

CASUALTIES OF WAR? AN ETHNOGRAPHIC EPIDEMIOLOGY OF
THE 1918 INFLUENZA PANDEMIC AMONG SOLDIERS IN CANADA

CASUALTIES OF WAR? AN ETHNOGRAPHIC EPIDEMIOLOGY OF
THE 1918 INFLUENZA PANDEMIC AMONG SOLDIERS IN CANADA

By

KANDACE L. BOGAERT, B.Sc., M.A.

A Thesis

Submitted to the School of the Graduate Studies

In Partial Fulfillment of the Requirements

For the Degree

Doctor of Philosophy

McMaster University

© by Kandace Bogaert, November 2015

Ph.D. Thesis

K. Bogaert McMaster University

Anthropology of Health

DOCTOR OF PHILOSOPHY (2015)

McMaster University

(Anthropology of Health)

Hamilton, Ontario

TITLE: Casualties of War? An Ethnographic Epidemiology of the 1918 Influenza
Pandemic Among Soldiers in Canada

AUTHOR: Kandace L. Bogaert, B.Sc. (University of Toronto), M.A. (McMaster
University)

SUPERVISOR: Dr. D. Ann Herring

NUMBER OF PAGES: 172

Abstract

This thesis is a biocultural analysis of the 1918 influenza pandemic among soldiers in the Polish army and the Canadian Expeditionary Force (CEF) training in Canada. Using an ethnographic epidemiological method and a variety of archival sources, I explore the 1918 influenza pandemic and focus on the first two pandemic waves which occurred between 1 January and 31 December 1918. This research examines the impact of influenza at the Polish army camp at Niagara-on-the-Lake, on soldiers treated in military hospitals across Ontario, and among recruits on troopships bound for Europe. The primary questions behind this thesis are: in what ways did the war effort intersect with pandemic influenza to affect soldiers in the Polish army camp at Niagara-on-the-Lake, across Ontario, and on troopships bound for Europe? What patterns of morbidity and mortality characterize the first two waves of the pandemic in Ontario's military hospitals? Were all soldiers equally vulnerable to infection and death from influenza? These questions are addressed in this 'sandwich thesis' in three papers which are either published or have been submitted for publication.

Pandemic influenza and the war effort in Canada were intimately linked. At the Polish army camp, crowding was prevalent in all aspects of the soldiers' lives and facilitated the spread of airborne infectious diseases, including influenza. Soldiers continued to be sent to Canada from infected cities in the U.S. throughout the fall wave of the pandemic. Similar events played out on troopships bound for Europe in the summer of 1918 where epidemics of influenza occurred on board, in spite of regulations established in the summer of 1918 to prevent troopships from transporting soldiers sick with influenza. These findings support Humphries's (2005, 2012) assertion that the war effort took precedence over the health of individual soldiers and the surrounding community. On the other hand, military authorities put the Polish army camp under quarantine in the fall of 1918 and great efforts were made to ensure that sick soldiers were cared for during the epidemic. This close examination of the epidemic in a particular

location suggests that military management of the influenza pandemic was complicated and was mediated by a variety of local factors.

Previous experience with the influenza virus, and the overarching social perceptions of the disease, also tempered the way in which military authorities managed the pandemic. I compare the way in which military doctors treated CEF soldiers hospitalized with influenza to those hospitalized with venereal disease. I argue that whereas influenza was understood to be a ‘normal’ or ‘everyday’ infection that rarely killed young people in the prime of life (being most deadly to the very young and old), other infectious diseases, such as venereal diseases, were treated with lengthy stays in hospital in spite of the need for soldiers overseas. This highlights the way the social perception of disease affected the ways in which the military handled sick soldiers.

This research also confirms the presence of the first wave of influenza among soldiers of the CEF in the spring and summer of 1918. The Admission and Discharge (A&D) records for military hospitals confirm that the first wave of pandemic influenza circulated among soldiers training in Ontario’s military camps between March and May of 1918. The second wave occurred between September and December that year. Mortality during the second wave was more severe, with a case fatality rate of 4.7% among hospitalized soldiers, more than double the rate of 2.3% from March to May. However, not all soldiers were equally vulnerable to the 1918 influenza pandemic. Morbidity and mortality were concentrated in the military district headquarters, and during the second wave, new recruits were more vulnerable to both infection and death than seasoned soldiers. I hypothesize that this is the result of cross-protection between successive waves of the pandemic, whereby seasoned soldiers were less vulnerable during the fall wave by virtue of exposure to the first wave of the pandemic in the military. Since new recruits were most likely conscripts, this is another way in which the war effort in Canada was linked to soldier morbidity and mortality.

Dedication

This thesis is dedicated to the memory of my cousin, Michael Leigh Bradshaw, who passed away on August 25th, 2013.
I miss you and wish you were here.

Acknowledgements

So many people have helped along the way, I cannot possibly thank all of them. Here is my best attempt:

My family has been ever supportive throughout this process. Mom, Dad, Korrie, Craig (and the pets, Sara and Abby) – I am so thankful for everything you have done to enrich life outside of research and writing, which would have been stale without you. My grandparents, aunts, uncles and cousins all contributed to the maintenance of my sanity in graduate school – I am so lucky to have such a tight knit group to go home to, I love you all. Robert Stark – I cannot thank you enough for everything. I am so pleasantly surprised you were not scared away by endless conversations on the 1918 influenza pandemic. Thank goodness you were not, as I do not know where I would be without your love and support.

The Department of Anthropology at McMaster University has been a wonderful place to spend 5.5 years. My supervisor, Ann Herring, has always gone above and beyond the role of supervisor – she is truly a mentor extraordinaire. Without her guidance, encouragement, and unwavering support this thesis would not have been completed. I will never be able to repay the debt of gratitude that is owed. Ann, and her husband Glen, also introduced me to another great friend, their dog, Relay, who provided much needed cuddles at my feet while I wrote. My other committee members, Tina Moffat and David Earn deserve thanks for always providing kind, insightful feedback. Other faculty and staff in the Department of Anthropology that I have had the pleasure of getting to know over the years include (but are not limited to), Tracy, Wayne, Ellen, Kate, Janis, Rabia, Sophie, Bonnie, Christine, Eszter, Delia and John. Thinking of you all makes me sad to leave. Many years ago now, Larry Sawchuk at the University of Toronto Scarborough, hired me as a summer research assistant and introduced me to this kind of research, and without him, it is certain I would have never found this passion.

My friends (many who were members of our Anthropology trivia team, and the concisely named Social Sciences and Humanities Research and Writing Group, where I wrote much of this thesis) were a big part of the reason that I have loved graduate school. Thank you: Lianne, Laura, Kyle, Tara, Matt, Maddy, Becky, Lori, Ashley, Lauren, Priscilla, Lena, Zack, Mary, Kari, Daiana, Steph, Dan, Diane, Alex, and Melissa. Megan O'Connor and Amanda Scales, two of my oldest friends, are owed special gratitude for being better friends than I could ever deserve.

Several anonymous reviewers helped to improve the quality of the papers within this thesis, and each paper contains specific acknowledgements to elaborate on those contained here. I am extremely grateful for the financial support for fieldwork and research provided by the Ontario Graduate Scholarships, the Social Sciences and Humanities Research Council of Canada, the Department of Anthropology and the Graduate Student Association of McMaster University.

Table of Contents

Title Page	i
Descriptive Notes	ii
Abstract	iii
Dedication	v
Acknowledgements	vi
Table of Contents	viii
List of Tables	x
List of Figures	xi
List of Abbreviations	xiii
Statement of Academic Achievement	xiv
CHAPTER 1: INTRODUCTION	1
Research Questions	2
Overview: the 1918 Influenza Pandemic	5
The Spread of the 1918 Influenza Pandemic in Canada	9
Study Context: Ontario in 1918	11
Theoretical and Methodological Framework	14
Thesis Format	18
CHAPTER 2: MATERIALS AND METHODS	23
Data Collection	23
Qualitative and Quantitative Sources	26
Methods	39
CHAPTER 3: TRACING ‘THE TRAIL OF INFECTED ARMIES’: MOBILIZING FOR WAR, THE SPREAD OF THE 1918 INFLUENZA PANDEMIC, AND THE CASE OF THE POLISH ARMY CAMP AT NIAGARA-ON-THE-LAKE, 1917-1919	43
From Poland to North America	44
Recruiting a Polish Army in the USA	47
From the USA to Niagara-on-the-Lake, Canada	49
1918 Influenza and the Movement of Soldiers during World War I	54
Soldiers with Influenza Travel to Polish Camp	56
Sick and Dying at Niagara-on-the-Lake	59
Interrupted Journeys	62
Endnotes	65
Acknowledgements	72
References Cited	72

CHAPTER 4: CROSS PROTECTION BETWEEN THE FIRST AND SECOND WAVES OF THE 1918 INFLUENZA PANDEMIC AMONG SOLDIERS OF THE CANADIAN EXPEDITIONARY FORCE (CEF) IN ONTARIO	78
Abstract	78
Introduction.....	80
Materials	82
Methods.....	85
Results.....	88
Discussion.....	92
Conclusion	94
Acknowledgements.....	95
References Cited	96
Supplementary Figures and Tables.....	101
CHAPTER 5: MILITARY AND MARITIME EVIDENCE OF PANDEMIC INFLUENZA IN CANADA DURING THE SUMMER OF 1918	104
Abstract	104
Introduction.....	105
The First and Second Waves of the 1918 Influenza Pandemic.....	108
A Maritime Epidemic: Evidence for Influenza in Canada in the Summer of 1918	114
Implications for the Deadly Fall Wave of the 1918 Influenza Pandemic	128
Acknowledgements.....	134
CHAPTER 6: DISCUSSION AND CONCLUSIONS	136
Pandemic Influenza and the War Effort in Canada.....	137
Social Understandings of Infectious Disease.....	140
Influenza: a Democratic Disease?.....	144
Conclusions.....	148
Future Directions	151
REFERENCES CITED	153
APPENDICES.....	166
Appendix A.....	166
Appendix B.....	169

List of Tables

CHAPTER 2: MATERIALS AND METHODS

Table 1. Name and location of Military Hospitals in Ontario studied along with the number of P&I admissions transcribed.....	29
Table 2. Transcribed records state of completeness for variables of interest.	31
Table 3. Description of unique, duplicate, transfer admissions and re-admissions for P&I.....	33
Table 4. Troop sailings and strength on board from Canada to all theatres of war, July-August 1918.....	35

CHAPTER 4: CROSS PROTECTION BETWEEN THE FIRST AND SECOND WAVES OF THE 1918 INFLUENZA PANDEMIC AMONG SOLDIERS OF THE CANADIAN EXPEDITIONARY FORCE (CEF) IN ONTARIO

Table 1. P&I case fatality rate by pandemic wave among soldiers in Ontario.....	90
Table 2. P&I morbidity and mortality among soldiers in Ontario during the second wave (Sept-Dec) of the pandemic, according to length of service in the army.	91
Supplementary Table 1. P&I admissions by military hospital and city, Ontario, 1918.....	101
Supplementary Table 2. Strength of the CEF in Canada and Ontario, and monthly enlistments in Ontario, 1918.....	102

CHAPTER 5: MILITARY AND MARITIME EVIDENCE OF PANDEMIC INFLUENZA IN CANADA DURING THE SUMMER OF 1918

Table 1. Summary of troopships reporting cases of influenza & pneumonia (P&I) in the summer of 1918.....	125
Table 2. Summer mortality from influenza/pneumonia and other causes in the Canadian Expeditionary Force, 1917 & 1918.....	126

List of Figures

CHAPTER 2: MATERIALS AND METHODS

Figure 1. Photograph of the Polish soldier cemetery at Niagara-on-the-Lake	25
Figure 2. Map showing the locations of Military Hospitals in southern Ontario, and at Kapuskasing in northern Ontario (right inset), in relation to the rest of Canada, and the United States (left inset)	29

CHAPTER 3: TRACING “THE TRAIL OF INFECTED ARMIES”:

MOBILIZING FOR WAR, THE SPREAD OF THE 1918 INFLUENZA PANDEMIC, AND THE CASE OF THE POLISH ARMY CAMP AT NIAGARA-ON THE-LAKE, 1917-19

Figure 1. Recruiting Poster, “Armia Polska we Francji/Polish Army in France”Library and Archives Canada, Acc. No. 1983-28-3798	46
Figure 2. Emergence of the Polish Army in France. Adapted from Valasek 2006 pg. 408	49
Figure 3. Niagara-on-the-Lake, Ontario, Camp Niagara and Polish Soldiers Cemetery	50
Figure 4. Polish soldier mortality and camp strength, September to December, 1918, Arthur D’Orr. War Diary A.D LePan, Vols. 1-2. Library and Archives Canada, MG 30 E 277, 1917-1919.	61
Figure 5. Polish Soldiers Memorial. Photograph by K. Bogaert, 2012	63

CHAPTER 4: CROSS PROTECTION BETWEEN THE FIRST AND SECOND WAVES OF THE 1918 INFLUENZA PANDEMIC AMONG SOLDIERS OF THE CANADIAN EXPEDITIONARY FORCE (CEF) IN ONTARIO

Figure 1. Comparison of P&I deaths among soldiers in Ontario in the CWGC database (Rewegan et al., 2015 and Rewegan, unpublished) and the A&D records	85
Figure 2. P&I admission rate per 1000 soldiers in Ontario, 1918.	89
Figure 3. P&I mortality rates per 1000 soldiers in Ontario, 1918.	89
Figure 4. P&I admissions by month in the military headquarters of Ontario.	91
Supplementary Figure 1. Location of Ontario’s military camps and district headquarters (red). Adapted from Martin et al. (1919: 271).....	103

**CHAPTER 5: MILITARY AND MARITIME EVIDENCE OF PANDEMIC
INFLUENZA IN CANADA DURING THE SUMMER OF 1918**

Figure 1. Number of cases reported daily on <i>HMT Pannonia</i> , 28 July – 15 August 1918.....	121
Figure 2. Number of cases reported daily on <i>HMT Atreus</i> , 10 – 25 August 1918.....	122

APPENDICES

Figure 1. Letter of Permission from McGill Queen’s University Press	166
Figure 2. Letter of Permission from Jane van Koeverden	167
Figure 3. Letter of Permission from D. Ann Herring.....	168
Figure 4. Photograph of soldier tombstones	169
Figure 5. Photograph of rows of tombstones registered with the CWGC.	170
Figure 6. Cross of Sacrifice at the Hamilton Cemetery	171

List of Abbreviations

A&D	Admission and Discharge
ADMS	Assistant Director of Medical Services
AR	Admission Rate
BC	British Columbia
CEF	Canadian Expeditionary Force
CFR	Case Fatality Rate
CI	Confidence Interval
CWGC	Commonwealth War Graves Commission
DDGMS	Deputy Director General of Medical Services
GA	Georgia
HMT	His Majesty's Transport
LAC	Library and Archives of Canada
MA	Massachusetts
MR	Mortality Rate
MSA	Military Service Act
NJ	New Jersey
NM	New Mexico
NY	New York
P&I	Pneumonia and Influenza
PA	Pennsylvania
PUO	Pyrexia of Unknown Origin
RAF	Royal Air Force
RG	Record Group
RNA	Ribonucleic Acid
RR	Relative Risk
SC	South Carolina
TB	Tuberculosis
U.S.	United States
USA	United States of America
VA	Virginia
WO	War Office
WWI	World War One
YMCA	Young Men's Christian Association

Statement of Academic Achievement

I am the main contributor to the three articles presented in this thesis. Chapter 3, “Tracing “The Trail of Infected Armies”: Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19,” is a co-authored paper published in 2013 in a McGill-Queen’s University Press volume, *Lives in Transition: Longitudinal Analysis from Historical Sources*, edited by Kris Inwood and Peter Baskerville. I am the first author. I conducted the archival research for this paper in 2012 and subsequently analyzed the data in collaboration with my co-authors, D. Ann Herring and Jane van Koeverden. I wrote the first draft, prepared the figures, and collaborated with my co-authors on revisions to the manuscript. Chapter 4, “Cross Protection between the First and Second Waves of the 1918 Influenza Pandemic among Soldiers of the Canadian Expeditionary Force (CEF) in Ontario,” is a single authored paper that has been accepted with minor revisions by the journal *Vaccine*. Chapter 5, “Military and Maritime Evidence of Pandemic Influenza in Canada During the Summer of 1918,” is a single authored paper I submitted for peer review to the journal *War and Society*. I collected the archival data for Chapters 4 and 5 in 2013, analyzed the data, wrote the manuscripts, and prepared the tables and figures.

CHAPTER 1: INTRODUCTION

The 1918 influenza pandemic has become widely known as the worst demographic disaster of the twentieth century, resulting in a staggering 50 to 100 million deaths worldwide, claiming more lives in a few months than the four years of the First World War (WWI) (Johnson and Mueller 2002). In general, the 1918 flu pandemic was experienced in three waves: a mild “herald” wave in the spring or summer, followed by the deadly fall wave, with recurrences in the winter of 1919 (Johnson and Mueller 2002; Olson et al. 2005; Andreasen, Viboud, and Simonsen 2008; Chowell et al. 2010; Fahrni and Jones 2012). In some places flu circulated into 1920 (Johnson and Mueller 2002; Fahrni and Jones 2012).

