PART 1

The 1918 Influenza in Missouri: Centennial Remembrance of the Crisis

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In September 1918, war-weary Missourians were bracing for the coming storm: not another extreme weather event, but the lethal influenza epidemic steamrolling through the country's eastern cities and military cantonments and bearing down on the Midwest. Tens of thousands of young people were dead; major cities were on the verge of collapse. Former Missourian Dr. Victor Vaughan, raised in rural Randolph County, headed the U.S. Army's Division of Communicable Diseases. In October 1918, Dr. Vaughan concluded, "If the epidemic continues its mathematical rate of acceleration, civilization could easily disappear from the face of the earth within a few weeks".[1]

This year marks the centennial anniversary of the 1918 Influenza pandemic. Although often overshadowed in our nation's collective memory by World War I, in fact influenza took more lives in a shorter time period in 1918-19 than any other event in human history.[2] Approximately 670,000 Americans succumbed to influenza in the U. S., more than the cumulative combat death toll of our military forces in World Wars I and II, the Korean conflict and the Viet Nam War.[3] Worldwide, 50-100 million died,[2,4] a figure vastly exceeding the mortality tolls of other pandemics in the 20th and 21st centuries (Figure 1). This article, the first in a series, will address the origins and spread of the 1918 influenza, its clinical and pathological manifestations, the impact of the pandemic on Missouri's population, the responses of dedicated medical and nursing professionals in our state, and insights gained from new assessment of available epidemiologic data. The word influenza is rooted in the medieval Italian phrase influentia del freddo (influence of the cold), reflecting the centuries-old observation that annual epidemics occur in the winter months.[5] Interspersed lethal pandemics emerge at unpredictable intervals a few times each century. In the early twentieth century, physicians had not yet identified the cause of this generally mild and self-limiting illness, commonly known as the "grippe." Although the germ theory of disease had been well-established for a few decades some physicians still attributed influenza to miasmas (noxious vapors) rather than infection. The field of virology was in its infancy and the possibility that influenza was a viral illness had not yet been considered seriously. No known treatment or prevention for influenza existed, nor would any become available until long after the 1918 pandemic (Figure 2.)

In 1918 the country's attention was focused squarely on World War I, which led to the mobilization of more than four million American military recruits and the construction of 30 hastily built cantonments throughout the country, each of which housed up to 50,000 soldiers in overcrowded barracks.[6] Historians have concluded that the war effort was inextricably linked to the spread of the 1918 influenza in the United States and abroad.[6] The extremely high risk for epidemics among soldiers had been well-known for centuries.[7] During the war millions of young men, many of whom were immunologically naive to highly contagious infections, were dispersed around the country to military camps en route to battlefields in Europe, setting the stage for an explosive pandemic.

Although the 1918 pandemic is widely known as the "Spanish Influenza," a more appropriate name could be the "Kansas Flu."[8] The federal Sedition Act of 1918 prohibited the use of "disloyal, profane, scurrilous, or

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abusive language" about the U. S. government, in a heavy-handed attempt to improve morale during the war. Accordingly, little was published in the U.S. about influenza. However, in neutral Spain the uncensored press reported freely about the influenza pandemic, leading to the enduring misperception that the disease had begun there. In fact most historians believe that the first wave of 1918 "Spanish" influenza in the world began on March 4, 1918 at Camp Funston, Kansas, 120 miles west of the Missouri border.[1] During the following weeks thousands of soldiers developed influenza and 38 died.[9] (Figure 3) As soldiers from Camp Funston were transported to other cantonments throughout the country, influenza spread like wildfire.

Thousands of military personnel worldwide developed influenza in the spring and early summer of 1918, but little alarm was raised as the illness was deemed to be "everywhere of a mild form."[9] Barry has postulated that the trigger for the Camp Funston epidemic was a smaller outbreak in Western Kansas the previous year.[2, 9] However, an analysis of death certificates in St. Joseph, the third largest city in Missouri in the early twentieth century, suggests a trend of increasing influenza mortality in Missouri as early as 1915.[10] The pandemic therefore may have been heralded by mutating viruses not only in Kansas but also in Missouri and elsewhere, well in advance of the deadly 1918-19 season.

