1.0	3.6	2.0	0.9	0.4	0.9	0.7	5.0	2.8	2.2	4.3	4.6
02		0.8	3.0	2.1	2.3	0.7	1.5	0.6	4.0	2.6	2.4	3.8	5.9
03		3.8	2.1	2.9	1.7	0.6	0.8	0.9	4.5	4.4	2.4	4.4	8.1
04		3.0	2.9	2.0	3.4	0.6	0.7	1.2	4.7	6.6	3.3	4.0	7.8
05		2.7	1.4	2.1	4.8	0.3	0.9	1.6	4.6	10.4	4.1	4.9	10.2
06	Feb	3.8	0.8	1.6	3.6	0.3	2.0	1.0	5.8	12.4	6.9	3.9	7.5
07		6.8	0.7	1.4	1.7	0.3	2.1	1.4	4.6	9.3	6.8	4.6	7.4
08		5.4	0.5	0.5	1.2	0.3	2.7	1.0	4.9	8.7	4.8	5.4	5.2
09		5.0	0.2	2.8	0.9	0.3	2.8	0.8	2.9	5.7	5.0	4.4	4.7
10	Mar	5.9	0.1	0.9	0.8	0.2	1.9	1.1	2.3	5.5	4.0	4.0	3.6
11		6.7	0.1	0.9	0.8	0.2	2.2	0.8	2.1	3.2	3.4	4.0	3.7
12		7.8	0.1	1.0	0.7	0.2	0.5	0.6	1.8	3.4	3.4	3.1	3.0
13		6.5	0.0	0.1	0.6	0.2	0.1	0.4	1.5	2.9	2.4	2.5	1.9
14	Apr	3.2	0.1	0.2	0.5	0.2	0.2	0.3	1.2	2.0	1.8	2.7	2.4
15		2.0	0.1	0.1	0.3	0.2	0.2	0.2	1.0	2.0	1.5	1.8	1.4
16		1.0	0.1	0.1	0.3	0.2	0.1	0.1	0.9	1.0	1.2	1.7	1.6
17		0.5	0.1	0.1	0.3	0.2	0.0	0.1	0.8	1.1	4.8	1.9	2.0
18	May	0.1	0.1	0.1	0.3	0.2	0.0	0.2	0.8	0.6	5.4	2.1	1.6
19		0.1	0.1	0.1	0.3	0.2	0.0	0.1	0.9	0.6	5.0	1.7	0.5
20		0.1	0.1	0.1	0.1	0.2	0.0	0.1	1.0	0.9	2.9	1.7	1.0
21							0.0	0.0	0.9	0.6	2.9	1.5	1.1
22	Jun						0.0	0.2	0.9	0.7	1.6	1.9	0.9
23							0.0	0.2	0.6	0.3	1.4	1.6	0.9
24							0.0	0.2	0.5	0.6	1.7	1.2	1.0
25							0.0	0.5	0.7	0.9	1.4	1.2	1.0
26	Jul						0.0	1.1	0.6	1.1	2.1	0.9	1.0
27							0.0	2.0	0.5	0.5	2.3	0.7	0.7
28							0.0	0.5	0.7	0.6	2.5	0.6	1.0
29							0.0	0.5	0.5	0.5	2.5	1.1	0.9
30	Aug						0.0	1.8	0.4	0.5	2.6	0.8	1.1
31							0.0	1.1	0.5	0.6	1.5	0.8	0.9
32							0.0	1.6	0.4	0.5	1.0	0.7	0.9
33							0.0	2.2	0.4	0.6	0.8	1.2	1.0
34								2.3	0.4	0.3	4.0	0.9	1.5
35	Sep							2.6	0.5	0.9	0.4	1.9	1.9
36								1.3	0.4	0.8	0.3	1.9	1.5
37								1.4	0.4	0.8	0.3	1.5	1.4
38								1.0	0.7	0.8	0.2	1.4	1.3
39	Oct							0.7	0.6	0.8	0.2	1.5	1.2

Table 1 displays in the first column - the weeks of the year, starting at week 40, which is usually at the beginning of October. In the second column, the month is displayed. Depending on the year, the beginning of the month may be a row above or below. The following columns display the seasons 1998-1999 to 2000-2011. The indicator of the intensity of the influenza

season is the combined percentage of ILI (Influenza-like illness) among the patients that visit the sentinel emergency rooms and physicians' offices. In the early years (1998 to 2004) the surveillance was limited to the estimated transmission season. Starting in 2005, surveillance was carried year-round.

A mild season would be characterized by low percentages of ILI: from 1% to 3%. A high intensity season would show percentages of at least 5% and above.