In Canada, 50,000 deaths are attributed to the pandemic out of a population of only 8 million (Pettigrew 1983; Johnson and Mueller 2002; Humphries 2013).¹ Recent research on the 1918 influenza in Canada has linked both the milder spring wave (which is thought to have occurred between March and April 1918) and the deadly fall wave (which began in September and peaked in October in most places) to soldiers training for overseas service (Humphries 2013; Rewegan et al. 2015; Bogaert, van Koeverden, and Herring 2015). Very little scholarly research has focused on the third wave of the pandemic in Canada, which occurred between January and April 1919 (Herring et al. 2010). Some communities may not have been exposed to each wave of the pandemic, and if they were, that exposure may have occurred at different times (Korol 2011). During the Russian influenza pandemic in 1890, some communities distant from the railway transit system appear to have escaped the infection altogether (Herring et al.

¹ It is unclear if the estimated mortality toll is attributed to the fall wave of the pandemic, which began in September 1918, or whether this includes mortality attributed to the herald wave in the spring of 1918, and recurrences into 1919.

2011; Mamelund 2011). For this reason, further studies using registers of morbidity and mortality across Canada during each wave of the 1918 pandemic are needed.

Soldiers played a key role in the spread of the epidemic and were among the earliest Canadians reported to be afflicted with influenza. Once influenza was established in military camps in Southern Ontario in the fall, the disease spread to adjacent civilian communities, and across the country, as Canadian troops were mobilized for both the Canadian and Siberian Expeditionary Forces (Humphries 2005). High rates of influenza mortality have been documented in army camps worldwide (Brundage and Shanks 2007; Byerly 2010). Beyond Humphries's important research (2005; 2012; 2013) that traces the "trail of infected armies" and links the Canadian military to the spread of the epidemic across the country, there has been no systematic study of influenza morbidity and mortality among soldiers in 1918; neither has there been a comprehensive analysis at either the provincial, training camp, or troopship level (for a discussion of Canadian soldiers overseas, however, see Herring and Padiak (2008).

Research Questions

To begin to address these gaps in the literature, in this thesis I ask:

1. In what ways did the war effort intersect with pandemic influenza to affect soldiers in the Polish army camp at Niagara-on-the-Lake, across Ontario, and on troopships bound for Europe? The Polish army camp at Niagara-on-the-Lake was an epicenter for the fall wave of the pandemic in Ontario (Humphries 2005), yet little has been written about the circumstances surrounding this outbreak in this particular setting, nor about the presence of the Polish army on Canadian soil. Similarly, while some historians have stressed the role in the pandemic played by sick CEF soldiers returning from Europe (Dickin-McGinnis 1977; Pettigrew 1983), soldiers sailing to Europe from

Canada during the summer of 1918 also experienced epidemics prior to the deadly outbreaks in the fall. This thesis takes up these neglected questions and local settings.

2. What patterns of morbidity and mortality characterize the first two waves of the pandemic in Ontario's military hospitals? Most research on the 1918 pandemic in Canada has focused on the second wave in the fall of 1918, and that research has been limited by a lack of detailed morbidity data (Herring et al. 2010; Korol 2011; Rewegan et al. 2015). This thesis examines both the spring/summer (first) and fall (second) waves of the pandemic using previously unstudied hospital and death records for soldiers in the CEF. Instead of isolating the fall wave as a single event, this research considers the relationship between the two waves and asks whether exposure to influenza during the first wave may have influenced the risk of death from influenza during the second, more deadly wave.

3. Were all soldiers equally vulnerable to infection and death from influenza? Recent research suggests that influenza was not a 'democratic disease', to which everyone was equally vulnerable. Some groups were at greater risk of dying from influenza than others (Barry, Viboud, and Simonsen 2008; Shanks et al. 2010; Shanks et al. 2011; Mamelund 2011; Herring and Korol 2012; Mamelund, Sattenspiel, and Dimka 2013). This thesis takes up this question within the CEF, asking whether new recruits were more likely to die from influenza than more seasoned soldiers.

These questions are examined in three papers for publication that form the body of this thesis. In the first paper, entitled, "Tracing "The Trail of Infected Armies": Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19," my co-authors and I examine in depth the social and environmental circumstances surrounding the outbreak of the fall wave of the pandemic among soldiers training at Niagara-on-the-Lake, Ontario. In the

second paper entitled, “Cross Protection between the First and Second Waves of the 1918 Influenza Pandemic among Soldiers of the Canadian Expeditionary Force (CEF) in Ontario,” the focus shifts to a detailed analysis of morbidity and mortality among soldiers of the Canadian Expeditionary Force in military hospitals across Ontario to examine whether recent recruits and more seasoned soldiers were equally vulnerable during the fall wave of the pandemic. The final paper entitled, “Military and Maritime Evidence of Pandemic Influenza in Canada During the Summer of 1918,” presents new evidence for influenza epidemics on troopships and other non-military vessels in Canada throughout the summer of 1918.

Through these analyses of the experience of Canadian soldiers during World War I, I take up a number of questions that continue to be debated in the literature on the 1918 influenza pandemic: was influenza a ‘democratic disease’ in which everyone was equally vulnerable (Jones 2007; Herring 2009; Swedlund 2010; Mamelund 2011; Herring and Korol 2012)? Did the military’s need to train soldiers and transport them overseas as quickly as possible take precedence over the management of influenza and without concern about the health of the general public (Humphries 2012)? What is the evidence for the presence of influenza among CEF soldiers, and on troopships heading for Europe, prior to the fall outbreak (Humphries 2013; Rewegan et al. 2015)?

Soldiers represent an ideal population within which to examine these research questions because their health was closely monitored. Sick soldiers were required to report to a medical officer if they were unable to report for active duty because of illness. Likewise, military hospitals were required to keep a record of those admitted and the outcome of such treatment (Humphries 2013). This is important, because in 1918, there was no comparable monitoring of the health of civilians (Dickin-McGinnis 1981; Humphries 2005).

Overview: the 1918 Influenza Pandemic

Three pandemics of influenza occurred in the twentieth century: 1918, 1957, and 1968, with the most deadly occurring in 1918 (Cox and Subbarao 2000). While pandemics occur unpredictably, influenza circulates regularly and causes seasonal epidemics each year (Taubenberger et al. 2001). Influenza A is the RNA virus behind the 1918 influenza pandemic (Taubenberger and Morens 2006), belonging to the family *Orthomyxoviridae* (Cox, Brokstad, and Ogra 2004). Influenza A viruses are respiratory pathogens named according to their surface antigens, haemagglutinin (HA) and neuraminidase (NA); the 1918 pandemic was caused by an H1N1 virus (Cox, Brokstad, and Ogra 2004; Taubenberger and Morens 2006). Influenza viruses undergo frequent change through the processes of antigenic drift (through natural selection over time new antigenic variations occur), and antigenic shift (the influenza RNA genome is segmented allowing for the exchange of RNA segments with human and animal viruses, whereby it acquires novel antigenic properties) (Cox, Brokstad, and Ogra 2004; Ahmed, Oldstone, and Palese 2007). The source of the 1918 pandemic strain of the virus is thought to be avian (Reid, Taubenberger, and Fanning 2004; Worobey, Han, and Rambaut 2014; Parrish, Murcia, and Holmes 2015). While pigs were once thought to have served as an intermediate host, or “mixing vessel” for the virus (Reid, Taubenberger, and Fanning 2004), recent research suggests that the virus infected humans first and then pigs in 1918 (Worobey, Han, and Rambaut 2014).

Upon infection via respiratory droplets or direct contact, the virus causes an acute respiratory infection characterized by “classic” influenza symptoms: fever, chills, headaches, weakness and muscle pain, along with a cough or upper respiratory tract complications (Morens and Fauci 2007). Most deaths during the 1918 pandemic were

caused by secondary bacterial infections, such as bacterial pneumonia (Brundage and Shanks 2007).

If an individual survives an influenza infection, the experience can affect their immune response to subsequent influenza infections. Influenza infection creates an immune response that protects against re-infection with the same virus, or against an antigenically similar strain of the virus (Cox, Brokstad, and Ogra 2004). This is the principle behind modern seasonal influenza vaccines, which are produced based on predictions of which strains might become epidemic the following year (Hasegawa, van Reit, and Kida 2015). Natural immunity produced through infection is thought to produce a superior immune response compared to vaccination (Cox, Brokstad, and Ogra 2004; Hasegawa, van Reit, and Kida 2015).

Advanced by Francis (1960), the theory of original antigenic sin is based on the idea that a person's immune system reacts to subsequent influenza A infections with the immune response to the influenza A virus first encountered (Adalja and Henderson 2010). Since original antigenic sin is a confusing, non-descriptive name, Ma and colleagues (2011) suggest antigenic imprinting as an alternative. The result of antigenic imprinting is that a person is best protected from strains of influenza A that are the most similar to the influenza A first encountered, and offers the least protection to strains of the virus that differ greatly from the original strain (Ma, Dushoff, and Earn 2011). The mortality registers of Montreal and Toronto reveal that in 1918 there was a peak in mortality during the fall outbreak at the exact age of 28 years (Gagnon et al. 2013; Hallman 2015). These are the individuals who would have been exposed to the Russian flu pandemic of 1890 when their immune systems were developing (Gagnon et al. 2013; Hallman 2015). Since the Russian pandemic is thought to have been caused by an H3 strain of influenza, it is suggested that antigenic imprinting caused a dysregulated immune response to the 1918

virus, resulting in increased mortality among these individuals when they encountered the antigenically different H1 influenza strain 28 years later (Gagnon et al. 2013). Mamelund (2011) hypothesized that communities not exposed to the 1890 pandemic by virtue of geographic isolation may have been immunologically naïve during the 1918 influenza pandemic. The age pattern of mortality that resulted from the 1957 pandemic in Canada also seems to support this theory (Ma, Dushoff, and Earn 2011). Others have hypothesized that antigenic imprinting can occur up until about 20 years of age and that exposure to subsequent pandemics can re-program an individual's antibody repertoire (Gagnon et al. 2015).

While antigenic imprinting generally refers to the first strain of influenza encountered, cross protection to influenza A viruses, sometimes called cross immunity, refers to the ability of the immune system to draw on its history of previous infections to reduce the likelihood of infection with a similar strain of the virus, or the hastened response of the immune system to viral control in the host (Nuño et al. 2008). During the 1918 influenza pandemic, influenza illness during the first waves of the pandemic, in the spring and summer of 1918, does appear to have conferred protection from illness and death during the more deadly fall wave of the pandemic (Chowell et al. 2006; Barry, Viboud, and Simonsen 2008; Rios-Doria and Chowell 2009). Rios-Doria and Chowell (2009) liken the number of infected individuals during the first wave of an influenza pandemic to the number naturally "vaccinated" against a closely related strain of the virus.

The 1918 influenza pandemic is unique for several reasons, including its heightened mortality rates, W-shaped mortality curve with heightened mortality among the very young and old, and young adults around the age of 30 years (Taubenberger and Morens 2006). There is also debate about the geographic origins of the virus, along with

the relationships between the multiple waves of the pandemic (Taubenberger and Morens 2006; Chertow, Cai, and Sun 2015). Although Taubenberger and colleagues (Taubenberger 1997; Reid et al. 1999; Tumpey et al. 2005) have completely reconstructed the genome of the virus, and the reconstructed virus was found to be deadly in animal studies (Kobasa et al. 2007), the virulence of the 1918 influenza pandemic has yet to be explained by genetic analysis (Sheng et al. 2011). A recent clinical, pathological, and virological analysis of preserved autopsy material from 68 soldiers who died during the first and second waves of the 1918 flu pandemic in American army camps provides an interesting insight (Sheng et al. 2011). Sheng and colleagues (2011) found that their analysis of the virus could not explain the heightened mortality that occurred during the second wave of the pandemic, but conclude that the virus was circulating at least four months prior to the fall outbreak. Phylogenetic analyses of the virus genome have also failed to determine its origins (Taubenberger and Morens 2006).

The relationship between influenza and increased susceptibility to secondary bacterial infections, such as pneumonia and tuberculosis, are believed to be significant (Noymer and Garenne 2000; Herring and Sattenspiel 2007; Brundage and Shanks 2008). The association between influenza mortality and tuberculosis, however, has been contested by some scholars (Sawchuk 2009; Hallman 2015). Furthermore, higher rates of mortality during this flu have been consistently reported among population sub-groups sharing socio-cultural characteristics, ages and prior health statuses. In 1918, these groups included soldiers in certain military camps, the impoverished, and Indigenous peoples worldwide (Lux 1997; Kelm 1999a; Jones 2007; Brundage and Shanks 2008; Herring and Korol 2012; Sattenspiel and Mamelund 2013; Mamelund, Sattenspiel, and Dimka 2013).

The Spread of the 1918 Influenza Pandemic in Canada

Camp Funston, Kansas was the first military camp in the United States to report an epidemic of influenza at the beginning of March 1918 (Soper 1918; Smallman-Raynor and Cliff 2004; Crosby 2003). In the following weeks other military camps across the United States, including Camp Sherman, Ohio and Camp Grant, Illinois in the Great Lakes region, experienced the apparently milder first wave of the 1918 influenza pandemic (Soper 1918; Crosby 2003; Smallman-Raynor and Cliff 2004). Recent analysis of the mortality registers of New York City show that this first wave of the pandemic, occurring between February and April 1918, was not limited to soldiers (Olson et al. 2005). Between April and May 1918, the disease was also circulating in Mexico City and Toluca, Mexico (Chowell et al. 2010). In both Mexico and New York, heightened mortality was observed among young adults, which is considered to be a hallmark of the 1918 influenza pandemic (Olson et al. 2005; Chowell et al. 2010). Newfoundland, not yet a part of Canada during WWI, did not experience the herald wave of the pandemic until the summer of 1918 (Sattenspiel 2011).

Canadian histories had long maintained that pandemic influenza arrived in Canada in July with soldiers returning from the European theatre of war (Dickin-McGinnis 1977; Pettigrew 1983). Mark Humphries's (2005; 2013) research has resulted in a significant shift in the narrative about the spread of influenza in Canada. Humphries (2005; 2013) argues that influenza did not spread from returning Canadian soldiers (since only one hospital ship returned in the summer – the *Araguaya*, as a result of the sinking of the *Llandoverly Castle*), but rather the disease spread north with American recruits headed for the Niagara-on-the-Lake training camp for the Polish Army in France, and delegates to a Eucharistic congress in Quebec (Humphries 2005). Using military hospital admission and discharge books from across the country, Humphries (2005) illustrates

how, beginning in September, the fall wave of the pandemic spread across Canada with soldiers headed to Europe and west with the Siberian Expeditionary Force (SEF). The disease traversed the country and reached Nova Scotia, Manitoba, and British Columbia within a month (Kelm 1999a; Jones 2007).

Perhaps because of the heightened mortality experienced during the fall wave of the pandemic compared to the milder herald wave the previous spring, most research in Canada has focused on the September to December period. Overall, the experience of pandemic influenza in the fall was characterized by regional heterogeneity (Sattenspiel 2011). Certain places and people in Canada experienced heightened mortality, including Indigenous people in Saskatchewan and British Columbia. This greater vulnerability has been ascribed to a lack of nursing care, nutritious food and crowded living conditions during the pandemic, the results of colonialism and systemic structural inequality (Lux 1997; Kelm 1999a). Herring and Korol (2012) link heightened mortality in certain wards of Hamilton, Ontario to crowded living conditions, poverty and social inequality, which were ideal for facilitating the spread of influenza. Conversely, some locations escaped the pandemic because of their remoteness. The disease did not reach some regions of Canada, such as the Keewatin District of central Manitoba, until the winter of 1918 (Herring 1994; Sattenspiel and Herring 2003; Sattenspiel 2011).

Mark Humphries's (2013) research also notes that public health records from British Columbia, and hospital admissions in four military hospitals across the country, suggest that influenza was present in Canada in the spring of 1918, well in advance of the fall wave of the pandemic (Humphries 2013). This research is supported by Ellen Korol's (2011) MA research based on the Ontario death registry. Korol (2011) found that at least fourteen cities in Ontario were likely to have been exposed to the herald wave of pandemic influenza, including major cities, such as Toronto, Hamilton and Ottawa. Most

of the communities in Korol's (2011) study experienced heightened pneumonia and influenza (P&I) mortality in April, but in others increased mortality was observed in March and May, and some communities experienced secondary peaks of excess P&I mortality in June, July and August. Recent research by Rewegan and colleagues (2015), based on an analysis of P&I mortality among soldiers of the CEF stationed across Canada, also confirms that soldiers based in Central and Eastern Canada experienced the herald wave of the pandemic.

This body of research on the first wave of the 1918 influenza pandemic indicates that the virus affected Canadians that spring at the same time as the virus was circulating in the United States and Mexico. Pandemic influenza was not constrained by international borders in either wave of the pandemic. Rather, Canada can be seen as part of the larger disease pool in North America (Rewegan et al. 2015). These studies, however, are limited by a lack of data on morbidity during the mild, first wave of the pandemic, which is significant because influenza mortality in the spring was low (Olson et al. 2005; Chowell et al. 2010; Sattenspiel 2011; Korol 2011; Rewegan et al. 2015).

