Infectious Reporting: Network Analysis of the 1918 Influenza Epidemic Using Historical Newspapers

Tom Ewing
Samah Gad
Naren Ramakrishnan
Virginia Tech

Shared Horizons: Data, Biomedicine, and the Digital Humanities
April 10-12, 2013
DRASTIC CLOSING ORDER ISSUED
TO AVERT INFLUENZA EPIDEMIC

Churches, College, Theaters, Schools and All Gatherings are Barred

Health Board, Acting on Suggestion of Surgeon General, Takes Stringent Measures to Control Outbreak; Affects Lodges, Dances, Funerals, Etc.
Principal Investigators:
- Tom Ewing, Department of History (VT)
- Bernice Hausman, Department of English (VT)
- Bruce Pencek, University Libraries (VT)
- Naren Ramakrishnan, Dept of Computer Science (VT)
- Gunther Eysenbach, Centre for Global eHealth Innovation (UT)

Graduate Research Assistants:
- Samah Gad, Dept of Computer Science (VT)
- Kathleen Kerr, Department of English (VT)
- Michelle Seref, Department of English (VT)
- Laura West, Department of History (VT)
Chronological map of the influenza epidemic of 1918. Based on preliminary reports from 376 localities. Indicating the approximate dates on which the disease reached an epidemic stage.
Chronicling America Newspapers covering the 1918 Influenza Epidemic

Coconin Sun
Mohave County Miner

Evening Herald
Bemidji Daily Pioneer

Ogden Standard
Evening Missourian

El Paso Herald

Breckinridge News
Mt. Sterling Advocate

Big Stone Gap Post
Mt. Sterling Advocate

Watchman & Southron

Chronological map of the influenza epidemic of 1918. Based on preliminary reports from 376 localities. Indicating the approximate dates on which the disease reached an epidemic stage.
Chronicling America
Newspapers: 1918
Influenza Epidemic

Washington Times
New York Tribune
Evening World
Evening Public Ledger
Washington Herald
Data and Biomedicine

Scope of Data: Disease
“Spanish Influenza” 1918 - 1919
- 50 million deaths globally
- 625,000 deaths in United States
- 25% of US population infected (estimate)

Scope of Data: Information
100,000 PLUS newspaper articles about the influenza pandemic in the United States and Canada, 1917-1919
### Scope of Data: Key word: “influenza”

<table>
<thead>
<tr>
<th>Database (Titles)</th>
<th>1917-1919</th>
<th>Just 1918</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronicling America (pages)</td>
<td>12,365</td>
<td>6,389</td>
</tr>
<tr>
<td>Peel’s Prairie Provinces</td>
<td>2,147</td>
<td>1,212</td>
</tr>
<tr>
<td>Newsbank America’s Historical Newspapers (articles)</td>
<td>51,929</td>
<td>31,717</td>
</tr>
<tr>
<td><strong>Proquest:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>New York Times</em></td>
<td>9,304</td>
<td>3,518</td>
</tr>
<tr>
<td><em>Washington Post</em></td>
<td>1,545</td>
<td>1,069</td>
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<tr>
<td><em>San Francisco Chronicle</em></td>
<td>1,366</td>
<td>914</td>
</tr>
<tr>
<td><em>Los Angeles Times</em></td>
<td>13,033</td>
<td>1,970</td>
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<tr>
<td><em>Chicago Tribune</em></td>
<td>3,430</td>
<td>1,455</td>
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<tr>
<td><em>Atlanta Constitution</em></td>
<td>1,772</td>
<td>931</td>
</tr>
<tr>
<td><em>Baltimore Sun</em></td>
<td>3,586</td>
<td>1,639</td>
</tr>
<tr>
<td><em>Boston Globe</em></td>
<td>1,440</td>
<td>843</td>
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<tr>
<td>Colorado Historical Newspaper Project</td>
<td>3,358</td>
<td>1,899</td>
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<tr>
<td>Georgia Newspaper Project</td>
<td>669</td>
<td>517</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>105,944</td>
<td>54,073</td>
</tr>
</tbody>
</table>
Network Analysis