The season 1998-1999 was unusual with a very slow start and a large peak (up to 8%) from February to April. Season 1999-2000 data is missing. From 2000 to 2002, seasonal transmission was low. The season 2003-2004 was very short with an early high peak at 5% in early November. The year 2005-2006 was a mild influenza season but was marked with some moderate activity in early September of 2006. It is important to remember that this surveillance is not specific for influenza. Outbreaks of other respiratory infections may also be shown as increased ILI. From 2006 on, the seasons were more intense, starting early in October and lasting until March.

Season 2008-2009 is the season when the novel H1N1 virus (Swine influenza virus from Mexico) pandemic occurred. The initial rows of column 0809 show en early and intense seasonal influenza starting at the beginning of October 2008 and lasting until the end of March 2009. By Mid-April and May 2009 a small high peak is detected, that is the initial surge of the novel H1N1 pandemic. From May to August 2009 the percentage of ILI was higher than expected for the season, resulting from a continuous moderate transmission of the novel virus. A few weeks after school started, in October 2009 an intense transmission took place with ILI percent reaching 9%. The pandemic lasted until April 2010. The season 2010-2011 showed a late onset but reaching a very high peak at above 10% ILI in February.

Age Distribution

Sentinel surveillance data from physicians and hospitals show major difference between the age group distribution of ILI and the population. The proportion of ILI

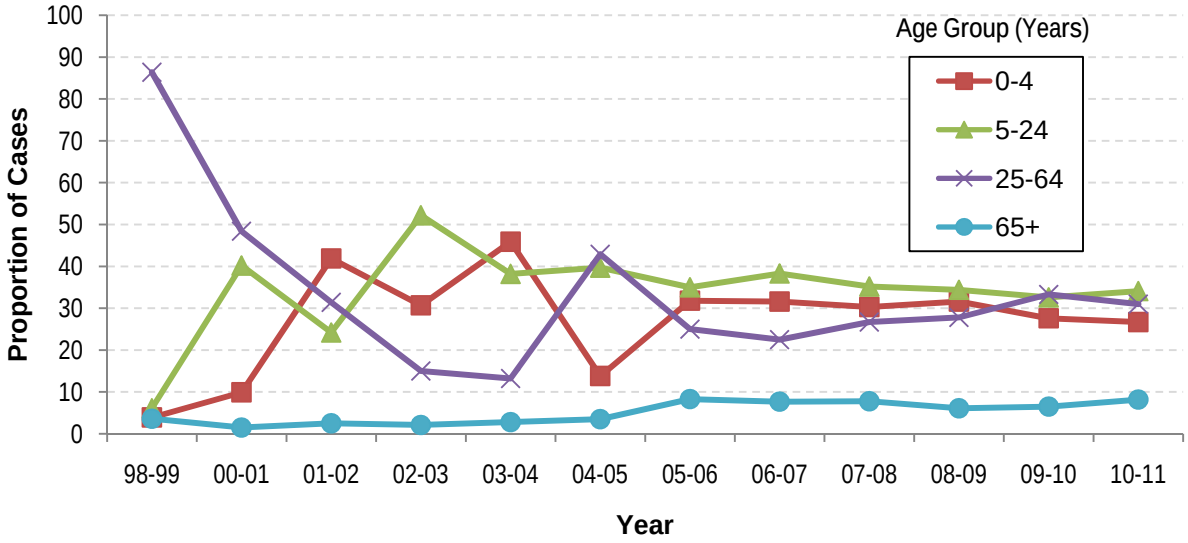
- is much higher among children younger than four years of age
- is similar among the five to 24-year age group
- is much lower among the 25 to 64 year age group
- is lower among the elderly (65+)

ILI activity does not show differences between males and females. The age group distribution of the proportion of cases shows some slight variations from year to year. (Table 2, Figure 2)

Table 2: Proportion of suspected cases (ILI) and of population by age group (years) Louisiana, 1998-2009

	0-4	5-24	25-64	65+
Total Cases	**29.7**	34.9	29.0	6.4
Population	7.2	29.5	**51.5**	**11.8**