Aside from Herring and Carraher's (2010) edited volume and the research of Dubois and colleagues in Quebec (Dubois, Thouez, and Goulet 2012), there has been almost no scholarly attention dedicated to the third wave of the pandemic in Canada. This wave of the pandemic circulated beginning in January 1919, and was also apparently milder than the second wave of the pandemic (Herring et al. 2010). In some places, like Quebec, pandemic influenza circulated into 1920 (Dubois, Thouez, and Goulet 2012).

Study Context: Ontario in 1918

Between 1914 and 1919, the war effort was a defining feature of Canadian life; an army of 600,000 was raised and 400,000 men were transported across the country and on

to Europe (Busch 2003; Humphries 2013). At the end of the war, Canadian families had mourned the loss of 60,000 soldiers (Morton 2004). During the war, Ontario served as the center of industry and finance as well as the political core of the country (Hopkins 1919). With its large population, Ontario supplied 43% of the total number of recruits from Canada (Hopkins 1919). By 1916, Ontario munitions factories were contributing between one third and one quarter of the ammunition of the British forces (Crerar 2005). While often thought of as urban, a major segment of Ontario's population was rural. In 1911, the last census year before WWI, 47% (n=1,198,803) people in Ontario were classified as rural. With the government's encouragement that farmers could serve the war effort by providing food (rather than through enlistment), the province nearly doubled its agricultural production of staples, such as wheat, in the first year of the war through increased acreage and planting (Hopkins 1919). With virtually all aspects of society on the home front geared towards victory, Canadian men and women enlisted for service overseas, worked in munitions factories, and on farms (cash crop and livestock) to supply the war effort (Crerar 2005; Humphries 2013).

While the war was met with initial enthusiasm, tied to the belief that hostilities would be short-lived, by 1916 voluntary enlistment had slowed to a crawl (Granatstein 2011). By 1917 there was a dire need for recruits after the CEF had suffered devastating losses in the European front (Granatstein 2011). Potential recruits were well aware of the loss of life on the European front and this, combined with the creation of well-paying factory jobs at home, made military service unattractive (Crerar 2005). Conscription through the Military Service Act (MSA) came into effect in January 1918 (Granatstein 2011). Discussions of conscription in Canada often focus on the tension between English and French Canadians, but the issue of conscription was also divisive in terms of rural and urban populations (Djebabla 2013). Conscription created a conflict between the need

for food versus the need for soldiers; after pushing farmers to increase acreage and production, the government of Canada was threatening agricultural production by forcing farmers into uniform (Crerar 2005; Djebabla 2013). Having been previously encouraged to increase production, and assured they would be exempted from service under the MSA, farmers were understandably upset when Prime Minister Borden's government revoked all exemptions (Djebabla 2013). In the first half of the war, farmers made up only 8.5% of recruits (Young 1974). In 1918, however, farmers were disproportionately affected by conscription – with 45.5% of conscripts reporting farming as their occupation (Granatstein and Hitsman 1977).

Throughout the war, most communities in the country were home to some form of military establishment – usually at minimum a recruiting depot – and across the country over sixty training camps were in operation (Love 1999). When the Spanish flu arrived in Canada, it was far from clear that the war would soon be over, and the Canadian military was actively filling these training camps with volunteers and conscripts destined for action overseas (Humphries 2012). After enlistment, the recruit syllabus was a minimum of 14 weeks long, with additional training to be completed upon arrival in England (Love 1999). Men between the ages of 18 to 45 were eligible for service, and underwent a medical examination upon enlistment to ensure that they were not mentally or physically deficient for service in the military (Love 1999). The average Canadian recruit was 26 years old (Cook 2007). During WWI, women were only permitted to serve in the CEF as nursing sisters in the Canadian Army Medical Corps (CAMC) (Mann 2001).

To facilitate the mass effort of recruiting, training and transporting troops during WWI, Canada was divided into military districts. All activities within each district were coordinated and directed by the district headquarters. Eastern Canada, with a larger population and ability to provide more personnel, was also home to Department of Militia

and Defense headquarters in Ottawa. Ontario was divided into four military districts, with district headquarters in London, Toronto and Kingston, and with the Thunder Bay and Rainey River areas reporting to headquarters in Winnipeg, Manitoba (Love 1999).

According to Sir Andrew MacPhail's (1925) history of Canadian medical services during World War I, responsibility for the medical branch of the Canadian military on the home front rested at first with the Ministry of Militia and Defense, but in 1915 the branch was transferred to the Military Hospitals Commission. The medical service was responsible for training reinforcements, preventing disease and preserving the health of troops, along with examining recruits and conscripts called up under the Military Service Act (MSA), and caring for recruits invalided home from overseas. Between 1 January and 31 October 1918, total admissions to military hospitals for troops not yet embarked overseas was 43,312, with 852 deaths. Overall, influenza was responsible for 23% of these admissions, and during the Spanish flu epidemic, about 49% of admissions. Influenza caused 51% of deaths in military hospitals, and pneumonia 20%. At the time of the epidemic, the majority of military physicians and nursing sisters were overseas. Ontario's soldiers were among the first to be affected by the Spanish flu, and the province was home to the highest concentration of military camps and military hospitals in the country (Love 1999). These factors make Ontario an ideal setting to examine the confluence of war, influenza and the social circumstances surrounding the spread of the disease.

Theoretical and Methodological Framework

The broad theoretical framework informing this thesis is the biocultural lens, which is approached methodologically through ethnographic epidemiology. Within anthropology, "the notion that human health and illness are interwoven biocultural

processes, best understood through a variety of humanistic and scientific perspectives, has status as a foundational principle” (Leatherman and Goodman 2011; 29). Examining human health from this perspective attempts to understand how particular social, political and economic processes, “get under the skin” (Leatherman and Goodman 2011; 29) to result in illness, disease and death in a particular setting.

As Mamelund and Sattenspiel (2013) observe, it is probably impossible to capture all of the complexity of human societies in a single study, but situating health and disease in a broader biocultural context has proven to be a fruitful avenue of inquiry. For example, North American media and medical researchers have framed obesity metaphorically as an epidemic disease. This narrow view can contribute to stigma and blaming of those who are most at risk, and reinforce the incorrect assumption that obesity is a purely social problem without real biological ramifications (Moffat 2010). As Moffat (2010) argues, in order to better understand this health issue from a biocultural perspective, there must be a middle ground that considers both the biological reality of obesity, along with the social, economic and political factors that affect the prevalence, perception and treatment of obesity in North America.

Anthropologists have examined a wide range of infectious disease epidemics in the past within the biocultural framework. For example, Sawchuk and Burke (2003) examine a cholera epidemic within the context of the social and ecological conditions in Gibraltar, which was a hub of military, trade and commercial activity. At the time of the 1865 cholera epidemic, Gibraltarians were without adequate water supply and sanitary infrastructure and were plagued moreover by overcrowding, social inequality, poverty and malnutrition. These conditions created an ideal environment for the spread of cholera and other illnesses resulting in heightened mortality, such as weaning diarrhea, respiratory diseases and tuberculosis (Sawchuk and Burke 2003).

One of the most influential theories to emerge from this framework is syndemics theory (Singer and Clair 2003). The term syndemic refers to the relationship between co-occurring epidemics that involve disease interactions at a biological level and are compounded and sustained in a community because of specific, often deleterious social conditions. Singer and Clair (2003) attribute at least some of the interest in the synergy between co-occurring diseases to the Spanish influenza, where it has long been understood that the interaction between the influenza virus and bacterial pneumonia proved deadly. Syndemics theory has been used to study a broad range of circumstances ranging from the co-occurrence of sexually transmitted infections and harmful social circumstances in the U.S. (Singer et al. 2006), to seasonal social patterns, and multiple pathogens affecting Northern Aboriginal communities in Canada during the 1918 Spanish flu pandemic (Herring and Sattenspiel 2007; Singer et al. 2011).

Research on the 1918 influenza pandemic has highlighted the need for a biocultural approach. The biological processes at hand include the interaction of multiple pathogens in conjunction with influenza, such as pneumonia and tuberculosis (Singer and Clair 2003; Herring and Sattenspiel 2007; Brundage and Shanks 2008; Sattenspiel and Mamelund 2013; Mamelund, Sattenspiel, and Dimka 2013), and other environmental factors such as temperature and humidity, that limit the spread of the virus, or increased susceptibility to influenza and secondary bacterial infections from an individual's lack of previous exposure to these pathogens (Barry, Viboud, and Simonsen 2008; Mamelund 2011; He et al. 2013; Gagnon et al. 2015). Social, cultural economic and political factors include human behavioral responses to the pandemic, such as the implementation of quarantine, seasonal patterns of behavior, the availability of resources such as medical care, food and housing, and other factors such as the movement of people in conjunction

with the war effort (Sattenspiel and Herring 2003; Herring and Sattenspiel 2007; Humphries 2005; Humphries 2012; Sattenspiel and Mamelund 2013).

Ethnographic epidemiology is a mixed methods approach particularly suited to a biocultural framework because it combines the qualitative and textual strengths of anthropology with the statistical and quantitative strengths of epidemiology (Trostle 2005; Inhorn et al. 2009). Inhorn et al. (2009: 169-171) note that while epidemiology as a discipline often focuses on disease prevalence or incidence and the assessment of association between risk factors and disease outcomes, “it often lacks in contextual understanding of why certain human groups are at risk of problems such as infertility at particular historical moments, in specific places, and within particular political, economic, legal and religious contexts”. From a biocultural perspective, it is imperative that these factors are considered (Leatherman and Goodman 2011). Therefore, in the context of this thesis, along with the epidemiological tools of admission and mortality rates, and comparison between groups of soldiers, I also consider the specific social contexts created by WWI that may have affected morbidity and mortality and soldiers’ experiences of the pandemic.

While ethnography typically relies on the ethnographic tools of participant observation or interviews in the field, this is impossible since the last Canadian veteran, who may have remembered the experience of the 1918 influenza pandemic as a soldier, died in 2010 (CBC News Canada 2010). Likewise, the last confirmed Polish veteran passed away in 2008 (Polskie Radio 2014). In spite of these limitations, archival evidence can be used to examine an epidemic from an ethnographic epidemiological standpoint (Inhorn et al. 2009; Bernard 2011). Using ethno-historical evidence from archives can support the chronology of events during an epidemic (Herring 1993), as well as give an idea of the impact of an epidemic and popular ideas about disease causation

and prevailing treatments (Kelm 1999b; Kelm 1999a). Following an ethnographic epidemiological method, I gathered evidence from a variety of primary sources including: Ontario's military hospital Admission and Discharge books, the Daily Orders of troopships leaving Canada for Europe, the Commonwealth War Graves Commission (CWGC) registry, the Ontario Death Registry, the War Diary of Lt. Col. Aurthur D'Orr LePan, and correspondence during the pandemic in order to detail soldiers' experiences of the 1918 influenza pandemic.

Thesis Format

This thesis is comprised of five chapters, where three chapters are standalone papers (Chapters 3-5), two for publication in scholarly journals (Vaccine; War and Society) and one published in an edited volume (Baskerville and Inwood 2015). The thesis is organized as follows:

CHAPTER 2: MATERIALS AND METHODS

In this chapter, I describe the process through which I collected the data to address the central research questions behind this work. I then describe the qualitative and quantitative sources (in greater detail than in the papers for publication) used to develop an ethnographic epidemiology of soldiers' experiences of the 1918 influenza.

CHAPTER 3: PAPER 1: TRACING “THE TRAIL OF INFECTED ARMIES”: MOBILIZING FOR WAR, THE SPREAD OF THE 1918 INFLUENZA PANDEMIC, AND THE CASE OF THE POLISH ARMY CAMP AT NIAGARA-ON-THE-LAKE, 1917-19

By: Kandace Bogaert, Jane van Koeverden, Ann Herring

Chapter 3 was inspired by the work of Mark Humphries (2005) which identified the Polish Army camp at Niagara-on-the-Lake as one of the starting points of the fall wave of the 1918 influenza pandemic in Canada. This paper is an examination of how a

foreign national force – the Polish Army – came to be under training at Niagara-on-the-Lake in 1918, and documents attempts to balance the need for soldiers overseas along with concerns over soldiers' health during the 1918 influenza pandemic. Recruiting efforts continued throughout the pandemic, resulting in soldiers being transported from the U.S. to Canada. Porous military quarantine regulations, combined with the features of military life at the camp, led to an airborne infectious disease spreading rapidly among the Polish recruits. This paper relies heavily on the war diary of the camp commandant, Col. Arthur LePan D'Orr, who documented the pandemic's occurrence, offering invaluable first hand descriptions of life in the camp. LePan made every effort to ensure that the Polish soldiers were cared for during the epidemic. This paper was co-authored with Jane van Koeverden and Ann Herring. I wrote the first draft of the paper, and my co-authors helped to write and revise the paper. This paper was published in April 2015 by Queen's McGill University Press in Peter Baskerville and Kris Inwood's (2015) edited volume, *Lives in Transition: Longitudinal Analysis from Historical Sources*. My co-authors and the permissions department of Queen's McGill University Press have granted permission for this book chapter to be reproduced in this thesis (see Appendix A).

CHAPTER 4: PAPER 2: CROSS PROTECTION BETWEEN THE FIRST AND SECOND WAVES OF THE 1918 INFLUENZA PANDEMIC AMONG SOLDIERS OF THE CANADIAN EXPEDITIONARY FORCE (CEF) IN ONTARIO

By: Kandace Bogaert

While Chapter 3 provides a high level of detail on the localized experience of the 1918 influenza pandemic at the Polish Army camp at Niagara-on-the-Lake, Chapter 4 takes a wider lens and examines the pandemic through military hospital records across the province of Ontario. This chapter analyses soldier morbidity and mortality from pneumonia and influenza (P&I) in Ontario throughout 1918 using the hospital admission

and discharge (A&D) records for twenty six military hospitals. This paper asks: were all soldiers equally vulnerable to influenza? Since it is known that soldiers in the CEF experienced the first wave of the pandemic, following the methodology of Barry et al. (2008) I use length of service in the military as a proxy for exposure to the first wave of the pandemic to examine the possibility for cross protection between the two pandemic waves. Soldiers with more than one month's service in the military were estimated to be 84% protected from death, and 82.5% protected from illness due to P&I. This is significant, since most new recruits in 1918 were conscripts, and most conscripts were rural farmers, who may have been more vulnerable during the pandemic. This paper also corroborates with detailed morbidity data that the first wave of the pandemic was less severe, with a case fatality rate of 2.3% compared to 4.7% during the fall wave. Breaking P&I hospital admissions down by district headquarters in Ontario, it becomes clear that Toronto hospitals dominate the morbidity profile of the pandemic, because the city was a crucial hub for military training. To my knowledge this paper is the first to document both morbidity and mortality of both waves of the 1918 influenza pandemic among soldiers in Ontario. This paper was accepted with minor revisions by *Vaccine* on 28 August 2015, and was re-submitted on 15 September 2015 in the form presented in this thesis.

CHAPTER 5: PAPER 3: MILITARY AND MARITIME EVIDENCE OF PANDEMIC INFLUENZA IN CANADA DURING THE SUMMER OF 1918

By: Kandace Bogaert

This chapter shifts the focus from the pandemic experience in Ontario to examine P&I among soldiers who died across the country in the summer of 1918, as well as soldiers who fell ill with P&I en route to the European theatre from Canada (many of

them before final departure from Halifax). Chapter 4 reviews the growing body of literature on the first wave of the 1918 influenza pandemic in Canada, and contributes new evidence for the presence of influenza in Canada during the summer of 1918 (see also Chapter 3). This discussion is based on archival military and government correspondence regarding influenza, the daily logs of several troopships transporting soldiers to Europe, and an analysis of soldier deaths from pneumonia and influenza (P&I) occurring across Canada derived from the Commonwealth War Graves Commission (CWGC) database. These sources indicate that influenza was more common than previously thought among soldiers on non-military and military transports in Canada during the summer of 1918. This paper was submitted on 28 July 2015 and is under review by the journal *War and Society*.

CHAPTER 6: DISCUSSION AND CONCLUSIONS

This thesis contributes to larger debates and discussions within anthropology and in the literature on the 1918 influenza pandemic. Did the need for troops overseas trump concerns over individual soldier's health? On one hand, troopships were allowed to sail to Europe in the summer with soldiers sick with influenza onboard, and recruitment continued throughout the fall wave of the pandemic. This suggests that the war effort superseded concerns over the health of the public and individual soldiers. On the other hand, there is evidence that on a local level some military officials were very concerned about the health of soldiers and tried to limit the spread of disease. In this section, I discuss how the social perception of influenza undoubtedly informed the military's response to pandemic influenza in 1918 and use the treatment of venereal disease as a case in contrast to the management of influenza.

The findings of this research also speak to the debate about whether the 1918 influenza was a 'democratic disease' in which everyone was equally vulnerable to illness

and death (Mamelund 2011; Herring and Korol 2012; Herring 2009). Geography and recent enlistment helped mediate vulnerability in Ontario; influenza was not a democratic disease.

This thesis also highlights several gaps in the literature on the 1918 influenza pandemic in Canada where the bulk of research concentrates exclusively on the fall wave of the pandemic, and focuses on influenza as a single epidemic, to the exclusion of other infectious diseases and illnesses. Future research focusing on a range of illnesses among soldiers throughout WWI in Canada using the hospital admission and discharge books of the Canadian Expeditionary Force can begin to address this gap.