Influenza Pandemic
Comparative Mortality

1918-9
U.S. 670,000 (0.6%)
Worldwide 50 Million (2.7%)

1957-8
U.S. 70,000 (0.03%)
Worldwide 2 Million (0.07%)

1968-9
U.S. 34,000 (0.02%)
Worldwide 1 Million (0.03%)

2009-10
U.S. 12,000 (0.004%)
Worldwide 284,000 (0.004%)

Figure 1. Influenza pandemic mortality, U.S. and worldwide, total (% of population).

The second wave of the 1918 influenza pandemic struck with a fury in August. Simultaneous outbreaks were reported in Camp Devins, Massachusetts, (near Boston), France, and Sierra Leone. In contrast to typical seasonal flu, the 1918 influenza strain that reappeared in August was exceptionally virulent and often lethal, especially among young adults. The highest mortality rates were reported among persons between 20 and 40 years old, an age group generally unscathed by seasonal influenza.[4] A contemporaneous description from a physician at Camp Devins paints a chilling picture. "Victims develop the most viscious (sic) type of Pneumonia that has ever been seen. Two hours after admission they have the Mahogany spots over their cheekbones and a few hours later you can begin to see the Cyanosis extending from the ears and spreading all over the face."[11] Typical symptoms included fever above 105 degrees, delirium, lethargy, prostration, bleeding from the nose and ears, and hemoptysis "(resembling) tomato puree."[12] A feature of illness noted by many observers was "strikingly intense cyanosis."[13] The mortality rate was shockingly high: 757 previously robust young soldiers at Camp Devins died.[14] Several observers described seeing people who were healthy one day and dead within 24 hours.

The 1918 flu also was particularly prone to enabling aggressive secondary bacterial pneumonia, a common cause of death.[15] A biphasic illness pattern was noted in many cases: typical influenza was followed by transient improvement but subsequent abrupt deterioration after secondary bacterial infection was established. Pathologists noted "immediate exudation of dark bloody fluid" from the lungs of influenza victims.[13] The lungs appeared shapeless, blue, foamy, and edematous.[16] Features consistent with acute respiratory distress syndrome, an entity not formally

Figure 2. Timeline of major events related to influenza

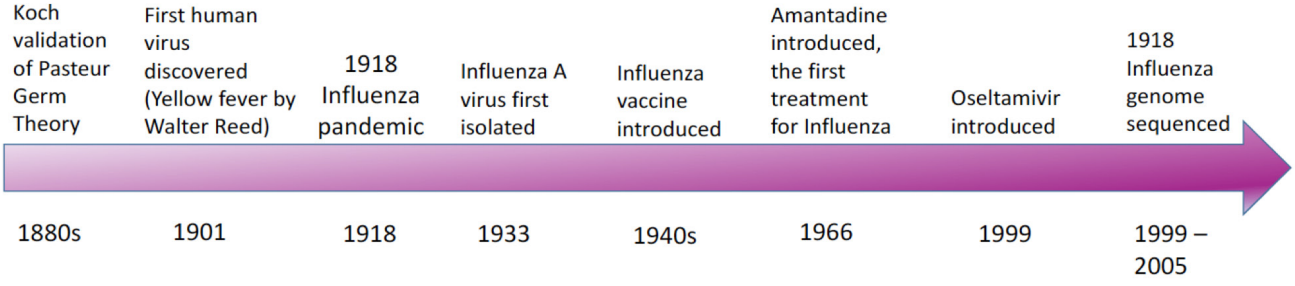

Figure 3. Camp Funston, Ks., emergency hospital during 1918 influenza epidemic.

described until decades after the pandemic, were noted in about half of autopsies.[17]

After influenza decimated Camp Devins and several other cantonments in September 1918, the disease quickly spread to eastern cities where public services and health care providers were nearly overwhelmed. The pandemic created widespread panic. A crossroads state, Missouri was an inevitable target. Historian Alfred Crosby's description was particularly applicable to our state: "Influenza moved across the United States in the same way as pioneers had, for it followed their trails, which had become railroads, and propagated fastest in those localities most attractive to them – the confluences of rivers and trails."[18] In a few weeks the state's health care workers would address the worst medical crisis in the state's history, one which took a heavy toll and had a lasting impact.

