

# TempMed Staffing: Flu Season Staffing Plan Interim Report

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## Project Overview

Motivation: The United States has an influenza season where more people than usual suffer from the flu. Some people, particularly those in vulnerable populations, develop serious complications and end up in the hospital. Hospitals and clinics need additional staff to adequately treat these extra patients. TempMed Staffing provides this temporary staff.

Objective: Determine when to send staff, and how many, to each state.

Scope: TempMed Staffing covers all hospitals in each of the 50 states of the United States, and the project will plan for the upcoming influenza season.

## Research Hypothesis

Data analyzed took the assumption that [people suffering from seasonal flu symptoms often do not seek medical care or get tested until symptoms worsen or become so severe as to cause death. \(Why CDC Estimates the Burden of Season Influenza in the U.S.\)](#) Investigation sought to identify geographical areas that with higher numbers of deaths to examine the increased demand on medical facility staffing. From this, the research hypothesis was developed:

States with higher death rates from seasonal flu among people aged 65 years and older also have higher numbers of provider visits for suspected seasonal flu. (See Appendix, Hypothesis Development for additional explanation.)

## Data Overview

- [US Census Bureau](#): U.S. population information by location, age, and sex for the years 2009-2017.
- [CDC Influenza Patient Visits](#): data set collected by the Centers for Disease Control and Prevention from reports by 3,500 outpatient healthcare providers by U.S. state, from 2010 – 2019. It compiles information on visits to health care providers for influenza-like illness (ILI), defined as fever, cough, and/or sore throat.
- [National Center for Health Statistics \(NCHS\) Mortality Surveillance Data](#) – death certificate data from U.S. state vital statistics offices for all deaths classified by ICD-10 codes associated with influenza or pneumonia.

## Data Limitations

- [US Census Bureau](#)
  - Inaccuracies: There is the possibility of underrepresentation errors due to literacy, language barriers, and frequent address changes. The Census data are collected every 10 years, and then estimated for years in between the actual counts, so there is increased potential for error for years outside of 2010.
- [CDC Influenza Patient Visits](#)

- Inaccuracies: There is the potential for bias in the populations that are more likely or more able to visit a provider for influenza-like symptoms, so actual cases of suspected flu may be higher than data listed.
- Timeliness: Data available through 2017, a significant time lag to present flu season. Data collected after 2019 complicates analysis by the inclusion of COVID-19 related deaths in this data set.
- Incompleteness: There were no records listed for Florida in the dataset, which represents 6% of total population reported in the Census data over that period.
- [National Center for Health Statistics \(NCHS\) Mortality Surveillance Data](#)
  - Inaccuracies: Data is included for deaths listing the single cause ICD-10 code for “influenza and/or pneumonia.” Some pneumonia cases may be counted that were not caused by seasonal influenza, so the mortality counts reported could be higher than actual flu death counts. Additionally, many counts were suppressed in reporting, presumably for privacy, so there is additional concern of underreporting.
  - Incompleteness: Reporting includes only October through December of the included years.

## Descriptive Analysis

### U.S. States, 2009-2017

	Average	Standard Deviation
<b>Flu Deaths 65 years and older</b>	826 deaths	1014 deaths
<b>Total Patient Visits per Provider</b>	388 patient visits per provider	281 patient visits per provider
<b>Percent of total provider visits reported as suspected flu visits</b>	1.70% suspected flu visits	1.06% suspected flu visits

Initial analysis focused on variability in *location* and *age*. Increased age correlated strongly with increased incidence of flu deaths (0.8), indicating that incidence of death by seasonal flu increases with age across the U.S. (Appendix, Table 1)

## Results and Insights

*Null hypothesis 1:* In states that have more suspected flu visits to providers, the providers see the same number of patients as in states with fewer suspected flu visits to providers.

*Alternative hypothesis 1:* In states that have more suspected flu visits to providers, the providers see the more as in states with fewer suspected flu visits to providers.

**At a confidence level of 95%, there is no significant difference in the number of patients seen by providers who see higher numbers of suspected flu cases and those who do not.** (Appendix, Table 2)

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*Null hypothesis 2:* In states that have more suspected flu visits to providers, the incidence of death from seasonal flu among people 65 years and older is the same as that in other states.

*Alternative hypothesis 2:* In states that have more suspected flu visits to providers, the incidence of death from seasonal flu among people 65 years and older is higher than that in other states.