CHAPTER 2: MATERIALS AND METHODS

As outlined in Chapter 1, this research centers around three major questions: 1. In what ways did the war effort intersect with pandemic influenza to affect soldiers in the Polish Army Camp at Niagara-on-the-Lake, across Ontario, and on troopships bound for Europe? 2. What patterns of morbidity and mortality characterize the first two waves of the pandemic in Ontario's military hospitals? 3. Were all soldiers equally vulnerable to infection and death from influenza?

In this chapter, I describe the process through which I collected the data to address these research questions. I then describe the qualitative and quantitative sources (in greater detail than in the papers for publication) used to develop an ethnographic epidemiology of soldiers' experiences of the 1918 influenza. These sources include: Ontario's military hospital Admission and Discharge books, the Daily Orders of troopships leaving Canada for Europe, the Commonwealth War Graves Commission (CWGC) registry, the Ontario Death Registry, the War Diary of Lt. Col. Arthur D'Orr Le Pan, and other diaries, correspondence, and newspaper accounts. Finally, I provide an overview of the methods employed to analyze these sources.

Data Collection

The data collection process for this thesis began in 2012 and continued until 2014. In the winter of 2012, I began the research for the first paper of this thesis, entitled, "Tracing "The Trail of Infected Armies": Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19," which examines the confluence of pandemic influenza and the arrival of American recruits training in Ontario for the Polish Army in France (Bogaert, van Koeverden, and Herring 2015). At the Library and Archives of Canada in Ottawa, I

photographed the diary of the Polish Army Camp's Commandant, Col. Arthur D'Orr Le Pan, who describes in detail the 1918 influenza pandemic at the Polish Army Camp at Niagara-on-the-Lake. I also studied documents at the Niagara Historical Society Museum in Niagara-on-the-Lake and the Polish Museum of America in Chicago to collect additional archival data and background information on the Polish Army in France. While in Niagara-on-the-Lake I visited and photographed the grave sites of the Polish soldiers who died during the influenza pandemic (Figure 1).

In the spring of 2013, I returned to the Library and Archives of Canada in Ottawa and spent one month collecting and photographing the Admission & Discharge (A&D) books of the Canadian Expeditionary Force in Canada in order to examine morbidity and mortality from influenza in Ontario's military hospitals during the first two waves of the 1918 influenza pandemic. By 1918, the Canadian military was in charge of administering the largest network of hospitals in the country, and the Province of Ontario was the site of the largest number of training camps and military hospitals in Canada (Love 1999; Humphries 2012). I focused on the A&D records for 26 military hospitals in fourteen locations in Ontario, nearly all of which cluster along the U.S. border in close proximity to American training camps (Figure 2). While it took one month to photograph these records, it took a substantially longer time to transcribe the data therein. From January 2013 to February 2015, I manually transcribed into an Excel database cases and deaths from pneumonia and influenza among soldiers in Ontario. This Excel database forms the basis of the paper entitled, "Cross Protection between the First and Second Waves of the 1918 Influenza Pandemic among Soldiers of the Canadian Expeditionary Force (CEF) in Ontario," which is the second paper of this thesis.

While I was waiting to access boxes of A&D records in the spring of 2013, I ordered several additional files that contained correspondence on pandemic influenza

between military and government officials and information on the “strength” or number of soldiers in Canada (who would be the population at risk for contracting influenza). I scoured the files on the troopships *Nagoya*, *Somali* and the hospital ship *Araguaya*, ships that are mentioned in nearly every Canadian history of the 1918 influenza pandemic. To my surprise, one of the files contained previously unreported daily logs of several troopships where cases and deaths from influenza were recorded in the ships’ logs during the summer of 1918. These data form the basis for the paper entitled, “Military and Maritime Evidence of Pandemic Influenza in Canada during the Summer of 1918.”

Figure 1. Photograph of the Polish soldier cemetery at Niagara-on-the-Lake. Photograph by K. Bogaert, 2012.



Qualitative and Quantitative Sources

Admission and Discharge Books

The Admission and Discharge books are among the most detailed publicly available sources of data on CEF morbidity and mortality and also provide other socio-demographic information on soldiers. All hospitals treating soldiers in Canada, which ranged from civilian institutions to military camp hospitals, were required to keep a daily record of patients admitted or discharged (Humphries 2008). Likewise, soldiers who fell ill with influenza, or with any other medical condition, could not simply stay in bed – they had to report to a medical officer (Humphries 2008). Since I was interested in the cases and deaths from influenza, and not the pathologies of war that dominated the Overseas books (including gunshot wounds and other traumas), I limited this research to the A&D books designated as “Canada Cases”. Before transcribing these records, it was necessary to develop a working definition of a “case” of influenza.

Defining a Case of Influenza

It is important to recognize that at the time of the 1918 influenza pandemic, influenza was poorly understood and was diagnosed based on symptoms that presented along an extremely variable spectrum, which makes physicians’ diagnoses difficult to interpret (Herring and Korol 2012; Jones 2007). “Classic” influenza symptoms include: fever, chills, headaches, weakness and muscle pain along with a cough or upper respiratory tract complications (Morens & Fauci 2007). However, in 1918, some symptoms would have been terrifying to behold, including nosebleeds, coughing up blood, and heliotrope cyanosis, where a patient’s face would turn a violet or blue grey colour, signifying that a patient was literally drowning in their own lung fluids (Morens and Fauci 2007). Because of the range of symptoms, and physicians’ differing

experiences and understandings of influenza, the particular diagnostic styles of physicians may have affected their use of the term in medical records (Herring and Korol 2012).

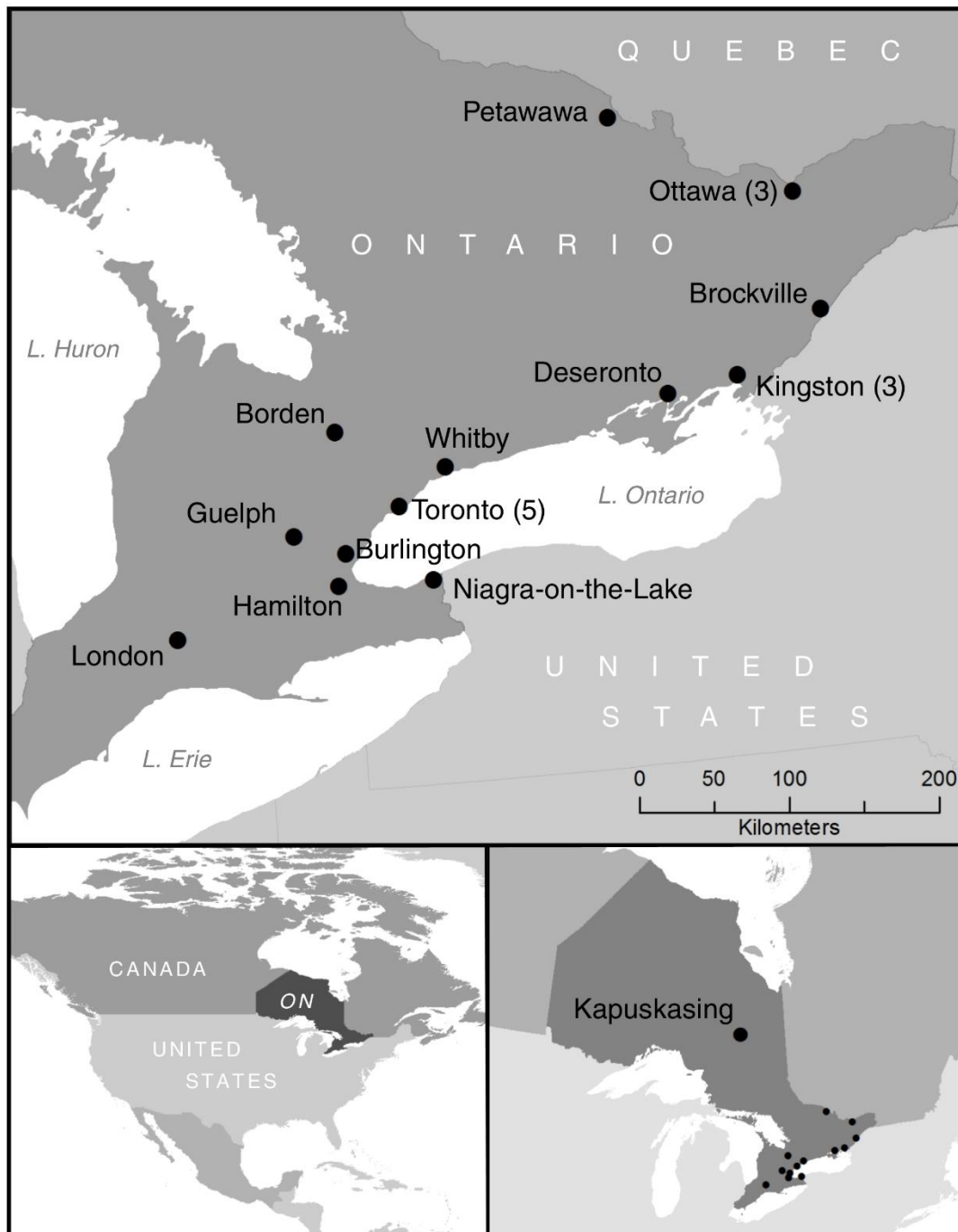
The first human influenza virus was not isolated until 1933 – influenza was literally an invisible pathogen until this point (Reid et al. 1999). Prior to this it was believed influenza was a bacterial infection (Mathers 1917). In Ontario, medical authorities seemed to operate under the belief that the initial disease acquired by a patient was influenza and that if no appropriate treatment were taken, the disease would become pneumonia. Therefore, physicians told patients to stay in bed (since bed rest was the only effective treatment) upon the first signs of the illness in order to avoid the natural progression to pneumonia (Slonim 2010).

In fact, most deaths during the pandemic were caused by secondary bacterial infections like bacterial pneumonia, and it has become common practice to ascribe cases and deaths due to the pandemic as P&I (pneumonia and influenza) (Brundage & Shanks 2008). For these reasons, I defined a case of influenza as all illnesses and deaths ascribed to pneumonia and influenza (P&I). I included any variant of pneumonia or influenza (for example, 'flu, "Spanish influenza", la grippe, pneumonia, bronchial pneumonia, lobar pneumonia or any diagnosis of this sort that occurred in the diagnosis or cause of death section).

Once the classification of a "case" of P&I was established, I began to systematically transcribe cases and deaths from the A&D books for the military hospitals of the CEF in Ontario (see Figure 1). Information on the hospital, case number, unit, the soldier's regimental number, rank, age, and length of military service, along with date of admission, marital status, religion, result (or outcome, including discharge, transfer or death), transfer origins if applicable, and date of discharge were transcribed. In total, I transcribed 6,212 P&I admissions recorded between 1 January 1918 and 31 December

1918. Among the admissions transcribed, 240 deaths due to P&I were recorded (Table 1).

Figure 2. Map showing the locations of Military Hospitals in southern Ontario, and at Kapuskasing in northern Ontario (right inset), in relation to the rest of Canada, and the United States (left inset).²



² Brackets indicate the number of military hospitals in locations where more than two were in operation. Map created by Mary Lynn Tobiasz. Sources: Commission for Environmental Cooperation 2011; Ministry of Municipal Affairs and Housing 2015.

Table 1. Name and location of Military Hospitals in Ontario in this study along with the number of P&I admissions transcribed.

Name of Hospital, Location in Ontario	Number of P&I Admissions Transcribed
Special Hospital Camp Borden, Borden	51
Base Military Hospital, Brockville	9
Brant Military Hospital, Burlington	248
Camp Mohawk Military Hospital, Deseronto	37
Guelph Camp Military Hospital, Guelph	24
Hamilton Military Hospital, Hamilton	566
Kapuskasing Station Hospital, Kapuskasing	99
Hotel Dieu Hospital, Kingston	21
Ongwandada Military Hospital, Kingston	152
Queen's University Military Hospital, Kingston	211
CAMC Hospital, London	151
London Military Convalescent Hospital, London	128
Wolseley Barracks Hospital, London	468
Niagara Camp Hospital, Niagara-on-the-Lake	327
Fleming Military Hospital and Convalescent Home, Ottawa	344
General Protestant Hospital, Ottawa	115
St. Luke's Base Hospital, Ottawa	363
Military Hospital Petawawa Camp, Petawawa	154
Base Military Hospital, Toronto	2158
Exhibition Camp Hospital, Toronto	169
Spadina Military Hospital, Toronto	11
St. Andrews Military Hospital, Toronto	72
Toronto General Hospital, Toronto	258
Whitby Military Hospital, Whitby	76
Total	6212

The A&D books contain information on each soldier's name, hospital, case number, unit, regimental number, rank, age, and length of military service, along with date of admission, marital status, religion, result (or outcome, including discharge, transfer or death), and transfer origins. However, not all registrars recorded complete information on each patient. Dates of admission, regimental numbers and rank were the most consistently recorded variables of interest transcribed from the A&D books, with 97-99% of records transcribed containing this information (see Table 2). Registrars were less likely to record information on religion, and in fact, only 12% of P&I admissions transcribed contained this information. Marital status and length of service in the military were fairly consistently reported, with 89% and 82% of P&I admissions transcribed containing this information.

Table 2. Transcribed records state of completeness for variables of interest.

Variable	Number of P&I Admissions with Complete Information	Number of P&I Admissions with In-Complete Information	Total	Percent of Total Complete
Regimental Number	5793	419	6212	93.3
Rank	6024	188	6212	97.0
Age	6060	152	6212	97.6
Length of Military Service	5080	1132	6212	82.0
Religion	767	5445	6212	12.3
Marital Status	5543	669	6212	89.2
Date of Admission	6205	7	6212	99.9
Disease Outcome	6101	111	6212	98.2

Some of this variability in the completeness of records could be attributed to the fact that during a pandemic, registrars themselves could be ill, or the urgency of the situation required hasty registration limiting the detail recorded for each case. Other problems with historical registries include missing records, non-registration, and misdiagnosis (Johnson and Mueller 2002). Many A&D registrars wrote in nearly indecipherable script that required lengthy scrutiny, and human error in transcription may have resulted from this. Furthermore, only some of the 26 military hospitals were in operation for the whole of 1918. St. Andrew's Military Hospital, for example, opened in November of 1918. Other gaps in the A&D records are likely the result of the failure of military officials to forward books to the Ministry of Militia and Defense. Consequently, all of these factors combined have most probably resulted in underestimates of P&I morbidity and mortality (Johnson and Mueller 2002).

It is clear that some registrars recorded admissions to subsidiary hospitals and that patient transfers between hospitals were common (see Table 3). Duplicate (n=377) and transfer admissions (n=158) were omitted from the calculations of admission and mortality rates and from the analysis of cross-protection (Chapter 4). Some soldiers (n=88) were admitted more than once with P&I in 1918 (with longer time periods in between admissions than would be expected for a transfer admission). These cases were left in the analysis because they represent separate admission events.

Table 3. Description of unique, duplicate, transfer admissions and re-admissions for P&I.

Description of P&I Admissions Transcribed for 1918 in Ontario	Number of P&I Admissions
Unique Admissions	5589
Exact Duplicate Admissions ¹	377
Transfer Admissions ²	158
Re-Admittances ³	88
Total	6212

¹ An exact duplicate of a unique admission.

² Transferred from 1 hospital to another, with less than 1 or 2 days in between admissions.

³ More than 1 admission, but separated in time by more than a few days.

Were soldiers diagnosed with P&I in Ontario representative of the CEF? The soldiers admitted to hospital for P&I in 1918 appear to be fairly consistent with the profile for soldiers who volunteered or were conscripted into the military at that time. The average age of a Canadian recruit during WWI was 26 years old (Cook 2007). The average age of soldiers admitted to hospital in Ontario from the A&D database was 24.6, with a median age of 23 and a modal age of 21, reflecting the young age of men enlisting in the military. The majority of these men were likely conscripts, as voluntary enlistment had slowed by this point in the war (Machin 1919). It is impossible to accurately evaluate based on regiment numbers whether the soldiers admitted to hospital were conscripts because there were several anomalies with the assignment of particular regiment numbers to conscripts (Dennis 2012). During WWI, women were only permitted to serve as nursing sisters in the CEF as part of the Canadian Army Medical Corps (CAMC) (Mann 2001). Few women with P&I were admitted to military hospitals in Ontario, with only 56 nursing sisters recorded in the database.

Daily Logs of Troopships

Like Canadian soldiers in training camps, soldiers who fell ill en route to Europe were required to report to a medical officer. The records for a small number of troopships are available at Library and Archives of Canada (Library and Archives of Canada 1918a). I photographed these records in the winter of 2013. The Adjutant, who was also often the Captain or O.C Troops, kept a daily record of promotions, disciplinary actions, admissions and discharges from the ship's hospital as well as a record of increases or decreases in the number of soldiers. This report was commonly known as the "Daily Orders Part II". The Director General of Shipping and Transportation reported that 23 of His Majesty's Troopships (HMT) embarked from Canadian ports en route to all theatres of war between June and August of 1918 carrying a total of 34,809 soldiers (Library and Archives of Canada 1918d). Only 14 Daily Orders forms from these voyages have been preserved (see Table 4), and therefore the analysis of troopship morbidity and mortality in Chapter 5 is not a representative sample, but a case study documenting the presence of influenza on board at least five outbound troopships in Canadian waters.