In the 1910s, Missouri's population was almost 3.3 million, seventh highest among the 48 states. St. Louis, population 687,000, was the nation's fourth largest city and Kansas City, with 248,000 citizens, ranked twentieth. The state's third, fourth, and fifth largest cities, respectively, were St. Joseph, Springfield, and Joplin. About half (49%) of the state's population resided in rural areas. Travelers primarily relied on a train system with more than 8,000 miles of track, twice today's figure. Although past their prime, riverboats plied the Osage River, which was still navigable a decade before the construction of Bagnell Dam created the Lake of the Ozarks, as well as the Mississippi and Missouri Rivers. Cross-state driving was challenging. Although each county was served by at least one highway, all of the highways were unpaved. Thus several routes existed for influenza's introduction to Missouri and its rapid spread throughout the state.

In Missouri, as in other states, the first cases of influenza probably began at a local military camp when infected soldiers arrived from cantonments in other parts of the country. The disease then spread quickly to the civilian population. On September 27, cases were reported at two Army motor schools in Kansas City; on October 4, 1918, influenza exploded at Missouri's large military base, Jefferson Barracks, near St. Louis, where 500 cases were reported among 6,000 soldiers. Simultaneously cases were reported in southwestern Missouri, possibly among soldiers returning home from training at cantonments in neighboring states. As the epidemic spread during the first weeks of October, physicians, nurses, hospitals, and health departments throughout Missouri struggled to cope with an unprecedented burden of disease, while handicapped by a substantially reduced work force: fully half of the state's physicians were away, serving in the military.

Missouri's physicians had few therapeutic options for their acutely ill patients with influenza. The primary goals of treatment were pain alleviation, cough control, and either stimulation or reduction of heart rate depending on the situation. The pharmaceutical armamentarium was limited. Quinine, first introduced in the U. S. in Arrow Rock, MO in the 1800s for treatment of malaria, was now given as an influenza preventative, without benefit. Other available medications included aspirin, morphine, codeine, heroin, atropine, digitalis, strychnine, and epinephrine. Physicians at the time correctly concluded that "no especial measure was of avail."[13] Aside from providing symptomatic treatment, probably the most useful functions of the physician were to advise bedrest and to monitor for signs of bacterial pneumonia, which

Table 1
Missouri All Cause Mortality Rate Analysis by Region (excluding St. Louis and Kansas City)
1915 and 1918, Missouri counties (n=112)

Region State of Missouri	*Number of counties*	***Pop. density mean (sd)*	*1915 mortality Mean (sd)*	*1918 mortality mean (sd)*	*% increase mortality from 1915 to 1918*
Southeast	13	33.7 (14.1)	11.8 (3.9)	15.1 (6.04)	28%
East	10	35.6 (17.2)	10.9 (1.7)	13.7 (1.9)	26%
West	12	37.2 (9.1)	11.2 (2.0)	13.7 (3.2)	22%
Northeast	16	34.3 (12.1)	9.5 (1.4)	12.6 (2.1)	32%
Central	13	31.5 (10.2)	10.2 (1.9)	12.5 (3.4)	22%
Northwest	15	32.5 (4.1)	10.3 (1.8)	11.7 (2.2)	13.5%
Southwest	18	35.1 (19.2)	9.3 (2.1)	11.4 (4.2)	23%
South Central	6	20.5 (2.6)	9.3 (1.9)	10.5 (1.7)	13%
South	9	17.8 (5.5)	7.9 (1.4)	9.4 (2.5)	19%

**Region based on current Missouri State Highway Patrol definition*
***Population density = people per square mile in 1910*

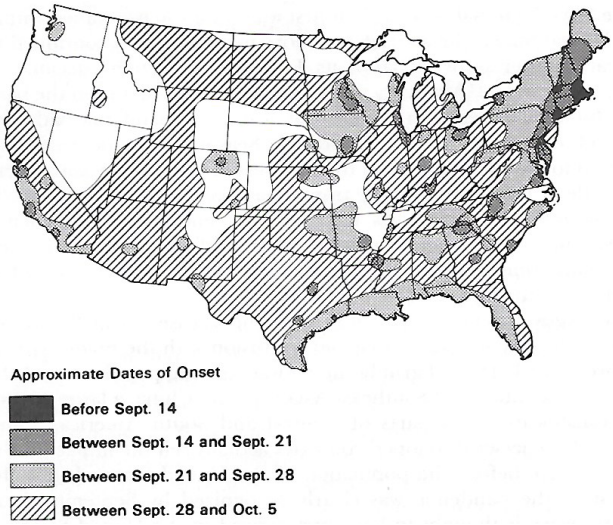

Figure 4. Approximate dates of onset.