• Disease networks: the spread of the flu, from army camps and eastern cities across the rest of the country
• Information networks: newspapers (reporting sites) provided news about disease in specific locations (infected sites)
• Infectious reporting: analysis of the relationship between disease networks and information networks across time/space
Addressing research questions drawn from recent scholarship in field of epidemiology:

• Association between public health measures, mortality rates, and mitigation of disease (Markel, et al, 2007; Bootsma and Ferguson, 2007)

• Relationship between personal / local narratives and broader scope / patterns of disease (Bristow 2012; Stern et al, 2010)

• Spatial dynamics of disease transmission based on connectivity between sites (Eggo et al, 2011)

• Using surveillance information to inform decision making about epidemics (Briand, 2012)

Themes: **timing, location, decision, impact**
Limits of Network Analysis

“Theory and empirical data are in principle intimately interwoven. Yet in the practice of social network analysis, there appears to be a disconnect: theorizing and empiricism often seem to occupy separate orbits, and these separate discussions may be difficult to relate to each other...A persistent problem...is the difficulty of relating theoretical network constructs back to some empirical reality...Despite all their difficulties, empirical descriptions of networks, both qualitative and quantitative, have the potential to find those abstract characteristics of a pattern, a task for which theoretical and simulation studies alone are not well suited.”

(Rothenberg and Costenbader 2011)
Research Question (part 1)

How widely (space) and how quickly (time) did American newspapers report about infected sites that had very high numbers of cases and deaths (networks of information / disease)?

Infected sites:
- Military camps: Devens (MA), Dix (NJ), Lee (VA)
- Cities: Philadelphia, New Orleans, Seattle
Dynamic Temporal Segmentation:

• Wraps around topic modeling algorithms for the purpose of identifying change points where significant shifts in topics occur.
• Automatically segments the total time period defined by the documents in the collection.
• Segment boundaries indicate important periods of temporal evolution and re-organization.
New York Herald Tribune
September 12-19, September 20-27, 1918
September 28 – October 5, 1918

<table>
<thead>
<tr>
<th>Date</th>
<th>New York City Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/5</td>
<td>First case</td>
</tr>
<tr>
<td>9/18</td>
<td>First NPI</td>
</tr>
<tr>
<td>9/29</td>
<td>Mortality acceleration</td>
</tr>
<tr>
<td>10/23</td>
<td>Peak excess death rate</td>
</tr>
</tbody>
</table>

Locations (national)
Locations (New York City)
Disease terms

- disease
- spanish
- epidemic
- camp
- bronx
- manhattan
- new york death
- death
Network Analysis

• Evolution of the network over time.
  – Track infection reporting over time.
    • Example: a node can have a degree of two and later acquire degree of twenty.
    • Identify key stages of network growth and reorganization.
• Discover impact of nodes, both epidemiologically and informationally
  – Determine the infected sites that got the most attention.
    • Centrality metrics (e.g. degree centrality) can be used to quantify the impact of a specific node.
    • Determine important conduits of information as information spreads
Infection Reporting - Week 1
Infection Reporting – Week 2
Infection Reporting – Week 3
Infection Reporting – Week 4

[Map showing connections between various cities, with cities like Philadelphia, New Orleans, Seattle, Camp Lee, Camp Dix, and Camp Devens highlighted.]
Reports on Infected Sites, September 15 to October 26, 1918

Week 1
- Philadelphia: 13
- New Orleans: 17
- Seattle: 10
- Seattle: 0
- Seattle: 1
- Seattle: 0
- Seattle: 10
- Seattle: 20
- Seattle: 22
- Seattle: 17
- Seattle: 4
- Seattle: 5
- Seattle: 7
- Seattle: 4
- Seattle: 5
- Seattle: 7
- Seattle: 11
- Seattle: 11
- Seattle: 11
- Seattle: 11

Week 2
- Philadelphia: 16
- New Orleans: 1
- Seattle: 4
- Seattle: 5
- Seattle: 7
- Seattle: 4
- Seattle: 5
- Seattle: 7
- Seattle: 11
- Seattle: 11
- Seattle: 11
- Seattle: 11