Table 4. Troop sailings and strength on board from Canada to all theatres of war, July-August 1918.

Vessel	June		July		August	
	Officers	Other Ranks	Officers	Other Ranks	Officers	Other Ranks
Bellerophon	24	727			11	1112
Cassandra*	111	1702			19	2003
Atreus*	7	742			11	1009
Pannonia*	48	1306			30	2066
Waimana*	24	1941				
Gloucestershire	2					
Ionic	27					
Tunisian			20	1406		
Valacia*			13	830		
Oxfordshire*			77	1892		
Saturnia*			94	1811		
Kildoan Castle			31		22	590
Thongwa			18	1116		
Corsican			20	1719		
Somali			14	1460		
Nellore*					26	1699
Tennyson*					7	695
Nankin*					17	1490
Huntsend*					33	1599
Carnavonshire*					18	1893
Ixion					23	2156
Kia Ora*					15	1081
Victorian					2	
Total		6661		10521		17627

*Indicates HMT's with Daily Orders Part II available for examination RG 150 Volume 274 File "Hospital Ships". Of these, only 5 transports reported cases of P&I en route to Europe in their Daily Orders. It is possible that cases occurred, but were not recorded as the level of detail recorded by each Adjutant in these orders varied on different ships, for example, on board HMT Huntsend, Major W.H. Grant's reports included the single word "Nil" for most days of their voyage between 3 August and 13 August 1918. While Major Grant did record at least two soldiers being sent to the Military Hospital in Halifax, he did not report the cause of admission.

The Commonwealth War Graves Registry

The Commonwealth War Graves Commission Registry (CWGC) is a rich source of detailed information on the deaths of all the soldiers from the Commonwealth who perished during World War I and World War II (see Appendix B, Figures 4-5, for photos of gravesites that would be registered by the CWGC in Canada). This registry includes each soldier's name, date of death, regimental number, and place of commemoration (Commonwealth War Graves Commission database online, n.d.). The CWGC website allows users to search the database by branch of military service, country of commemoration and date of death. To document CEF deaths in the summer of 1918, I searched the CWGC database for soldiers in the Canadian Expeditionary Force who were commemorated in Canada from 1 June to 31 August for 1917 and 1918. This yielded a database of 485 deaths. In order to determine which deaths were caused by influenza and pneumonia, the records were manually linked using name, date of death and regiment numbers, to the Circumstances of Casualty database in Ancestry.com, which lists an exact cause of death (Ancestry.com, n.d.).

Removing the records for soldiers commemorated on large memorials (e.g the Halifax Memorial) or who did not die in Canada (n=119), and those for whom a cause or place of death could not be established (n=90), resulted a final database of 276 soldiers who died in Canada during the summer months of 1917 and 1918. This record-linked data was compiled into a Microsoft Excel database during the summer of 2014 in order to examine whether influenza mortality was higher among soldiers in the summer of 1918 than during the previous summer.³

³ This data was originally collected as part of a larger database created for another project examining the first wave of the 1918 influenza pandemic in the CEF across Canada (Rewegan et al. 2015). The time consuming process of record linking was conducted in the summer of 2014 by Melissa Yan and Alex Rewegan. I am grateful to my colleagues who have allowed me to analyze and present this data here.

Diaries, Correspondence & Newspapers

The diary of Lieutenant-Colonel Arthur D'Orr Le Pan provides invaluable contextual information on the 1918 influenza pandemic in the Canadian military camp at Niagara-on-the-Lake. LePan was born in 1885 in Owen Sound, Ontario. After receiving a degree in engineering at the University of Toronto, LePan served in the Canadian Expeditionary Force as the Camp Commandant of the Polish Army Camp at Niagara on the Lake (Tunnell 1969). After LePan's death in 1976, his two volume war diary, which makes up the "Arthur D'Orr LePan fonds" was donated to the Library and Archives of Canada in 1977 by LePan's son, Douglas V. LePan (Library and Archives of Canada 2008). I photographed the two volume diary in the winter of 2012 at the Library and Archives of Canada in Ottawa.

Very few diaries of soldiers have been utilized to describe the experience of the 1918 influenza pandemic (Summers 2012). In the Canadian context, Hunt (2009) uses the memoirs of the Royal Air Force (RAF) recruit Roland Michener⁴ to describe the experience of the 1918 influenza pandemic among recruits in the Toronto area. Recruits were forced to give up their training temporarily and assist with the care of their sick comrades (Hunt 2009). Michener's memoir describes how the fall of 1918 was particularly cold, and that the recruits were kept busy transporting a constant stream of sick soldiers to the overwhelmed base hospital in Toronto (Hunt 2009).

These personal narratives add to our understanding of the pandemic in a particular local setting and add detail to the social and environmental circumstances that are often missing in sterile official accounts. For this reason, I rely heavily on the war diary of the Polish Army Camp Commandant Colonel Arthur D'Orr Le Pan. LePan's diary reveals

⁴ Roland Michener, after his time in the RAF eventually became the Governor General of Canada. He also wrote the forward to Eileen Pettigrew's book "The Silent Enemy," where he describes his memories of the pandemic while he was an RAF recruit training in Toronto.

that the Polish Army Camp was overwhelmed during the pandemic – at the height of the fall wave, LePan stated that he would, “accept assistance from God, man or the devil” in dealing with the epidemic (LePan 1918: 81-2).

LePan’s (1918) diary also provides a detailed record of camp demographics, such as the number of soldiers and soldier deaths in the camp, the movement of troops in and out of Niagara-on-the-Lake, housing arrangements, daily routines and life in the camp. To check the validity of the detail in LePan’s diary, I compared LePan’s record of deaths to the Ontario Death Registry for 1918 in Lincoln County, Ontario (Archives of Ontario 1918). The 25 Polish soldier deaths recorded by LePan match the listings in the Ontario Death Registry, illustrating how carefully LePan recorded the details of camp life in his diary.

In order to further contextualize daily life in the Polish Army Camp, I searched Polish language newspapers, primarily Chicago’s largest and oldest Polish newspaper *Dziennik Zwiazkowy* for accounts published by soldiers. I also examined advertisements to understand how recruitment was approached in the United States.

In my search for letters from patients in hospital suffering from influenza, I found letters written by soldiers to senior military officers from Toronto’s Military Base Hospital (Library and Archives of Canada 1916). These soldiers had been hospitalized for venereal disease, not influenza. While venereal disease and influenza are both infectious diseases, they were treated very differently by military officials. I used these first-hand accounts to form the basis for a comparison of the handling of soldiers hospitalized with influenza to that of soldiers with venereal disease, in order to illustrate how the perception of a disease can have a profound impact on the way it is managed (Trostle 2005).

Other correspondence informed Chapters 3 and 4 and the discussion section of this thesis (Chapter 6). While conducting fieldwork at the Library and Archives of Canada in Ottawa, I photographed files from the Department of National Health and Welfare fonds (RG 29) and National Defense fonds (RG 24). These files contain military and government correspondence detailing the arrival and progression of the 1918 Spanish influenza in Canada (Library and Archives of Canada 1918c; Library and Archives of Canada 1918b). The correspondence consists primarily of memoranda and telegraphs sent between Canadian officials, including the Director General of Public Health, Frederick Montizambert, and public health officials in charge of quarantine, along with correspondence between military officials in places including Montreal, Halifax and Ontario. This correspondence contains details on the development of national quarantine policy regarding pandemic influenza, along with military policies for dealing with influenza on troopships prior to embarkation from Canada. The correspondence also chronicles attempts to deal with pandemic influenza on troopships and non-military ships prior to the fall outbreak of influenza in Canada.

Methods

Mortality Rates

Mortality, morbidity and case fatality rates from P&I were estimated, where possible, using the formulas outlined below (Gail and Benichou 2000). Crude rates must be used carefully since they do not take into consideration the age and sex composition of the population (Gage, DeWitte, and Wood 2012). However, soldiers were generally between the ages of 18-45, making it difficult to examine patterns of morbidity and mortality by age, and the vast majority of soldiers were male (as women were only permitted to serve as nursing sisters). P&I mortality rates were calculated as:

$$MR = \left(\frac{d_i}{p_i} \right) k,$$

where MR is the monthly mortality rate for P&I among soldiers in Ontario, d_i is the number of soldier deaths from P&I in a given month, and p_i is the number of soldiers at risk of dying from P&I in the same month in Ontario, and k is 1000.

Admission Rates

Along with estimating mortality rates, an important goal of this thesis was to evaluate the impact of influenza illness (or morbidity) among soldiers. Mortality during the first wave of the pandemic was reported as negligible (Korol 2011) and to date there has been no systematic study of influenza illness among soldiers in Ontario. P&I admission rates were calculated as:

$$AR = (c_i/p_i)k,$$

where AR is the monthly admission rate for P&I among soldiers in Ontario, c_i is the number of P&I admissions among soldiers in Ontario in a given month, and p_i is the number of soldiers at risk of being admitted to hospital from P&I in the same month in Ontario, and k is 1000.

Case Fatality Rates

In order to evaluate the severity of the pandemic among soldiers, the case fatality rate was calculated to illustrate how many soldiers with P&I died from it. Case fatality rates were calculated as:

$$CFR = (d_i/c_i)k,$$

where CFR is the case fatality rate from P&I among soldiers in Ontario, d_i is the number of soldier deaths from P&I in Ontario in a given time period and c_i is the number of P&I admissions in Ontario in a given time period and k is 100.

Estimating Exposure to the First Wave

One of the goals of this thesis is to examine vulnerability and risk among soldiers – were all soldiers equally at risk of illness or death from P&I during the pandemic? In keeping with the observation that recent military recruits tend to be more susceptible to pneumonia-influenza (Shanks and MacKenzie 2010; Brundage and Shanks 2008; Byerly 2005), I used length of military service as a proxy for exposure to the first wave of the 1918 pandemic. The observation that recent military recruits tend to be more susceptible than ‘seasoned personnel’ to respiratory diseases is not new, and by the end of the Second World War was well established (Sartwell 1951; Bernstein 1957).

Using length of service as a proxy for exposure to the first wave of influenza has limitations because it assumes that soldiers with longer service were exposed earlier to pandemic influenza than new recruits. It was impossible to track soldiers in the A&D records from the spring through the fall of 1918. Soldiers were highly mobile and only 18 unique regimental numbers were traceable from the first wave of the pandemic into the second. Length of service in the military, therefore, is likely is a better estimator of exposure to the herald wave of the pandemic. Some conscripts and volunteers may have been exposed to the first wave of influenza before enlisting (Barry, Viboud, and Simonsen 2008). At the same time, conscription in Canada in 1918 drew disproportionately from rural farmers (Kirk-Elleker 2008; Granatstein and Hitsman 1977), who were less likely to have been exposed to influenza.

In order to assess cross-protection between the first two waves of the pandemic in Chapter 4 of this thesis, I replicated the methodology published by Barry and colleagues (2008). P&I cases were partitioned into two groups: soldiers with less than 1 month’s service (new recruits) and soldiers with more than 1 month’s service (‘seasoned’ recruits). The number of new recruits in Ontario was extracted from a report on CEF enlistments

(Library and Archives of Canada, n.d.) and the number of new recruits was subtracted from the total strength of the province each month to derive the number of seasoned recruits (Library and Archives of Canada 1918e; Library and Archives of Canada, n.d.). The relative risk of P&I illness and death was compared between the first wave of influenza (March to May) and the second wave (September to December). The effect of cross-protection was estimated as $1 - RR$ (Barry, Viboud, and Simonsen 2008). Confidence intervals (CI) were estimated around the effect of cross protection by subtracting the CI for RR from 1 (Sackett et al. 1997).

**CHAPTER 3: TRACING ‘THE TRAIL OF INFECTED ARMIES’:
MOBILIZING FOR WAR, THE SPREAD OF THE 1918 INFLUENZA
PANDEMIC, AND THE CASE OF THE POLISH ARMY CAMP AT
NIAGARA-ON-THE-LAKE, 1917-1919**

By: Kandace Bogaert, Jane Van Koeverden and D. Ann Herring

Originally published in: *Lives in Transition: Longitudinal Analysis from Historical Sources*, edited by Peter Baskerville and Kris Inwood, 274–91. McGill Queens University Press.

Reprinted in this thesis with the permission of McGill-Queens University Press, and co-authors, Jane van Koeverden and D. Ann Herring (see Appendix A, Figures 1-3).

The First World War was a time of unprecedented human mobility as millions of military personnel, along with the civilians who provided supplies and services to them, moved within and between continents and across oceans in support of the war effort. Between 1914 and 1919 in Canada alone, an army of 600,000 men was raised, some 400,000 of whom were transported across the country and on to Europe.¹ Their story has become a defining element in the emergence of the modern Canadian state. Foreign troops also passed through Canada en route to the European theatre of war. Among them were over 22,000 soldiers who volunteered to fight for the Polish Army in France, most of whom were recruited in the USA then sent to be trained by Canadian military officers at Camp Niagara at Niagara-on-the-Lake, Ontario.

In the fall of 1918 as Canada and the USA concentrated on sending replacement troops overseas as quickly as possible, the deadly second wave of the Spanish influenza spread around the globe. The spread of the epidemic was facilitated by the rapid movement of soldiers through crowded army camps and on packed troop trains and ships.² Influenza followed “the trail of infected armies”: American soldiers from the

Eastern seaboard heading to Europe on Canadian transports, Canadian troops heading west to support the Siberian Expeditionary Force and the Polish Army of America, training in southern Ontario, but destined for France.³ The Polish Army Camp at Niagara-on-the-Lake was one of the first places in Canada to report an epidemic of influenza.⁴ Military officials decided that stopping the movement of the Polish Army from the USA to Canada during the epidemic would be too heavy a blow to the Polish Army in France.⁵ As a result of this decision, recruits continued to arrive in Canada from infected cities in the United States and many soldiers were found to have influenza upon arrival at Niagara-on-the-Lake. This paper discusses how the Polish Army was mobilised in the USA, the routes by which the volunteers travelled to Niagara-on-the-Lake, and how the demand for fresh troops from North America to sustain World War I resulted in the transportation of sick soldiers across the Canadian border.

From Poland to North America

Polish citizens began migrating to North America toward the end of the eighteenth century, in the wake of a series of civil uprisings in Eastern Europe. Many had moved to the United States and found work in Northeastern or Midwestern industrial cities, such as New York, Pittsburgh, Cleveland and Chicago. By 1914, some 2.2 million Poles had relocated to the United States.⁶ In response to the influx of immigrants, Polish organizations formed to ease the difficult transition into the socially and environmentally harsh climate of North America.⁷ The athletic society known as *The Sokóls* (*The Falcons*) emerged as one of the most influential organizations. The Falcons provided an environment that emphasized physical fitness, friendship based on Polish heritage, and loyalty to Poland.⁸ The Falcons had begun mobilizing their membership in 1912 in

anticipation of the potential need for soldiers in Poland, and waited only for approval from the United States government to begin official recruitment.⁹ The precedent of a Polish Army in America, however, had been set.