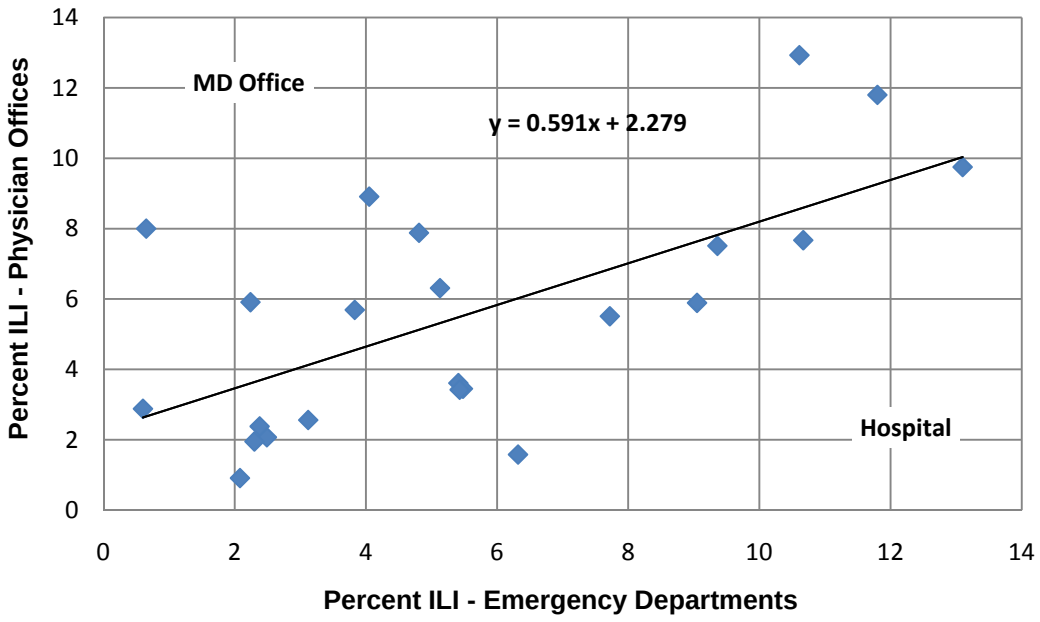
Figure 2: Proportion of cases by year - Louisiana, 1998-2011



Correlation Between ILI Proportion in Physicians' Offices and Hospital Emergency Departments

Figure 3 shows the correlation between the proportion of ILI among all visits in physicians' offices and emergency departments (ED) by region and by week (from week 2009-40 to week 2010-02). Each point in the graph represents a matched pair (% ILI in MD offices in the vertical axis; % ILI in ED in the horizontal axis).

Figure 3: Correlation between proportion of ILI visits in physicians' office and emergency departments – Louisiana - October, 2009 – January, 2010

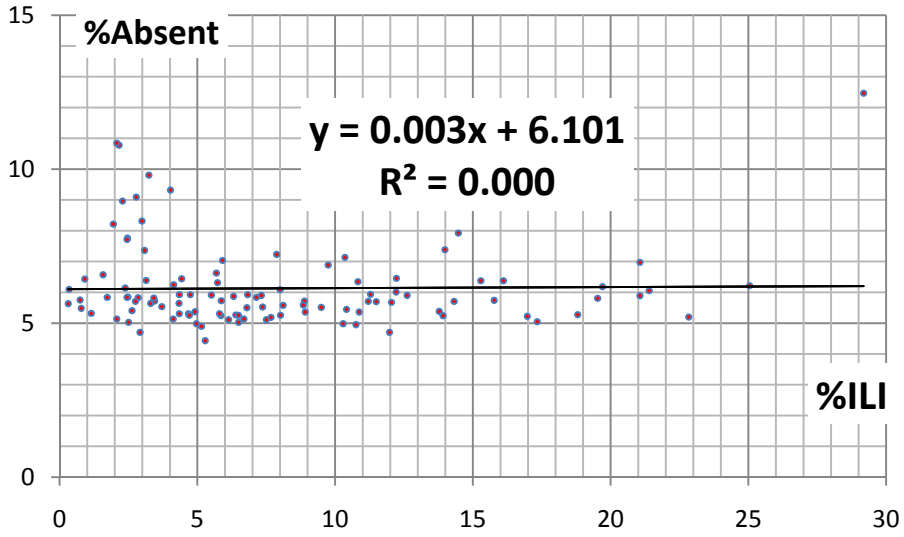


The slope of the regression line is 0.59, correlation coefficient 0.649, CI 0.323 to 0.837, Costas-Santos measure of disagreement 0.42. In summary there is a good correlation between the two methods.

School Absenteeism Does Not Correlate Well With ILI Data

During the 2009-2010 season data was systematically collected for most of the schools. Schools report daily their absenteeism data (number absent, enrollment) to the Department of Education in an electronic format. The electronic data was made available to Infectious Disease Epidemiology Section, OPH for monitoring school absenteeism under the assumption that school absenteeism was a reliable indicator of absenteeism secondary to illness, and particularly secondary to influenza during the pandemic. Absenteeism data collected in such a manner does not differentiate between absenteeism due to illness or any other causes (Figure 4).

Figure 4: Correlation Between School Absenteeism by Region and by Week
Louisiana - October 2009 - January 2010



Each point in the graph represents a matched pair (% Absenteeism in the vertical axis, % ILI in the horizontal axis, from week 2009-40 to week 2010-02). The slope of the regression line is 0.003, correlation coefficient 0.016, CI -0.174 to 0.204, Costas-Santos measure of disagreement 0.517. In summary there is an extremely poor correlation between the two methods. Using absenteeism on such a wide scale does not contribute to a better surveillance.