Week 3
- Philadelphia: 81
- New Orleans: 54
- Seattle: 54
- Seattle: 35
- Seattle: 50
- Seattle: 28
- Seattle: 20
- Seattle: 22
- Seattle: 17
- Seattle: 11
- Seattle: 17
- Seattle: 11
- Seattle: 11
- Seattle: 11
- Seattle: 11
- Seattle: 11

Week 4
- Philadelphia: 38
- New Orleans: 42
- Seattle: 42
- Seattle: 35
- Seattle: 50
- Seattle: 28
- Seattle: 20
- Seattle: 22
- Seattle: 17
- Seattle: 19
- Seattle: 7
- Seattle: 4
- Seattle: 5
- Seattle: 7
- Seattle: 11
- Seattle: 11
- Seattle: 11

Week 5
- Philadelphia: 17
- New Orleans: 54
- Seattle: 54
- Seattle: 35
- Seattle: 50
- Seattle: 28
- Seattle: 20
- Seattle: 22
- Seattle: 17
- Seattle: 19
- Seattle: 7
- Seattle: 4
- Seattle: 5
- Seattle: 7
- Seattle: 11
- Seattle: 11
- Seattle: 11

Week 6
- Philadelphia: 54
- New Orleans: 40
- Seattle: 40
- Seattle: 20
- Seattle: 22
- Seattle: 17
- Seattle: 19
- Seattle: 7
- Seattle: 4
- Seattle: 5
- Seattle: 7
- Seattle: 11
- Seattle: 11
- Seattle: 11
- Seattle: 11
- Seattle: 11
- Seattle: 11
Viewshare is a free platform for generating and customizing views (interactive maps, timelines, facets, tag clouds) that allow users to experience your digital collections.

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Enhance digital collections with visualizations of historical data.

Import Collections
Ingest collections from spreadsheets or MODS records. Upload from your desktop or import them from a URL.

Generate Views
Generate distinct interactive visual interfaces to your digital collections, including maps and timelines, and sophisticated faceted navigation.

Embed and Share
Just copy-paste to embed your interface in any webpage. Provide your users with novel and intuitive ways to explore your content.
Infected Site: Camp Devens, Massachusetts (by reporting site)
Infected Site: Camp Devens, Massachusetts (by newspaper)
Infected Site: Philadelphia, Pennsylvania (by newspaper)
Philadelphia as Infected Site: Number of Mentions by Week
September – October 1918

First case: 8/27
Mortality acceleration: 9/25
First NPI: 10/4
Peak Excess Death: 10/16
Answers to Research Question (part 1)

• The earliest infection sites were covered very extensively by American newspapers
• Information networks spread reports about the outbreak of influenza in distant locations
• Information about infected sites spread more widely and more quickly than the disease
Research questions (Part 2)

• As the influenza approached a reporting site, how did the location of infected sites change (shifting from national to regional)?
• Did the tone of the reporting change as the location of infected sites changed?
• Did the timing and tone of the reports affect public health measures (NPI = non-pharmaceutical interventions)?
• Is it possible to answer these questions using automated information retrieval and data mining across a broader range of newspapers?
Reporting Site: Colorado Springs, Colorado
Edmonton Bulletin, Reporting Site
Moving from manual analysis to automated information retrieval
Welcome

“They are placed on the cots until every bed is full and yet others crowd in. The faces soon wear a bluish cast; a distressing cough brings up the blood stained sputum. In the morning the dead bodies are stacked about the morgue like cord wood.”

—Victor Vaughan, A Doctor’s Memories

An estimated 650,000 Americans lost their lives to the infamous and tragic 1918-1919 influenza epidemic, a small but significant fraction of the approximately 50 million deaths the disease caused worldwide. Countless more were left without parents, children, friends, and loved ones. Communities across the country did what they could to stem the rising tide of illness and death, closing their schools, churches, theaters, shops and saloons. Doctors, nurses, and volunteers gave their time — and, occasionally, their lives — to care for the ill.