When the First World War began in 1914, loyalties were divided amongst Poles in America. Many longed for re-unification of their homeland and saw supporting the Allied war effort as a means to achieve that end. Russia had been a long-time enemy but, as liberal nationalists, American Poles held anti-German sentiments as well.¹⁰ The French were drawn into the scheme because the staggering losses to its army created a shortage of soldiers as the war dragged on. In June of 1917, French President Raymond Poincaré announced his plans for the creation of a “Polish Army in France”¹¹, to be formed of volunteers from around the world, including the United States. The scheme would help replenish his forces while at the same time respond to French sympathies toward the cause of Polish independence.¹²

President Wilson had endorsed a free, united Poland in a speech to the American Senate in January, 1917; in a speech on 2 April 1917, he argued that the United States must go to war against Germany. Building on the excitement of this declaration, on 3 April Ignacy Jan Paderewski, leader of American *Polonia*, spoke before a convention of the Polish Falcons in Pittsburgh, urging the Falcons to support the American military effort with the formation of *Kościuszko's Army*, concluding with the rally cry, “Long live a free, independent and reconciled Poland!”¹³ Paderewski lost no time in convincing Washington to support the army.¹⁴

Figure 1. Recruiting Poster, “Armia Polska we Francji/Polish Army in France” Library and Archives Canada, Acc. No. 1983-28-3798



Recruiting a Polish Army in the USA

To avoid inflaming public opinion and weakening its own armed forces, the United States War Department imposed a number of conditions on the recruiting efforts of the Polish Military Commission: no citizen of the United States of Polish Nationality eligible for the American Army draft could sign up; neither could someone whose family would be left without any means of support. To circumvent the problem of a foreign force training on American soil, the soldiers would be trained in Canada. Recruiting had to be conducted discreetly, using only small posters and signs (Figure 1). The volunteer recruitment campaign began with great success on 9 October 1917; by the end of the day, 161 men from Chicago had volunteered, and the first 60 recruits had begun the journey to Niagara-on-the-Lake, the Canadian location where volunteers were trained.¹⁵

It was well understood that “recruiting [could] be successful only with the fullest cooperation of the local Polish clergy”.¹⁶ The Polish Roman Catholic Church was thus a key player in the success of the project, spearheading fundraising and recruiting. In the Pittsburgh Diocese, for instance, Reverend A. Pniak recruited 12 men for the army at a rally held at the Guardian Angels Roman Catholic Church.¹⁷ Other effective strategies were used to spur young men to enlist. Advertisements and letters in local Polish language newspapers, such as one written by Jan Słociński, presented appealing depictions of life at Niagara-on-the-Lake. According to Słociński, “We only train six hours a day and we spend the rest of our time playing a variety of games so we’re never bored...We have a theatre here thanks to the YMCA that shows concerts and moving pictures, which is completely free for us...Many guests/friends come visit us from Buffalo since it’s so close... The town is small but has a lot of cheer.”¹⁸

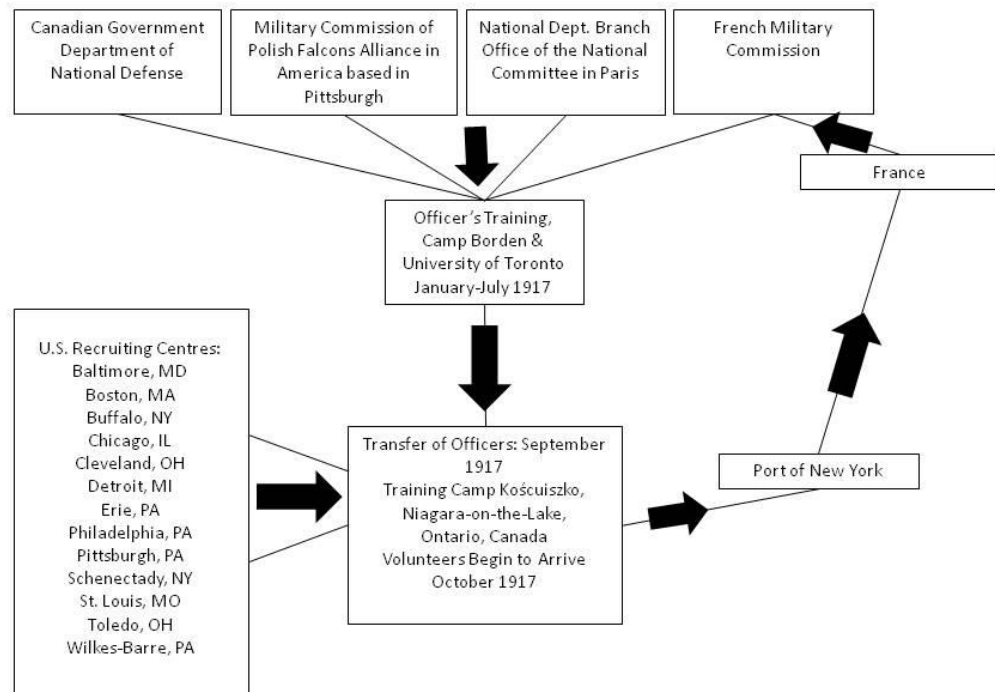
Polish artists supported the recruiting effort through music and film. In 1917, Ignacy Jan Paderewski composed the rousing battle hymn, *Leć, Orle Biały*, (*Soar, White*

Eagle)¹⁹ and a Polish Military Band was organized to bolster recruitment.²⁰ The Polish Military Commission's film, *Za Wolność i Ojczyznę (For Freedom and Fatherland)*, featured scenes from Niagara-on-the-Lake and the famous recruiter, Waclaw Gasiorowski, speaking in front of a memorial to Kościuszko at Chicago's Humboldt Park.²¹ When Polish volunteers were loaded onto trains headed for Niagara-on-the-Lake, care was taken to ensure that crowds of people cheered them off with patriotic sentiments, such as "Come back healthy and victorious!"²²

Although the Polish Military Commission failed to muster the 100, 000 men originally promised to President Wilson, its efforts were successful nonetheless. Recruiting centres in major U.S. cities, such as Chicago, Detroit, New York, Philadelphia and Boston, and in smaller cities, such as Bridgeport, Connecticut, attracted 40, 000 men for the Polish Army during the three years in which it operated (Figure 2).²³ Only about 30, 000 were accepted for training, and even fewer actually made it overseas.²⁴

Recruits were required to undergo a medical examination to ensure that each man was fit to serve in the army.²⁵ Grounds for rejection included signs of tubercular disease and syphilis, or evidence of corporal punishment or "defective intelligence".²⁶ A second medical examination was conducted by Canadian medical officials at Niagara-on-the-Lake.²⁷ At least one soldier who had tubercular disease managed to pass both medical tests, which calls into question the thoroughness with which the examinations were undertaken. He never reached Europe, perishing from tuberculosis at Niagara-on-the-Lake.²⁸ His body was sent home for burial to Greenwood, Pennsylvania.²⁹

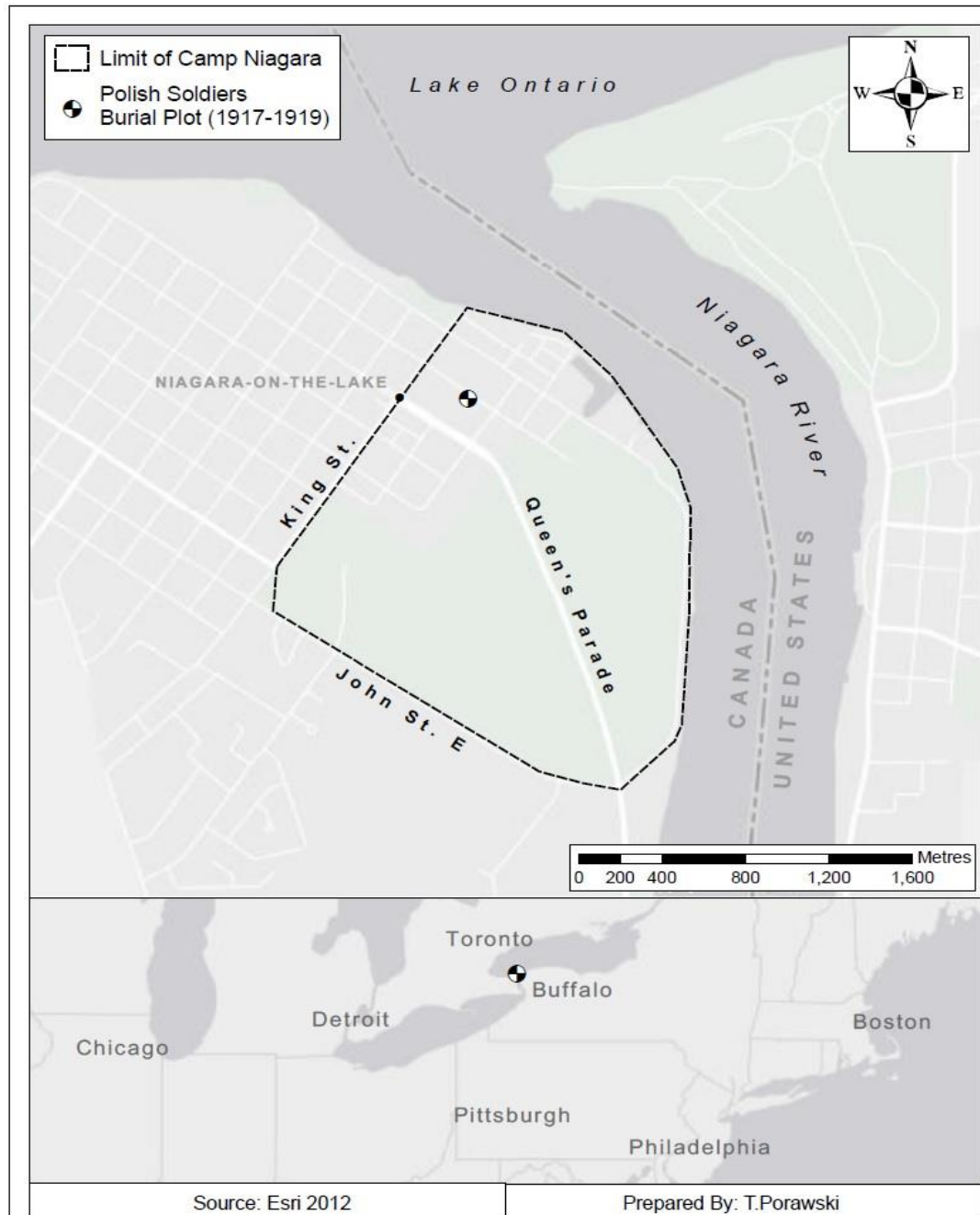
Figure 2. Emergence of the Polish Army in France. Adapted from Valasek 2006 pg. 408.



From the USA to Niagara-on-the-Lake, Canada

When sufficient numbers of men had signed up, the new recruits were sent by train to Camp Niagara where they received military training at Polish Camp (Figure 3),³⁰ set up adjacent to the Canadian Army's Camp Niagara.³¹ Niagara-on-the-Lake was chosen because of its history as a military centre and its proximity to Buffalo, NY where recruits were mustered to be transported to Canada. The location was accessible from the USA via rail and from the Niagara River.³² Polish American recruits began arriving at Niagara-on-the-Lake on 3 October 1917.³³

Figure 3. Niagara-on-the-Lake, Ontario, Camp Niagara and Polish Soldiers Cemetery.



The camp was headed by Lieutenant-Colonel Arthur D'Orr LePan, who served in the Canadian army from 1915 to 1919. He was appointed Camp Commandant when the Polish Army Camp at Niagara-on-the-Lake was formed and served in that capacity until 1919 with the dissolution of the camp.³⁴ Although a young officer, at the age of 32 Col. LePan was already distinguished as the superintendent of the University of Toronto prior to the war, and as an instructor for the Canadian Officers Training Corps (COTC) since 1914.³⁵ LePan believed strongly in the Polish cause for independence, and worked tirelessly on the behalf of the volunteers in his camp, ceaselessly requesting extra blankets, jackets, and boots to outfit the Polish volunteers who often arrived poorly equipped to endure the cold climate.³⁶

Recruits arrived after a long trip aboard crowded troop trains. Owing to the high cost of transportation, the Polish Military Commission aimed to send as many men as possible en masse to Niagara-on-the-Lake, since the price of train tickets was reduced with higher volume.³⁷ Sometimes as many as 350 volunteers were transhipped at a time.³⁸ When the U.S. government took control of the railway system to facilitate troop movements on 28 December 1917, passenger trains operating on duplicate routes were eliminated. This reduced the number of trains available for the Polish Military Commission. Sleeper car services had also been removed, worsening the crowding and making intolerable the jammed and stuffy conditions on trains.³⁹ With thousands of foreign soldiers crossing the US border into Canada, the Polish Military Commission was able to make arrangements with customs officers to expedite the process.⁴⁰

Four wooden winter barracks had been constructed to house the recruits, however for most of the year they lived 'under canvas', in tents.⁴¹ Staff Captain of the 13th Division, Stanislaw Nastał, described his daily routine at the Polish Army Camp,⁴² which included training in British drill, bayonet training (but without musketry or rifle drilling),

mixed with calisthenics and sport.⁴³ New recruits were trained for three to four weeks, then sent to Europe to enlist in the French army.⁴⁴

The first few months did not proceed according to plan, however. The Allied forces had failed to make arrangements for the Polish soldiers to travel to Europe and were unable to spare any ships for that purpose. As a result, Polish recruits piled up at Niagara; with winter imminent, the camp faced a serious housing crisis.⁴⁵ To make matters worse, the winter of 1917 arrived unusually early and was exceptionally cold.⁴⁶ LePan's diary for November records chilly temperatures of 22 degrees Fahrenheit, the accumulation of "quite a lot of snow" by 23 November,⁴⁷ and his efforts to secure greatcoats and winter accommodation for the men. At this point, soldiers were living eight men to a tent, and by 1 December 1917, there were only sufficient barracks to house 1200 of the 3078 soldiers at the camp.⁴⁸ As more recruits continued to arrive, camp strength swelled to over 4000 men before the end of November.⁴⁹ As a stop-gap measure to ease the unbearable over-crowding, soldiers were shipped to military camps in St. John, Quebec, and Fort Niagara in the USA.⁵⁰ Barracks were constructed by December, but they were not large enough to accommodate all of the volunteers. At this point, the citizens of Niagara-on-the-Lake agreed to billet the freezing soldiers.⁵¹

The residents of Niagara-on-the-Lake had initially dreaded the opening of a military camp for Polish soldiers. They were wary of a foreign army training in their midst,⁵² even though the town was accustomed to the presence of large numbers of soldiers because of nearby Canadian Camp. Prejudice against eastern Europeans was long-standing in Canada⁵³ and only added to the anxiety and unease about the presence of the Polish Army so close to town. In a post-war speech, LePan mentions that an elderly lady captured the sentiments of community members during those early days: "Oh my

God, those fellows will murder us in our beds".⁵⁴ This attitude changed however, as the relationship between the soldiers and townspeople gradually warmed.

It is not clear when or how the Polish soldiers won over the residents of Niagara-on-the-Lake, but the soldiers became part of the daily life of the town. The Polish Army hosted dances and concerts that included the townsfolk and volunteered to assist the locals in a variety of ways, such as shoveling snow. When the owner of a local canning factory was short of men, Col. LePan offered to send Polish recruits to assist with the work.⁵⁵ By the winter of 1917, the townspeople had come around and many were prepared to help resolve the housing crisis at Polish Camp. Approximately 3110 soldiers were billeted for free around the community; temporary residences included Western Home (a former courthouse), the town hall, a bathhouse, gymnasium, canning factory, steamboat shed, paint shop, and a few houses.⁵⁶

Billeting was followed by community initiatives to enhance the Polish soldiers' stay in Canada. The Canadian YMCA organized sports tournaments and set up a canteen at Polish Camp, the profits of which were used to purchase goods for the soldiers.⁵⁷ The Polish Band was commissioned for performances in Toronto and New York and garnered high praise for its showmanship.⁵⁸ The positive attitude toward the Polish soldiers appears to have continued throughout the war. In a feature for the *Niagara Advantage*, one journalist writes nostalgically about the departure of the Polish soldiers and the disbanding of the camp on 11 March 1919,

...our regret is that the Polish boys could not stay with us indefinitely. Both from a financial and social point of view, we have benefited greatly but it goes without saying that we regret the departure of our Polish friends, more because they were our friends than because their sojourn here was of financial benefit...our regret at parting is keen, not only because of our long and pleasant association with such a magnificent lot of men, but because they were, first, and always soldiers and above everything gentlemen.⁵⁹

This sentiment is particularly poignant in light of the evidence that the 1918 influenza pandemic was unwittingly brought to the townspeople of Niagara-on-the-Lake by recruits for the Polish Army in France.

1918 Influenza and the Movement of Soldiers during World War I

When the first cases of what scholars now believe to be influenza appeared among soldiers in Europe in the spring of 1918 (the first of three waves of the epidemic), there was considerable concern about what was causing the outbreak. The disease was first reported in early April among the American Expeditionary Forces at Brest and in a rest camp near Bordeaux;⁶⁰ it emerged subsequently amongst other armies in France. These two observations suggested to epidemiologists of the time that the disease had been brought by American soldiers to the European theatre of war.⁶¹ Army and civilian records for the USA that spring show influenza moving with infected soldiers from Army camp to Army camp, then on to cities, such as New York.⁶² From February to April 1918, regularly collected death certificates and statistics show that an early wave of influenza and/or pneumonia killed larger than expected numbers of New Yorkers.⁶³ New York was the port of disembarkation of the American Expeditionary Force to the western Front.

The etiology of influenza, however, was poorly understood in 1918, even though the disease had been endemic in Europe and North America since the 1889 Russian Pandemic.⁶⁴ When influenza surfaced in April among soldiers in the Second Army of the British Expeditionary Force in France, it was initially labelled as ‘PUO’, pyrexia of unknown origin.⁶⁵ The Allies had been caught unprepared for chemical warfare in 1915 and when this seemingly new illness emerged in the spring of 1918 there were suspicions that it might have been caused by a biological or chemical weapon. The environment

surrounding Étapes, France had already been contaminated with 23 gases, including chlorine, phosgene, and mustard gas⁶⁶ and there were worries that enemy troops had aerosolized bubonic plague and dropped it on the Allied armies.⁶⁷ In 1918, viruses were neither filterable nor observable through microscopy, literally rendering them invisible.

By mid-May, however, ‘pyrexia of unknown origin’ was recognized to be a mild form of influenza,⁶⁸ identified by the presence of a constellation of symptoms: high fever that lasted for several days, body aches, muscle and joint pain, headache, sore throat, sometimes leading to bleeding of the nasal membranes, and cough that sometimes produced a thin, brownish mucous. Thousands of soldiers fell ill with influenza that spring, but relatively few died.⁶⁹ Until the fall of 1918, for instance, influenza was but a minor illness among the Canadian Expeditionary Force in France, compared to the more serious problems of diarrhoea, dysentery, sexually transmitted diseases, trench foot, and war-related injuries.⁷⁰ Reports of influenza in army camps on both sides of the Atlantic received little public attention relative to the horrors of the trenches and growing opposition to a war of attrition that had dragged on far too long.⁷¹

Thus, when the recruits for the Polish Army in France were undergoing medical examinations in the USA, influenza was neither a major concern nor a reason to reject nor even detain volunteers from being transported on troop trains. Even after the spring and summer outbreaks of influenza, worrisome reports about epidemics in France, and recommendations by medical officers in the USA to reduce epidemics of respiratory diseases, influenza was not added to a list of possible threats issued in a 6 September 1918 memo from The Medical Department.⁷² On the other side of the Canadian border, influenza was not a reportable disease under the 1912 Ontario Public Health Act⁷³.