**At a confidence level of 95%, there is a significant difference in the incidence of death in states that have higher numbers of suspected flu cases. (Appendix, Table 3)**

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Statistical results indicate that staffing decisions should not be based primarily on provider-to-patient ratios. Further analysis is underway to examine the variability of providers by week of the year (variability of *time*) to support flu season recommendations.

### Remaining Analysis and Next Steps

Based on the statistical results, the next steps of the TempMed Staffing Flu Season Staffing Plan will be:

- Additional analysis of datasets to include statistical analysis of provider variability in past flu seasons for staffing forecasting, following the project timeline.
  - Deliverables: composition charts; temporal, statistical, spatial, textual analysis.
- Presentation to TempMed Staffing administrators and hospital and clinic staff representative board on Tuesday, February 28.
- Follow up meeting: review of incorporated changes, TempMed Staffing Flu Season Staffing Plan assessment measures and data collection, Wednesday, March 8.

### Resources

United States Census Bureau, Data Tools and Apps, <https://www.census.gov/data/data-tools.html>

United States Census Bureau, Within Population and Housing Unit Estimates, <https://www.census.gov/programs-surveys/popest/about.html>

U.S. Influenza Surveillance: Purpose and Methods, Data Collection Overview <https://www.cdc.gov/flu/weekly/overview.htm>

U.S. Influenza Surveillance: Purpose and Methods, Mortality Surveillance, <https://www.cdc.gov/flu/weekly/overview.htm#NCHSMortality>

Why CDC Estimates the Burden of Season Influenza in the U.S., <https://www.cdc.gov/flu/about/burden/why-cdc-estimates.htm>

## Appendix

### Hypothesis Development

The initial research hypothesis focused on the variable of age:

Adults over the age of 65 are at high risk for severity of symptoms and death from seasonal influenza. If adults over 65 are more vulnerable to severe effects from influenza, then influenza deaths should be higher in this age group than in other age groups.

The strong correlation between higher age and higher mortality prompted expanded analysis to include the data on provider visits for suspected flu in the [CDC Influenza Patient Visits](#). In addition, the [National Center for Health Statistics \(NCHS\) Mortality Surveillance Data](#) had temporal limitations (reporting in October to December of each year included, as discussed in Data Overview). Inclusion of the CDC Influenza Patient Visits data set supplied data by week of the year, for a more complete picture of fluctuations throughout the year.

The two statistical hypotheses were developed from this initial hypothesis, focusing on the variables of location AND age:

- The areas with high death rates also have fewer providers to see patients with suspected flu.
- The areas with high death rates also have higher numbers of provider visits for suspected flu.

Further analysis is underway to inspect the variability of providers by location and weeks of the year, for the inclusion of the variable of time.

Table 1

#### Total Influenza Deaths by Age, U.S. 2010-2015

Correlation coefficient: 0.8

<i>Age Range</i>	<i>Total Deaths</i>
0-4	0
5-14	10
15-24	11
25-34	304
35-44	1192
45-54	7779
55-64	26857
65-74	53446
75-84	113081
85+	212739

Table 2

## Hypothesis 1: Patients Per Provider and Influenza-Like Illness Visits

t-Test: Two-Sample Assuming Unequal Variances

	405.4329609	299.0129513
Mean	373.7674662	400.9404547
Variance	106167.8982	53497.43189
Observations	199	200
Hypothesized Mean Difference	0	
df	357	
	-	
t Stat	0.960113825	
P(T<=t) one-tail	0.168823866	
t Critical one-tail	1.649133053	
P(T<=t) two-tail	0.337647733	
t Critical two-tail	1.966631204	

At a confidence level of 95%, there is no significant difference ( $p\ 0.33 > \alpha\ 0.05$ ) in the number of patients seen by providers who see higher numbers of suspected flu cases and those who do not.

Table 3

## Hypothesis 2: Deaths as Percent of Population 65+ and Influenza-Like Illness Visits

t-Test: Two-Sample Assuming Unequal Variances

	0.000715284	0.002196122
Mean	0.001300974	0.001712395
Variance	5.55079E-07	5.49164E-07
Observations	199	199
Hypothesized Mean Difference	0	
df	396	
	-	
t Stat	5.523067875	
P(T<=t) one-tail	3.02146E-08	
t Critical one-tail	1.648710601	
P(T<=t) two-tail	6.04293E-08	
t Critical two-tail	1.965972608	

At a confidence level of 95%, there is a significant difference ( $p\ 6.04293\ 10E-08 < \alpha\ 0.05$ ) in the death rate in states that have higher numbers of suspected flu cases.