Hospital Discharge Data

Each year, Louisiana hospitals report hospital admission and discharge data to the state Department of Health and Hospitals (Louisiana Hospital Inpatient Discharge Database - LAHIDD). This data contains the number and nature of persons admitted to Louisiana hospitals. This dataset contains the main diagnosis and up to eight additional diagnoses for each patient,

recorded by ICD9 code. Records of patients with influenza were extracted using the following ICD9 codes whether in the main diagnosis or in the eight additional secondary diagnoses:

CODE	DISEASE
487.0	Influenza with pneumonia
487.1	Influenza with other respiratory manifestations
487.8	Influenza with other manifestations.

The total number of hospitalizations vary from 500 to 1,600 per year, with the rate varying from 15 to 35 per 100,000 population per year. The hospitalization rate and the proportion of ILI are not always parallel. The numbers and rates obtained from LAHIDD data do not represent the true burden of influenza hospitalizations because:

1-influenza is not systematically diagnosed and

2-there is no reliable way to determine the role of influenza in a hospitalization.

Mortality Data

Note on Influenza mortality from the CDC Website: Questions and Answers Regarding Estimating Deaths from Influenza in the United States.

Flu-related deaths are deaths that occur in people for whom influenza infection was likely a contributor to the cause of death, but not necessarily the primary cause of death. We do not know exactly how many people die from flu each year using death certificate data. There are several reasons for this: Influenza is infrequently listed on death certificates of people who die from flu-related complications and many flu-related deaths occur one or two weeks after a person's initial infection, either because the person may develop a secondary bacterial co-infection (such as a staph infection) or because influenza can aggravate an existing chronic illness (such as congestive heart failure or chronic obstructive pulmonary disease). Also, most people who die from flu-related complications are not tested for flu, or they seek medical care later in their illness when influenza can no longer be detected from respiratory samples. Influenza tests are only likely to detect influenza if performed within a week after onset of illness. For these reasons, many flu-related deaths may not be recorded on death certificates. These are some of the reasons that public health agencies in the United States and other countries use statistical models to estimate the annual number of flu-related deaths. However it is important to convey the full burden of flu to the public. Flu is a serious disease that causes illness and deaths nearly every year in the United States. CDC estimates of annual influenza-associated deaths in the United States are made using well-established scientific methods that have been reviewed by scientists outside of the CDC. The CDC feels that these estimates are a timely representation of the current burden of flu on the United States.

The number of influenza-associated (i.e., flu-related) deaths varies from year to year because flu seasons often fluctuate in length and severity. The CDC estimated that about 36,000 people died of flu-related causes each year, on average, during the 1990s in the United States. This figure includes people dying from complications of flu. This estimate came from a 2003 study published in the Journal of the American Medication Association (JAMA), which looked at the 1990-91 through the 1998-99 flu seasons [*Thompson WW et al. Mortality associated with influenza and respiratory syncytial virus in the United States. JAMA 2003; 289(2):179-186]*.

Statistical modeling was used to estimate how many flu-related deaths occurred among people whose underlying cause of death on their death certificate was listed as a respiratory or circulatory disease. During these years, the number of estimated deaths ranged from 17,000 to 52,000. In 2009, the CDC published additional estimates of flu-related deaths comparing different methods, including the methods used in the 2003 JAMA study. The seasons studied included the 1993-94 through the 2002-03 flu seasons *[Thompson WW et al. Estimates of U.S. influenza-associated deaths made using four different methods. Influenza and Other Respiratory Viruses 2009;3(1): 37-49.]*. Results from this study showed that during this time period 36,171 flu-related deaths occurred per year, on average.

The CDC uses underlying respiratory and circulatory (R&C) deaths in its mortality modeling because R&C deaths provide an estimate of deaths associated with respiratory infections that is more sensitive than underlying pneumonia and influenza (P&I) deaths and more specific than all-cause deaths. (Table 3)

The estimated ranges of cases, hospitalizations and deaths generated by this method provide a sense of scale in terms of the burden of disease caused by influenza. Quoting from the CDC: "*It may never be possible to validate the accuracy of these figures. The true number of cases, hospitalizations and deaths may lie within the range provided or it's also possible that it may lie outside the range. The underlying assumption in this method is that the level of influenza activity (based on hospitalization rates) in EIP sites matches the level of influenza like illness (ILI) activity across the states*".

Table 3: Cause of death related to influenza – United States and Louisiana, 1990-1999

Cause of Death	Number In USA	Number In LA	Proportion of Deaths in the Category
Pneumonia and influenza (P&I)	8,000	119	9.8%
Respiratory and circulatory (R&C)	36,000	545	3.1%
All-cause deaths	51,,000	772	2.2%