Influenza had been designated a reportable, quarantinable disease by Federal maritime officials in July of 1918, but quarantine regulations only applied to ships

arriving from overseas. Canadian quarantine policy at the time reflected concerns about defending the country from unwanted immigrants from Europe and the diseases they were believed to bring with them, such as had occurred in the mid-nineteenth century when cholera epidemics affected Montreal and other port cities. The border with the United States was viewed entirely differently and Americans, deemed to be so similar to Canadians, were not viewed as needing to be isolated and segregated in the same way as foreigners from abroad. Consequently, neither U.S. coastal nor land borders were subject to federal quarantine regulations. At the time of the Spanish flu pandemic, therefore, Canadian-American land and sea borders were open, and war time cooperation necessitated the transportation of American troops across those borders.⁷⁴ No one could have predicted that the second, more deadly, wave of influenza that erupted in the early fall of 1918 would threaten to overwhelm medical services at the Polish Army Camp at Niagara-on-the-Lake where thousands of Polish-American recruits had gathered for training.

Soldiers with Influenza Travel to Polish Camp

The American Expeditionary Force under General John (Black Jack) Pershing had begun to increase troop movements to France in January of 1918; by May, some 200,000 men a month were being sent to France; by August Pershing's army had reached one million.⁷⁵ Although the Polish Army had been training in Canada and sending troops to France since October of 1917, camp strength in 1918 grew from some 1200 men at the end of August to over 2500 by the week of 21 October (Figure 4).

The need for replacement troops to maintain the war effort and support the largest campaign of the war, the Meuse-Argonne Offensive, meant that in the fall of 1918 Canada and the USA sent soldiers to Europe as quickly as possible, reducing training

times, sending conscripted soldiers to the front, and filling spaces on Canadian troop ships departing from Montreal and Quebec City with American soldiers from the eastern seaboard.⁷⁶ The second wave of influenza emerged and spread in conjunction with these wartime conditions of rapid transportation, over-crowded training camps, troop trains and ships, and the wretched conditions of trench warfare on the Western front.⁷⁷ Boston has been consistently identified as the North American starting point for the second wave of influenza that erupted in the fall of 1918.⁷⁸

The earliest well-documented evidence suggests the second wave of influenza arrived at Boston's Commonwealth Pier on 27 August 1918; by 8 September it had spread to the civilian population, as well as to the Army's Camp Devens, located just outside the city. Within a fortnight, the base hospital and regimental infirmaries at Camp Devens were treating hundreds of sick trainees. The epidemic escalated such that on one day alone – Saturday, 14 September – more than 500 soldiers suffering from influenza were seen at the hospital.⁷⁹ The epidemic virtually exploded along the eastern seaboard, with several Army camps (Devens, MA; Upton, NY; Lee, VA; Dix, NJ; Jackson, SC) reporting influenza during the first week of the fall wave.⁸⁰ By the week of 21 September influenza was reported in civilian populations in Lowell, Massachusetts and in New York City.⁸¹

Boston was a primary recruiting centre for the Polish Army and was linked to Niagara-on-the-Lake by the New York Central Railway, which operated the Michigan Central Railway through southern Ontario.⁸² This is likely the area from which the virus came to Niagara-on-the-Lake, brought inadvertently by Polish soldiers recruited by the Polish Military Commission from infected cities in the northeastern United States.⁸³

There are some discrepancies in the reports about the first cases of influenza at Niagara-on-the-Lake. According to LePan,⁸⁴ the disease entered Polish Camp on 13

September 1918 along with American recruits. Dr. J. L. Robinson, the camp's officer in charge of medical services, dates the entry of influenza to Polish Camp to 10 September 1918,⁸⁵ just two days after its identification at Camp Devens, Massachusetts. We are inclined to put more weight on Dr. Robinson's opinion, given that he was in charge of medical services. Whichever date is correct, this is the earliest record of the second wave of the 1918 pandemic in Canada.⁸⁶ On 12 September, the battalions of the camp were assembled for panoramic photographs, bringing all of the men into close contact.⁸⁷ Given that influenza has on average a two-day incubation period, the infection could have spread easily from person-to-person during the gathering. On 17 September, the Camp was put under quarantine; the first death from influenza occurred just one day later on 18 September.

It is unlikely that any single location can be identified as the origin of the pandemic in Canada. This highly contagious infectious disease could have easily percolated into southern Canada across the U.S. border from many northeastern locations. After all, the disease emerged almost simultaneously in various locations around the world.⁸⁸ Around the time influenza appeared in Polish Camp, for instance, it was reported in a school in Victoriaville, Quebec, likely brought by visitors from the USA to a Eucharistic Congress.⁸⁹ On 20 September, soldiers at St. Jean Barracks in Quebec fell ill with influenza; military officials linked the outbreak to the epidemic in Boston because the soldiers had been sent from there.⁹⁰ Another identified source of infection was Sydney, Nova Scotia, where an American Transport carrying soldiers to France arrived and docked, with influenza in tow.⁹¹ Within days, over 660 soldiers had been removed from the ship into Sydney's small hospital, overwhelming the facility.

Once influenza had been introduced to Canada, however, the war effort influenced both the paths by which the disease spread, and official responses to it.⁹² Intensification of

the war effort via the Siberian Expeditionary Force and the Meuse-Argonne Offensive trumped concerns about public health as sick soldiers were transported across the country and overseas.⁹³ Polish Camp had been put under quarantine on 17 September, a week after Dr. Robinson marks the onset of the epidemic. Exemplifying how the military's priority to rush soldiers overseas outweighed public health concerns,⁹⁴ military officials decided that stopping the recruitment process would severely compromise the Polish Army in France. Recruits thus continued to arrive from infected cities in the United States and many were found upon arrival to have influenza. On 1 October, for instance, Polish Camp received 180 soldiers; after an initial examination, 62 were sent to segregation and five to the hospital. By 19 October, all influenza admissions during the previous ten days were incoming recruits.⁹⁵ There are reports of troops travelling on "sealed" military trains to prevent the spread of influenza⁹⁶, however once sick recruits arrived at the camp, they were sent to the camp hospital, continually re-introducing the virus to the camp. The health of recruits at the camp (and the surrounding civilian population) was deemed secondary to the push to get fresh troops overseas, and recruitment and transportation to Niagara-on-the-Lake continued unabated throughout the epidemic.

Sick and Dying at Niagara-on-the-Lake

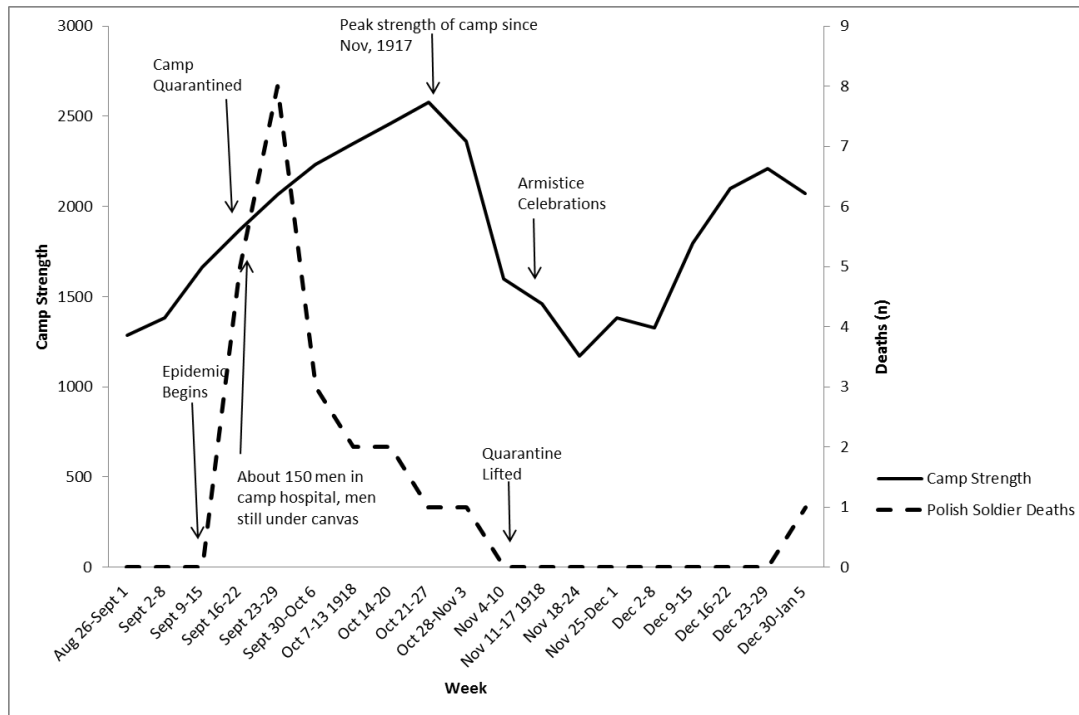
When influenza arrived at Polish Camp in the fall of 1918, soldiers were still being housed in a "city of tents".⁹⁷ During the height of World War I, over 18,000 men in the Polish Camp and adjacent Canadian Camp were housed primarily in tents that slept 8 or 9 men, their heads facing in the same direction.⁹⁸ It is no wonder that influenza, an airborne infectious agent, rapidly overwhelmed the recruits and spread quickly from Polish Camp to Canadian Camp.⁹⁹

During the period in which the camp was supposedly under quarantine, LePan's¹⁰⁰ diary mentions daily visits to inspect the crisis from majors, generals, and other military officials. This was clearly a very leaky quarantine. Major Morrison, who had advised LePan to quarantine the camp, visited on at least two occasions to assess the situation and to offer advice.¹⁰¹ Medical officers from Fort Niagara, such as Major Fink and Major Hough, also came to observe the conditions.¹⁰² To mitigate staff shortages in the hospital, two nurses arrived in the camp on 22 September.¹⁰³ Civilians also visited, often providing medical and other supplies requested by LePan.

Before quarantine was imposed, soldiers were permitted to obtain visitors passes to leave the camp, spend time in the town of Niagara-on-the-Lake, and circulate within the camp at recreation centres such as the YMCA tent. Clearly, there were plenty of opportunities for the epidemic to spread beyond the camp. The first civilian death from influenza in Lincoln County was recorded on 19 September, just one day after the first soldier death at Polish Camp.¹⁰⁴ By 30 September influenza was reported at the Armament School of the Royal Air Service in West Hamilton and soon spread to Hamilton's civilian population where the first influenza death occurred on 3 October 1918.¹⁰⁵

During the course of the fall wave of the epidemic, LePan maintained detailed death records of the names, officer numbers, place of burial, and date and cause of death for all fatalities that occurred at Polish Camp. His records match the soldier deaths listed for Polish Camp in the registered deaths for Ontario.¹⁰⁶ In all, 25 Polish soldiers died from influenza or influenza-related pneumonia during the fall wave of the epidemic, and in a subsequent recurrence during the third wave of the pandemic in January, six more perished. This represents about three-quarters of the 41 deaths recorded from 1917 to 1918 among Polish recruits at Niagara-on-the-Lake.

Figure 4. Polish soldier mortality and camp strength, September to December, 1918, Arthur D'Orr. War Diary A.D LePan, Vols. 1-2. Library and Archives Canada, MG 30 E 277, 1917-1919.



Col. LePan's careful record of influenza deaths shows a rapid rise in mortality in September, peaking in the last week of September at nearly 4 deaths per 1000, then a precipitous drop in November to only 0.42 deaths per 1000, with none recorded for December. Morbidity was much higher, with 368 soldiers and 11 officers falling ill with influenza during the height of the epidemic between 10 September and 21 November.¹⁰⁷ Approximately 20 percent of the Polish soldiers fell ill during the fall wave and the virus was fatal for nearly 2.5 per cent of them.¹⁰⁸ As recruits died, they were buried together in a special plot set aside for the Polish army unless arrangements were made with the family to send their body home. LePan hand-drew a detailed plan of the cemetery

indicating the location of each grave, and where a larger cross of granite was placed with the inscription, “*Died for Poland.*”¹⁰⁹

Interrupted Journeys

The story of the Polish Army at Niagara-on-the-Lake is a little known piece of Canadian history. Our exploration of this relatively short, two-year period in which over 22,000 Polish Americans moved to southern Ontario to train for military service was stimulated by Mark O. Humphries’s¹¹⁰ analysis of the role played by military priorities and decisions in the spread of the 1918 influenza in Canada and his contention that influenza came to Canada via American troop movements, rather than from Canadian soldiers returning from Europe. Most research on the Polish Army in the United States has centered on the recruitment of soldiers and their subsequent military service in France; little has been written about their travel to Canada, their history within the Spanish Influenza pandemic, nor how they touched the community in which they trained. The soldiers, however, have had a lasting and visible effect on Niagara-on-the-Lake. Most of the men from Polish Camp who died from influenza during the 1918 pandemic were buried at *Polski Cmentarz Hallerczyków* (Polish Soldiers Burial Plot), a small plot of graves in St. Vincent de Paul cemetery dedicated to General Józef Haller’s “Blue Army” (Figure 5). Their story has become part of the local history of the town and their memorial an enduring symbol of their presence there.

One of the curiosities of the 1918 influenza pandemic lies in the paradox of a global toll of anywhere from 50 to 100 million people¹¹¹ and the apparent forgetting of its occurrence over the subsequent decades¹¹². Some authors have suggested the pandemic was omitted from official histories because it was overshadowed by the war,¹¹³ or because it was an affront to sensibilities about twentieth century modernity and

medicine,¹¹⁴ or because it was a relatively small blip against a larger backdrop of more persistent infectious diseases.¹¹⁵

The Polish Soldiers who perished from influenza at Niagara-on-the-Lake during the fall of 1918, however, have not been forgotten. Polish Americans and Canadians visit this site each year to remember the Polish Army that passed through this small town en route to the European theatre of war.¹¹⁶ The soldiers whose lives ended at Niagara-on-the-Lake have come to represent the Polish odyssey to the Americas and the dream of an independent Poland;¹¹⁷ the cemetery is now a site where Polish identity and nationalism are celebrated and performed. It is a singular site in Canada; to our knowledge it is the only special memorial for soldiers who died during the 1918 pandemic. Yet, the manner of their death means less than the cause for which they fought.

The graves of the Polish soldiers also draw attention to the priority placed by Canadian and American military officials on transporting sick soldiers across national borders, despite the threat to public health posed by the deadly influenza pandemic. The effects of this decision were far-reaching. The impact of the Polish Army's fleeting migration to this small town was profound as Niagara-on-the-Lake became one of the first places in Canada to experience the 1918 pandemic, eventually losing 17 of its residents during the fall outbreak.¹¹⁸

Figure 5. Polish Soldiers Memorial. Photograph by K. Bogaert, 2012.



Endnotes

¹Busch, *Canada and the Great War*, xii

² Oxford et al., “WWI may have allowed emergence of “Spanish” flu,” 111-4

³ Humphries, *The Last Plague*,

⁴ Humphries, “The Horror at Home”, 249-50

⁵ LePan, “War Diary,” 1:54 & LePan, “War Diary,” 2:Letter from LePan to the Chief of General Staff, 8

⁶ Ruskoski, “The Polish Army in France”, 12

⁷ Brannigan & Lin, “When East Meets West”, 87-108

⁸ Ruskowski, “The Polish Army in France”, 15

⁹ Hapak, “The Polish Military Commission”, 28

¹⁰ Hapak, “The Polish Military Commission”, 29

¹¹ Ruskoski, “The Polish Army in France”, 23

¹² Rzepniewski, “The General Haller’s Polish Army”, 2

¹³ Hapak, “Recruiting a Polish Army”, 46.

¹⁴ Biskupski, “Paderewski as Leader”, 39, At the helm of the Polish National Department during the Great War, Ignacy Jan Paderewski was instrumental in forming the Polish Army in France: “I collected a considerable sum of money for the relief of the hungry, I reconciled and united the huge Polish immigration of four million, I gained for Poland the ardent help of the United States, [and] I created the Polish Army in France from Polish volunteers...”.

¹⁵ Hapak, “Recruiting a Polish Army”, 97-98

¹⁶ Borkowski, “The City of Pittsburgh’s Part”, 41

¹⁷ Borkowski, “The City of Pittsburgh’s Part”, 40-41

¹⁸ Słociński, “Z Obozu Kosciuszki”, 5

¹⁹ Hapak, “Recruiting a Polish Army”, 143

²⁰ Hapak, “Recruiting a Polish Army”, 143-145

²¹ Ruskoski, “The Polish Army in France”, 43 & Hapak, “Film in the Service”, 27, The film told the story of a young Polish man who was reluctant to volunteer for the Polish Army in France. Labeled a coward by his friends, family and fiancée (who broke off their engagement), he was reconciled with them after he joined up. In another patriotic storyline, a young man secretly joined the army with the help of his sister, a decision accepted with resignation by his widowed mother.

