# Death and Survival in the Spanish Influenza Pandemic of 1918

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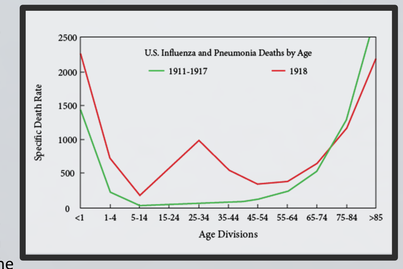
## Introduction

The 1918 Spanish Influenza pandemic was one of the deadliest global outbreaks of disease since the Black Death. One of the most extraordinary aspects of the Spanish flu pandemic was the unusual age-at-death distribution. Most seasonal outbreaks influenza are primarily fatal to young children and the elderly, generally the segments of the population who are most frail. The 1918 pandemic, however, disproportionately **killed young adults between the ages of 20-40 years** old, the most resilient segment of a population.




Though numerous theories have been advanced to explain this phenomenon, ultimately the reason remains unknown. Were all young adults were equally susceptible or were certain individuals more likely to die? Were previously frail individuals more likely to die, or was the flu killing indiscriminately?

**This project proposes to investigate the role of pre-existing frailty in contributing to increased mortality during the Spanish Influenza Pandemic.**

### Spanish Influenza Pandemic

The pandemic was one of the deadliest global outbreaks of disease since the Black Death. An estimated 50 million people worldwide died, and while the entire pandemic stretched from about 1918-1920, over two-thirds of these deaths occurred from September-December of 1918. The symptoms of the flu ranged from mild respiratory distress, to a deadly pneumonia. Most of the deaths were caused not directly by the influenza virus, but by secondary bacterial pneumonia infection.

## Research Question

Were frail individuals more likely to die during the Spanish Influenza Pandemic?

## Proposed Materials

The **Hamann-Todd documented skeletal collection** is an ideal dataset with which to examine frailty during the 1918 pandemic. It is comprised of over 3,000 individuals who died between 1910-1938 in Cleveland, Ohio.

Documentation on the individual's name, age-at-death, sex, ancestry, cause of death and date of death is available for each individual.

**Proposed Sample**

| Time of Death | # Individuals |
|---|---|
| September 1918 - March 1919 | 106 |

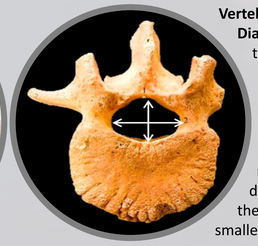
## Proposed Methods

Anthropologists have relied on the analysis of **nonspecific indicators of skeletal stress** – skeletal lesions caused by systemic stress – to examine individual- and population-level health. These lesions reflect disruption to biological homeostasis resulting from ecological, environmental or social factors. To measure frailty, **I will collect data on 4 nonspecific indicators** of skeletal that manifest at various stages in the life cycle from the skeleton and dentition.

**Periostosis -** Pathological new bone formation caused by a reaction of the periosteum and can be caused by physical trauma, local or systemic infection or other infectious diseases such as tuberculosis or leprosy.

**Periodontal disease** - A bacterial infection in the oral cavity that destroys the gums and other tissues. It manifests in the archaeological record as increased porosity to the alveolar bone and destruction to the alveolar crest.

**Linear Enamel Hypoplasia** - Linear defects in tooth enamel caused by disruption in the process of enamel formation. They are most commonly caused by systemic stress, malnutrition or disease in childhood.

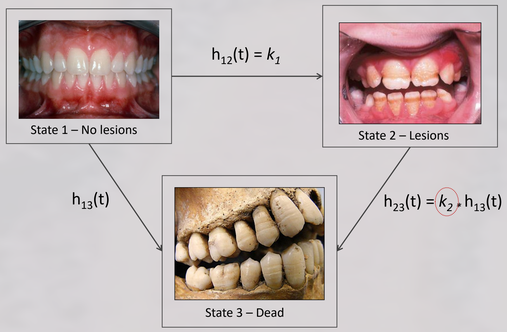


**Vertebral Neural Canal Diameter** - The size of the canal through which the spinal cord passes in the vertebrae. The diameter of the canal is affected by stress, malnutrition, and disease. When stressed, the canal will end up smaller than is normal.

## Proposed Analytical Methods

A multi-state model of morbidity and mortality developed by Usher (2000) will be used to assess whether markers of frailty are associated with increased risk of death during the pandemic.

- In Usher's model, an individual can exist in one of three non-overlapping states: state 1=no lesions, state 2=lesions, and state 3=death. Using the distribution of ages and lesions within the sample, the **model estimates the rate of transition between the states** allowing us to predict if an individual with lesions has an increased risk of dying (moving from state 2 to state 3) compared to an individual of the same age without lesions.




- The $k_2$ **term describes the difference in the risk of death** between an individual with a stress lesion and an individual without the lesion**. When $k_2$ is greater than one**, the rate at which individuals are moving from state 2 to state 3 is greater than moving from state 1 to state 2; when $k_2$ is less than one, the rate is lower.

## Expected Results

- **If those who were frail were more likely to die during the pandemic I expect $k_2>1$**

→ Interpretation – If individuals with lesions died at a greater rate than those without, the pandemic did not kill indiscriminately. Individuals with a pre-existing frailty caused by poor nutrition, decreased access to healthcare, genetic susceptibility, etc., were more likely to die.

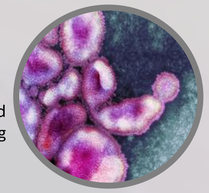

- **If those who were frail were not more likely to die during the pandemic I expect $k_2 \leq 1$**

→ Interpretation – If frail individuals did not die at a greater rate than those who were not frail, the pandemic struck all young adults equally, regardless of any pre-existing frailty. The 1918 virus killed healthy, resilient individuals.

## Significance

This project will:

- Help reveal how and **why young adults we disproportionately affected** by the 1918 Influenza virus.
- Provide insight into the bases of human biological and cultural variation and contribute to our understanding of **human origins and human-pathogen coevolution**.



- Make more sophisticated methods for analyzing paleopathological **data more widely accessible** to anthropologists and paleodemographers.
- **Identify risk factors** for increased influenza mortality and characterize how the disease may spread differently in various populations
- Aid with **predicting how a future influenza outbreak** could spread and develop into another pandemic.

## References and Image Credits


- Usher BM. 2000. A multistate model of health and mortality for paleodemography: Tirup cemetery.
- *Additional references available upon request.*

- https://www.gov.uk/government/news/public-health-england-update-on-avian-influena
- https://www.cnbc.com/2014/07/28/ebola-outbreak-is-real-danger-epidemic-of-fear.html
- https://archaeologynewsnetwork.blogspot.com/2015/04/extra-molar-found-in-neolithic-skeleton.html#8SI6HfglarLQc6Tz.97
- https://sites.google.com/site/stressedoutconference/meeting-information/programme
- https://www.flickr.com/photos/museumoflondon/7286144390
- https://twitter.com/gocmnh/status/1049295511944142848
- https://en.wikipedia.org/wiki/Enamel_hypoplasia
- http://aboutmanchester.co.uk/a-portrait-of-a-pandemic-bbc-marks-the-centenary-of-spanish-flu-revealing-the-untold-stories-of-its-impact-on-people-and-places-across-the-country/
- https://www.theguardian.com/world/2018/sep/09/spanish-flu-pandemic-centenary-first-world-war