These pages contain the stories of the places, the people, and the organizations that battled the American influenza epidemic of 1918-1919.
Reporting site: Columbia MO
Infected Sites: 50 cities from Influenza Encyclopedia
Newspaper: *Evening Missourian*, available from Chronicling America
Reporting site: Columbia MO
Infected Sites: 50 cities from Influenza Encyclopedia
Newspaper: Evening Missourian, available from Chronicling America
Reporting site: New York City
Newspaper: *New York Tribune*, available from Chronicling America
Week Two: September 22-28, 1918
Reporting site: New York City
Newspaper: New York Tribune, available from Chronicling America
Week Four: October 6-12, 1918
Reporting site: New York City
Newspaper: *New York Tribune*, available from Chronicling America
Reporting site: New York City
Newspaper: *New York Tribune*, available from Chronicling America
Discussion of research questions (pt 2)

- As the influenza approached this reporting site, more reports were published about regional / local infected sites: shorter connections = more frequency
- Reports about regional / local sites were more detailed: shorter connections = more depth
- Hypothesis: Newspapers that reported extensively on the disease in other locations helped prepare health authorities and the public for more urgent, extensive and sustained NPI (comparisons needed).
- Methods: Tone detection needs to accompany information retrieval in order to interpret relationship between reporting sites and infected sites.
Next steps

• Moving from manual analysis => information retrieval => data mining
• Checking and curating the automated analysis
• Expanding the scope of newspapers to include more US and Canadian reporting sites
• Connecting analysis of newspapers to data on mortality and reports of public health measures
Reporting site: Washington DC
Newspaper: *Washington Herald*, available from Chronicling America
NEWELL DID HIS BIT.
Captured 33 Huns, 5 Machine Guns, 'Aided Wounded Sergeant.
Corp. Alexander Newell, of the United States Infantry, has been 'awarded the Distinguished Service Cross for gallant conduct under fire in the engagement near Chateau Thierry on July 15.
Corp. Newell, leading a squad of nine men, passed through the enemy barrage, and captured five machine gun?and thirty-three prisoners\and brought back a sergeant of his company who had been wounded in the heavy artillery fire.
The hero Is the son of Joseph ?Newell. 11.949 LaFayette avenue, j
Chicago, 111.

N. Y. PORT QUARANTINED.
Spanish Influenza Causes Action by Health Commission.
New York. Sept. 11?Announcement I was made tonight by city Health Commissioner Copeland of the establishment of a rigid quarantine at the port of New York, and the beginning of an anti-spitting crusade in order to prevent the spread of Spanish influenza in this city.
Twenty-five persons suffering from the disease who were landed here 'from a French ship have been ?so-?laid.

Washington Herald,
September, 11, 1918, p. 1
Case study
Albert C. Carey of Fredonia, Kan., died late last night at Beth-El Hospital of pneumonia. He came here 10 days ago with the third draft contingent for the Colorado college wireless school and was ill at the time of his arrival. He was the first of the student soldiers to become affected with what was at first called Spanish influenza but which later appears to be an ordinary form of la grippe. He contracted pneumonia, however, and for several days his condition was been critical. He was taken to the hospital day before yesterday and has had the best possible medical attention at all times. He is survived by his mother, Mrs. A.C. Carey of Fredonia, who has been at his bedside for several days. No funeral arrangements have been made.
Dr. George B. Gilmore, city health officer, said yesterday that while all physicians of the city are obliged to report any case of grippe which may be suspected of being Spanish influenza some have not been complying with the rule. No cases have been reported at the city health office outside of those under observation at Colorado college, although there are known to be some others in the city. Indications yesterday from information available at the city health office was that the number of grippe cases in the city had fallen off considerably from what it had been during a few days previously.
There is little doubt but that the epidemic which is now sweeping Colorado Springs is the Spanish influenza which has proved so disastrous in the east. According to members of the city health department, the two diseases are identical, whether called Spanish influenza or plain la grippe, and some action must be taken to prevent its further spread.

Gilmour Urges Care.