connoted a worsened prognosis.[19]

Actually, by far the most important need of 1918 influenza patients was for nursing care. "Nursing is nine tenths, just the same," said the nurse in Katherine Anne Porter's "Pale Horse, Pale Rider," referring to the totality of a patient's care.[20] Porter, who almost died from influenza, probably was underestimating. However, in 1918 nurses were in even shorter supply than physicians: there were one-quarter as many trained nurses as doctors. The American Red Cross (ARC), founded by Clara Barton in 1882, stepped into the void. The Red Cross not only had full responsibility for supplying nurses for the U.S. Army, but also was tasked with identifying civilian nurses to battle the epidemic at home.[21] Many Missouri nurses became ill while caring for their patients, and those who remained on the job had staggering workloads of 30-40 inpatients per day.[22]

Missouri's influenza and pneumonia mortality rate in 1918, 476.6 per 100,000 population, ranked 22nd among in the 30 states for which data are available.[23] This figure more than doubled from the prior year.[24] In 1918 detailed disease surveillance data were maintained for the state's two largest cities, St. Louis and Kansas City, but not in other areas of the state. The mortality ratio in these two cities has been reported to be 1.32 times higher than in Missouri's rural areas.[24] However, "rural" areas included cities of up to 100,000 population.[24]

We conducted a more detailed analysis of the geographic differences of 1918 influenza on the state's population. The annual all-cause mortality rates of Missouri counties (n=112) were compared to baseline figures from 1915 using data from the U. S. Bureau of the Census (Table 1).[23] Data from St. Louis City and County (administratively distinct entities) and Jackson County, each of which had much higher death rates than the remainder of the state, were omitted from our analysis. Counties were grouped into nine regions, as defined by the Missouri State Highway Patrol currently. The mean statewide mortality in 1918 per 1,000 population was 12.4 (range 5.1-29.4), up from 10.1 (range 5.1-19.9) in 1915. In each of the state's regions the mortality rate in 1918 was significantly higher than that in 1915 (p= .000). The three counties with highest mortality rates were Dunklin (29.1), Vernon (23.1), and Butler (23); the lowest rates were identified in Dallas (5.1), Douglas (6.1), and McDonald (6.2) counties. The southeastern region of Missouri had the highest mortality rate (15.1); the two lowest rates were seen in the south (9.4) and south central (10.5) regions, the least populated areas in the state. A 5.7-fold mortality difference was noted between the state's highest and lowest ranked counties. Thus, although influenza in 1918 significantly increased mortality in every region of the state, there was an uneven impact on Missouri's population.

To some extent Missouri was fortunate to be struck by influenza's second wave at a later stage than the eastern seaboard, particularly in rural areas of the state (Figure 4). As a general rule influenza cases were less severe in the later weeks of the epidemic's

Figure 5. "We've got that durned influenzy agin" by A.B. Frost, *Kansas City Star,* November 27, 1918

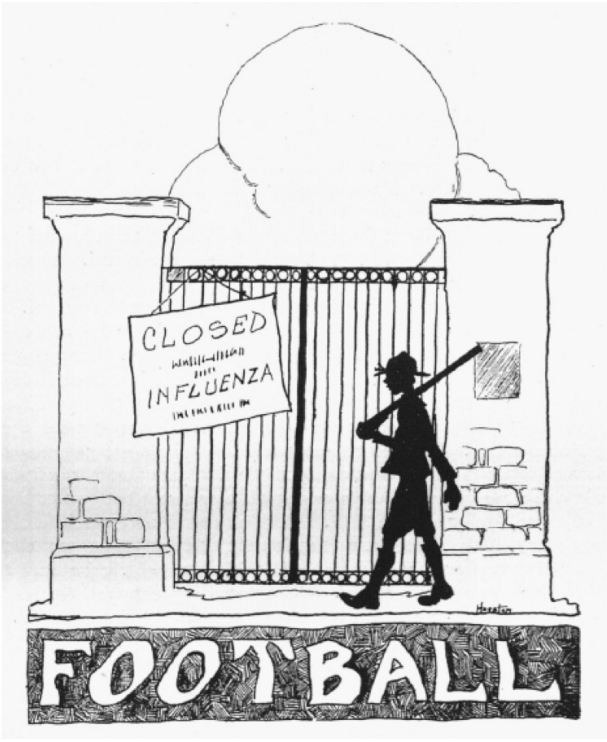

Figure 6. University of Missouri yearbook The Savitar, 1919

second wave than at the beginning.[25] This factor may have contributed to Missouri's disproportionately lower mortality than other highly populated states. Social determinants of health, such as poverty, may have accounted in part for the higher death rate in southeastern Missouri.