In discussing the subject last night, Dr. G. B. Gilmour, city health officer, stated that coughing and sneezing were the chief means of transmitting the disease. Parents should be very careful about sending their children to school, he said. The minute they develop a cough or a sore throat, they should be kept home until a physician has been called and the cause of the sore throat established.
'DON'T BE PANICKY, BUT DO BE CAREFUL,'

PHYSICIANS' INSTRUCTIONS TO CITIZENS

Schools and Public Institutions Will Be Closed if Occasion Warrants; Committee to Prepare Circulars

Finally, it was decided that for the present at least, schools and theaters should be kept open with the possibility always in mind that they be closed promptly if the disease continued to spread. The debate was a hot one with many of the physicians arguing that everything should be closed immediately and such measures taken as would prevent a possible wide spread of the disease, which, it is declared, is nothing other than the grippe in a very virulent form.
DRASTIC CLOSING ORDER ISSUED TO AVERT INFLUENZA EPIDEMIC

Churches, College, Theaters, Schools and All Gatherings are Barred

Health Board, Acting on Suggestion of Surgeon General, Takes Stringent Measures to Control Outbreak; Affects Lodges, Dances, Funerals, Etc.
Doctors Give ‘Don’ts’ to Avert Further Spread of Influenza Here

By Committee of El Paso County Medical Society

People should be especially careful not to sneeze or cough in their homes or in any public place without covering their mouth and nose with a handkerchief.

There should be plenty of fresh air in homes, offices, stores and all public places. Crowds should be avoided. Crowded street cars are especially bad.

If taken sick, go to bed and call your physician.

Avoid fatigue and exhaustion.

Since the disease probably gains entrance thru the eye, nose and throat, a 20 per cent solution of argyrol or a 10 per cent solution of silvot could be used in the eye and nose and a suitable gargle used as a prophylactic.

The following rules are advocated by the United States surgeon general:

1—Avoid needless crowding. Influenza is a crowd disease.
2—Smother your coughs and sneezes. This prevents the spread of germs thru the air.
3—Breathe thru your nose.
4—Do not keep too warm.
5—Keep the windows open.
6—Wash your hands before eating.
7—Don’t use a napkin, towel, spoon, fork, glass or cup which has been used by another and not washed.
DRASTIC CLOSING ORDER ISSUED TO AVERT INFLUENZA EPIDEMIC

(Continued From Page One)

To meet a critical emergency, but as a preventive measure which was better
accomplished now before the epidemic became general than later when it
might be less effective. The health department, in effect, was to be
locking the door before the horseman arrived.

In discussing the order Mayor Thomas said:

"While I do not feel that the

widespread apprehension is justified in this

community, I recognize the need of

exercising the greatest care and there-

fore readily accept the judgment of the

medical profession and the health

department."

The Text of the Order.

The complete text of Dr. Gibson's

closing order follows:

To meet the present emergency

the health department of the city of

Colorado Springs, with the

approval of a committee representing the

El Paso County Medical society

and the Chamber of Commerce,

has decided to carry out the

recommendations of Surgeon General Blue

for general closing.

The department therefore, hereby

orders that all schools and colleges,

churches, theaters, moving picture

houses, pool and billiard halls and

amusement parlors be closed until

further orders, and that all indoor

public gatherings, dances, social

meetings, etc., be prohibited, and

that the public be excluded from

each room and prohibited from

congregating in public buildings.

All public libraries and reading

circles to be closed, except for

the return of books now in circulation.

The grounds, football, swimming

pools of the Y.M.C.A., the Y.W.C.A., and the Boys

Club to be closed. It is recommended

that all weddings and funerals

be private. All physicians and

those practicing the art of

healing, called to attend any case of

illness, be prepared. All physicians

and attorneys practicing the art of

healing, called to attend any case of

illness, be prepared.

Dr. F. O. Hanford—I don't know

that there has been a general spread of the

disease from the college, where it had

its beginning. If the disease has not

been checked there, I am certain in

favor of a general closing order.