Contemporaneous accounts described the impact of influenza throughout the state. At the University of Missouri, Dr. Dan Stine recorded 1,020 student cases of influenza between September 26 and December 6. He "saw one patient die within 18 hours of this disease and 12 hours after being put to bed."[26] The volume of influenza cases was so high in Columbia that patients were admitted not only to Parker Hospital but also to the Athens Hotel, Welch Military Academy, and a women's dormitory at the University. In Van Buren, members of several families were all are sick in bed at the same time and "both local doctors (were) on the go both day and night."[27] Dr. William E. Kitchell of St. Clair, the county health officer, was so busy that he didn't change clothes for three straight days and nights.[28] Private Charles Hill died from influenza while fighting in France. His commanding officer informed Private Hill's mother of Dunnegan, Mo., that "it came so fast and with such little warning that the best medical care could not save him."[29]

Famous Missourians were among those afflicted with the 1918 influenza. General John J. Pershing, of Laclede Mo., was commander of the American Expeditionary Force in World War I. He developed severe influenza in late October and became encephalopathic, before he recovered fully. U.S. Representative Champ Clark, from Louisiana, Mo., the only Missourian to serve as U.S. Speaker of the House of Representatives, was confined to bed with influenza, necessitating a several-week recess of the U.S. Congress. Clark recovered but two of his fellow Missouri congressmen, Representatives Jacob Meeker and William Borlan, did not. Meeker visited Jefferson Barracks on October 10 and seven days later was dead from influenza, likely acquired at the base. Borlan, co-founder and former Dean of Kansas City School of Law (predecessor of the University of Missouri-Kansas City law school), died from influenza while touring army camps in France. Captain Harry Truman, writing to his fiancée Bess Wallace in Independence in early 1919 from Europe, expressed relief at her recovery from influenza. Walt Disney lived in Marceline, Mo., (the model for Main Street USA at Disney World) from 1906-11 and in Kansas City from 1911-17. He enlisted in the Red Cross Ambulance Corps in Chicago in September 1918, and developed influenza while in training. The resultant convalescence period delayed his departure to Europe until after conclusion of the war's bloodiest fighting.[30] Thus, arguably influenza may have saved Mr. Disney's life.

Missouri's schools and universities were substantially impacted by influenza. Each of the state's three medical schools (the American School

of Osteopathy, now known as A.T. Still University; Saint Louis University; and Washington University) graduated their classes early, to bolster the understaffed health care workforce. Washington University students received their degrees in absentia in Europe. Public school systems across the state cancelled classes for weeks at a time, sometimes on multiple occasions, leaving parents to care for restless children in their quarantined homes (Figure 5.) The University of Missouri was quarantined twice, and the Mizzou Tigers, under Coach John F. Miller, cancelled the entire 1918 football season (Figure 6).

After the 1918 influenza pandemic receded, Missourians continued to carry a heavy burden. Some survivors developed von Economo disease (post-encephalitic Parkinson Disease.)[31] Thousands of families lost loved ones; countless children were orphaned. Despite, or perhaps because of, the trauma of these grievous experiences, in the coming decades most survivors preferred to avoid the subject. Famous authors of the era, including former Kansas Citian Ernest Hemingway, a *Kansas City Star* reporter in 1917 and 1918, did not discuss influenza in their works. This dearth of recorded material may have contributed to the general lack of recognition by subsequent generations of the catastrophic impact of 1918 influenza.

The next article in this series will compare the well-documented experiences with 1918 influenza in Missouri's two largest urban areas, St. Louis and Kansas City, including important public health lessons that still resonate after a century. In addition the impact of influenza on Jefferson Barracks and Base Hospital 21, a World War 1 medical center in France staffed by Missourians, will be addressed.

Acknowledgment

The authors dedicate this manuscript to Ladene Stark Smith, our great Aunt, who succumbed to influenza in early 1919 at age 19 shortly after moving from Missouri to an adjacent state.

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