Dr. John B. Hartwell—I feel very

strongly that we ought to use strong

measures now and not later on. The

statement of Surgeon General Blue

and the precedent furnished us by other

cities in the east is worthy of the

most serious consideration. I strongly

advocate closing everything. It is not

too late to lock the door after the horse

is gone. —Buy Liberty Bonds.
Text from articles about the local effects of influenza, from the Colorado Springs Gazette, September 27 to October 7, 1918.
Ward Off Influenza

Spanish Influenza is an affliction more dreadful by far than grippe or bad cold. Don't take chances on being cured after you get it. Guard against getting it. Keep the respiratory passages resistant by using the pleasant preventative—INHALATUM.

INHALATUM PROTECTS YOU AGAINST INFLUENZA, GRIPPE, COLD

Inhalatum is a PREVENTATIVE. Let the doctor do the CURING. INHALATUM offers a strong antiseptic barrier to the dreaded germs of Influenza, grippe or cold. Simple to use morning, noon and night—after being in any crowd. Carry the little inhaler with you and be guarded. Get an outfit now—35c, $1.10 or $1.25.

Buy More Liberty Bonds

Sold At All Leading Druggists

Manufactured by Inhalatum Chemical Co., Colorado Springs.
Dr. Gilmore: “I have asked before that merchants do not advertise special sales, which would result in crowds forming in their stores. Some of them have not obeyed the request, so I now made it an order which will be enforced by the health department. It is not my intent to interfere with advertising except in cases where articles are offered for sale at a low price and in such a manner that might be expected to cause many persons to go to the store at a time.”
Inconsistencies

Inconsistencies influence us in various ways, some more
than others. It is important to understand how
influences work, as they can be misleading.

Garments

Our attention, as well as our present prices,
are set on high. Our garments are made by
seasonal patterns, and prices are adjusted
accordingly.

Dresses

$18.50

These are the same that are advertised. We offer
them for purchase at the stated price. The
quality is guaranteed.

Millinery

If you cannot find a millinery hat at your store,
you may order it from us. We offer a wide
variety of styles, including hats for every
occasion.

Thorsen's

Do Your Xmas Shopping Now as Much as You Can.

Colorado Springs Gazette
October 27, 1918, p. 7
Inconsistencies

Influenza, a malignant, devastating epidemic, is in our midst, as you all know, and it's with the full knowledge of its ravishing nature, due precautions are observed wherever it is in evidence.

It's preordained, some say, whom it's destined to reach; again others believe in giving it a wide berth by going in hiding or cut off all communications. The greater majority, however, look upon it with more common sense, using all due care and precautions, mingling more or less as before—keeping their systems well regulated, avoid all panicky tendencies and trusting in an all-wise providence at all times, wanting to act within the limits of orders issued by a legally constituted power, to control the health of our city.

You are told to stay at home, yet you may come down or uptown if you don't bring your whole family at one time.

While ours is a store, as most of you know, organized and dedicated to specializing and special values—you are not to allow us any advantage thereof in reading our prices, but to use your own judgment, but always to remember we are making quotations on quality goods.

That's about all, except to remind you we are observing rigidly all the precautions ordered, but as long as the wearing of masks is only recommended we are as yet refraining from putting them into use.

Our store is splendidly ventilated by doors, transoms and windows—owing to its wide frontage—and only 75 feet deep to an alley, as compared with the usual building up to 180 feet deep—and then again, we are located on the corner.
Our selection, as well as our present prices, we are sure do not encourage shopping elsewhere, and during these feverish times that is just what is desired. To find what you want, quick, and then get out in the air and home again is the idea.

We are not making any quotations in today’s ad, but we can safely tell you, unless you want to shop, if our extensive selection offers you the garment with which you can make merry, you may be sure the price will be within reasonable bounds, so much so as to discourage any further shopping.
References


Morens, David M. and Jeffrey K. Taubenberger, “1918 Influenza, A Puzzle with Missing Pieces,” *Emerging Infectious Diseases*, February 2012, Vol. 18, No. 2


The Epidemiology of Information: New Methods for Interpreting Data and Disease
Virginia Tech Research Center-Arlington (Ballston Metro)
October 17, 2013
Details announced at www.flu1918.lib.vt.edu
Contact: Tom Ewing (etewing@vt.edu)