²² Skarzyński, “The Polish Army”, 116 & Nastał, “The Blue Division”, 263

²³ Pliska, “The Polish American Army”, 56

²⁴ Pliska, “The Polish American Army”, 56

²⁵ Valasek, “Medical Examinations of Recruits”, 73-79

²⁶ Valasek, “Medical Examinations of Recruits”, 73-79

²⁷ LePan, “War Diary”, 2:7

²⁸ LePan, “War Diary”: List of Deaths at Polish Army Camp, 2: n.p

²⁹ LePan, “War Diary”: List of Deaths at Polish Army Camp, 2: n.p

³⁰ Jerzy et al. *Czyn zbrojny wychodźstwa polskiego*, 219

³¹ Merritt, *On Common Ground*, 134

³² Hapak, “Recruiting a Polish Army”, 103 & LePan, “War Diary”, 1: LePan’s War Diary contains many references to organizing transportation via train. Often these remarks express frustration at having no warning of a troop train’s arrival, or having had prior warning, no train arrived.

³³ LePan, “War Diary”, 2: Polish Army Camp Strength, 1

³⁴ LePan, “War Diary”, 2: Remarks of Lt-Col LePan at Banquet at Closing of Camp

³⁵ Carnochan, “The Polish Army”, 8

³⁶ LePan, “War Diary”, 1: LePan’s Diary is full of instances where he requested supplies for the Polish soldiers (ranging from boots, blankets and jackets, to underwear), usually by telephone.

³⁷ Jerzy et al. *Czyn zbrojny wychodźstwa polskiego*, 219

³⁸ LePan, “War Diary”, 1:11

³⁹ Stover & Carnes, *The Routledge Historical Atlas*, 54-55; LePan “War Diary, 1:31: One Canadian officer discovered this problem the hard way when he refused to get back on a crowded troop train after a stop at Niagara Falls when he realised there was no sleeper car. After a firm telephone call from Col LePan, the officer was quickly back on the packed train.

⁴⁰ LePan, “War Diary”, 2:10 & Jerzy et al. *Czyn zbrojny wychodźstwa polskiego*, 165: Arrangements were made with the Superintendent of Immigration, W. Scott, to allow bearers of a card or document signed by recruiting authorities in the United States to be shown every consideration and allowed into Canada at the border.

⁴¹ Hawkings et al., *Toward a History*, 6-12 & LePan, War Diary, 1:64 & Nastał, *The Blue Division*, 263

⁴² Nastał, “The Blue Division”, 263

⁴³ Nastał, “The Blue Division”, 264, LePan, “War Diary”, 2:4

⁴⁴ Hawkings et al., *Toward a History*, 6-12

⁴⁵ Hapak, “The Military Commission”, 29

⁴⁶ Merritt, *On Common Ground*, 136

⁴⁷ LePan, “War Diary,” 1:7

⁴⁸ LePan, “War Diary,” 2:1

⁴⁹ LePan, “War Diary,” 2:Daily Strength, 2

⁵⁰ LePan, “War Diary”, 2: LePan’s letter to the Chief of General Staff, Militia & Defense, 5

⁵¹ LePan, “War Diary,” 1:9

⁵² Carnochan, “The Polish Army,” 9

⁵³ Brannigan & Lin, “When East Meets West,” 87-108

⁵⁴ LePan, “War Diary,” 2: Remarks of Lt-Col LePan at Banquet at Closing of Camp, 2

⁵⁵ LePan, “War Diary,” 1:50

⁵⁶ LePan, “War Diary,” 1:9

⁵⁷ LePan, “War Diary,” 2: LePan’s letter to the Chief of General Staff, Militia & Defense, 10 & LePan, “War Diary,” 2: Remarks of Lt-Col LePan at Banquet at Closing of Camp, 6 & Ascher, “Polish Relief Work,” 25: The American Red Cross provided care kits for soldiers who were being sent overseas and set up facilities that enabled them to communicate with relatives in enemy countries. LePan also commends the American Red Cross and the YMCA for providing aid during the influenza outbreak of 1918, which included the provision of medical supplies, visiting the hospital to cheer the inmates, and writing letters home for them.

⁵⁸ LePan, “War Diary,” 1:48, 49

⁵⁹ LePan, “War Diary,” 2: LePan’s letter to the Chief of General Staff, Militia & Defense, 9

⁶⁰ Burnett & Clark, *Influenza*, 70-71

⁶¹ Patterson & Pyle, “The Geography & Mortality,” 8

⁶² Crosby, *America’s Forgotten Pandemic*, 62 & Barry, *The Great Influenza*, Chapter 14, 1

⁶³ Olson et al., “Epidemiological Evidence,” 11059-63

⁶⁴ Bristow, *American Pandemic*, 36 & Patterson & Pyle, “The Geography & Mortality”, 8

⁶⁵ Herring & Padiak, “The Geographical Epicentre,” 1-8

⁶⁶ Oxford et al, “WWI may have allowed emergence of “Spanish” flu,” 111-4

⁶⁷ Crosby, *America’s Forgotten Pandemic*, 9

⁶⁸ Soltau, “Note on mild Pyrexial Epidemic,” n.p.

⁶⁹ Byerly, *Fever of War*, 6

⁷⁰ Herring & Padiak, “The Geographical Epicentre,” 1-8

⁷¹ Byerly, *Fever of War*, 69-74

⁷² Byerly, *Fever of War*, 73

⁷³ MacDougall, “Toronto’s Health Department,” 229

⁷⁴ Humphries, *The Last Plague*, 91-108

⁷⁵ Byerly, *Fever of War*, 70

⁷⁶ Humphries, “The Limits of Necessity,” 22-26

⁷⁷ Oxford et al., “WWI may have allowed emergence of “Spanish” flu,” 111-4 & Ewald, “Transmission Modes,” 1-30

⁷⁸ Byerly, “U.S Military & the Influenza Pandemic,” 82-91

⁷⁹ Byerly, *Fever of War*, 74

⁸⁰ Smallman-Raynor and Cliff, *War Epidemics* , Fig. 7.19

⁸¹ Smallman-Raynor and Cliff, *War Epidemics*: 406, Fig. 7.12

⁸² Hapak, “Recruiting a Polish Army,” 148 & Solomon & Schafer, *The New York Central Railway*, 14

⁸³ LePan, “War Diary,” 2: LePan’s letter to the Chief of General Staff, Militia & Defense, 8

⁸⁴ LePan, “War Diary,” 2: LePan’s letter to the Chief of General Staff, Militia & Defense, 7

⁸⁵ Robinson, “Polish Camp Hospital,” n.p

⁸⁶ Humphries, “The Horror at Home,” 250

⁸⁷ LePan, “War Diary,” 1:50

⁸⁸ Patterson & Pyle, “The Geography & Mortality,” 4-21

⁸⁹ Humphries, “The Horror at Home,” 250

⁹⁰ Humphries, “The Horror at Home,” 252

⁹¹ Humphries, “The Horror at Home,” 252

⁹² Humphries, “The Horror at Home,” 235-260 & Humphries, “The Limits of Necessity,” 21-47

⁹³ Humphries, “The Horror at Home,” 252 & Humphries, “The Limits of Necessity,” 21-47

⁹⁴ Humphries, “The Limits of Necessity,” 22 & Humphries, “The Horror at Home,” 253

⁹⁵ LePan, “War Diary,” 1:50 & Byerly, *Fever of War*, 75

⁹⁶ Humphries, “The Limits of Necessity,” 27

⁹⁷ Hawkings et al., *Toward a History*, 22

⁹⁸ Hawkings et al., *Toward a History*, 22 & Nastał, “The Blue Division,” 264, Byerly, *Fever of War*, 83:

In the United States, however, medical officers made the men alternate head and feet direction in order to prevent contagion.

⁹⁹ LePan, "War Diary," 1:50-64 & Humphries, "The Limits of Necessity," 38: LePan was frustrated when quarantine was put into effect because the Assistant Director of Medical Services (ADMS), Major Morrison, would not allow Polish soldiers living without heat and under canvas to be billeted in the town. Throughout the epidemic, LePan describes the weather as very cold, with frequent heavy rains. It must have been a miserable time to be under canvas. Aware of the influenza outbreak at Camp Niagara and Polish Camp, the Mayor of Toronto, Thomas Church, protested that despite the wet autumn weather, soldiers were still being housed in tents, and requested they be provided with warmer, more sanitary conditions in Toronto. On 20 September, LePan made arrangements to house incoming recruits at the O'Neill Canning Factory. Sick recruits were taken to the camp hospital.

¹⁰⁰ LePan, "War Diary," 1: 51-64

¹⁰¹ LePan, "War Diary," 1:51-2

¹⁰² LePan, "War Diary," 1:52-53, 81-82: The ever-pressing need for more resources became more urgent during the epidemic. LePan authorized any expenditure that would bring succour for the Polish soldiers, including the purchase of extra milk and other food for the sick. Some men received as many as six to eight eggs per day and up to six pints of milk. A court of inquiry was called after the epidemic to investigate these extra expenses, but LePan was resolute. The lack of supplies frustrated LePan to the point he would "accept assistance from God, man or the devil" in dealing with the epidemic.

¹⁰³ LePan, "War Diary," 1:53

¹⁰⁴ Archives of Ontario (AO), "Lincoln County Registration of Deaths," MS 935, Reels 244-245

¹⁰⁵ Shen, *Origins & Spread*, 5-15

¹⁰⁶ Based on a comparison of Archives of Ontario, "Lincoln County Registration of Deaths," MS 935, Reels 244-245 & LePan, "War Diary," 2: List of Deaths at Polish Army Camp for deaths occurring between September-December 1918.

¹⁰⁷ Robinson, *Polish Camp Hospital*, n.p

¹⁰⁸ This estimate of the influenza attack rate is based on the average strength of the camp September to November, 1918, which was 1879 men. Smallman-Raynor and Cliff, *War Epidemics*: 405, Table 7.11

provide estimates of attack rates for a sample of US Army Camps. On average, the estimated influenza attack rate for the sample was 21.6%, very close to the estimated attack rate for Polish Camp, though rates at US camps were as low as 0.8 (Wheeler, GA) and as high as 49.8% (Cody, NM).

¹⁰⁹ LePan, “War Diary”: Plan of Grave Plot of Polish Army & Ascher, “Polish Relief Work”, 23

¹¹⁰ Humphries, “The Horror at Home,” 235-260 & Humphries, “The Duty of the Nation,” 172-274 & Humphries, “The Limits of Necessity,” 21-47

¹¹¹ Johnson & Mueller, “Updating the Accounts”, 105-115

¹¹² Fahmi & Jones, “Introduction” note, however, that scholarship on the pandemic has “exploded” since the 1990s, 8.

¹¹³ Crosby, *America’s Forgotten Pandemic*, 295

¹¹⁴ Byerly, *Fever of War*, 21-23 & Bristow, *American Pandemic*, 8, Kelm, *Flu Stories*, 167-192

¹¹⁵ Swedlund, “Everyday Mortality,” 153-174

¹¹⁶ Ascher, “Polish Relief Work”, 23

¹¹⁷ Craggs, “Remembering Polish Soldiers,” n.p & Mosse, *Fallen Soldiers*, 70-106

Acknowledgements

We would first like to thank Dr. Kris Inwood & Dr. Peter Baskerville for including us in this project. Richard Kujawa, Małgorzata Kot, the helpful volunteers from the Polish Museum of America in Chicago, Sara Maloney and staff at the Niagara Historical Society Museum generously gave their time and assistance during research visits to Chicago and Niagara-on-the-Lake. Tara Jenkins and Tom Porawski of Timmins Martelle Heritage Consultants Inc. produced the map. Paul Sulzycki and Lukas Magier provided assistance with Polish. David Earn provided the data files on influenza mortality in Lincoln County. Errors and omissions are entirely ours.

References Cited

Archives of Ontario (AO) "Lincoln County Registration of Deaths." (1918) MS 935,

Reels 244-245.

Ascher, Elizabeth "Polish Relief Work in Niagara." *Niagara Historical Society*, no. 35

1923): 14-25.

Barry, John. *The Great Influenza: The Epic Story of the Deadliest Plague in History*.

New York:Penguin, 2004.

Biskupski, M.B. "Paderewski as Leader of American Polonia, 1914-1918." *Polish*

American Studies, 43, no.1 (1986):37-56.

Borkowski, Edward. "City of Pittsburgh's Part in Formation of Polish Army World War

I 1917-1920," in *Haller's Polish Army in France*, translated & edited by Paul

Valasek, 21-70, United States of America: Whitehall Printing, 2006. Originally

published in Edward Borkowski, *City of Pittsburgh's Part in Formation of*

Polish Army World War I 1917-1920. Pittsburgh: Central Council of Polish

Organizations of Pittsburgh, PA, 1956.

- Brannigan, A & Lin, A. "Where east meets west": Police, immigration, and public order in the settlement of Canada from 1896 to 1940. *The Canadian Journal of Sociology*, 4, no.1 (1999), 87-108.
- Bristow, Nancy. *American Pandemic: The Lost Worlds of the 1918 Influenza Pandemic*. Oxford and New York: Oxford University Press, 2012.
- Burnet, F.M, Clark, E. *Influenza*. London: Macmillan, 1942.
- Busch, Briton C ed. *Canada and the Great War: Western Front Association Papers*. Kingston: McGill-Queen's University Press, 2003.
- Byerly, Carol. *Fever of War*. New York:New York University Press, 2005.
- Byerly, Carol."The U.S. Military and the Influenza Pandemic of 1918-1919." *Public Health Reports* 125 S3, (2010):82-91.
- Carnochan, Janet."The Polish Army in Niagara" *Niagara Historical Society*, no. 35 (1923): 7-12.
- Craggs, S. "Remembering Polish soldiers who trained in Niagara-on-the-Lake 90 years ago. The *St. Catharines Standard*. June 3, 2008,
<http://www.stcatharinesstandard.ca/2008/06/03/remembering-polish-soldiers-who-trained-in-niagara-on-the-lake-90-years-ago>
- Crosby, Alfred. *America's Forgotten Pandemic*. Cambridge: Cambridge University Press, 2003.
- Dickin-McGinnis, Janice. "The Impact of Epidemic Influenza: Canada, 1918-1919." *Historical Papers*. 12 no. 1 (1977):120-140.
- Ewald, P.W. "Transmission modes and the evolution of virulence." *Human Nature*. 2,

no.1(2005)1-30.

Hapak, Joseph. "Film in the Service of Polish Independence." *Polish American Studies*, 44, no. 1 (1987):25-37.

Hapak, Joseph. "The Polish Military Commission, 1917-1919," *Polish American Studies*. 38, no.2 (1981): 26-38. .

Hapak, Joseph. Recruiting a Polish Army in the United States, 1917-1918. PhD Dissertation (University of Kansas, 1985).

Hawkings, Trevor, Mayer, Robert, Richard-Onn, Lynne. *Toward a History of Camp Niagara*, Niagara-on-the-Lake, Ontario, Canada. Parks Canada, 1990.

Herring, D.A and Padiak, J. "The geographical epicentre of the 1918 influenza pandemic," In: *Written in Bone*, edited by M. Smith and M. Brickley, 1-18. British Archaeological Report International Series 1743. London: Archaeopress, 2008.

Humphries, M.O. "The Duty of the Nation: Public Health and the Spanish Influenza in Canada, 1918-19," PhD diss. University of Western Ontario, 2008.

Humphries, M.O. "The Horror at Home: The Canadian Military and the "Great" Influenza Pandemic of 1918." *Journal of the Canadian Historical Association*, 16, no. 1 (2005): 235-260.

Humphries, M.O. *The Last Plague: Spanish Influenza and the Politics of Health and War*. Toronto: University of Toronto Press, 2013.

Humphries, M.O. "The limits of necessity: Public health, dissent, and the war effort during the 1918 influenza pandemic," In: *Epidemic Encounters: Influenza*,

- Society, and Culture in Canada, 1918-20*, edited by M. Fahrni and E. W. Jones, 21-47. Vancouver and Toronto: University of British Columbia Press, 2012.
- Jerzy, W, Praga, J, Kumoz, Z. *Czyn Zbrojny Wychodztwa polskiego w Ameryce: zbior dokumentow I materialow historycznych*. Warsaw: Wydawnictwo Conandor, 2001.
- John Stover. *The Routledge Historical Atlas of the American Railroads*. New York: Routledge, 1999.
- LePan, Aurther D'Orr. War Diary A.D LePan, Vols. 1-2. Library and Archives Canada, MG 30 E 277, 1917-1919.
- MacDougall, Heather. "Toronto's Health Department in action: Influenza in 1918 and SARS in 2003," In: *Epidemic Encounters: Influenza, Society, and Culture in Canada, 1918-20*, edited by M. Fahrni and E. W. Jones, 225-265. Vancouver and Toronto: University of British Columbia Press, 2005.
- Merritt, Richard. *On Common Ground: The Ongoing Story of the Commons in Niagara-on-the-Lake*. Toronto: Dundurn, 2012.
- Nastał, Stanisław. "The Blue Division" in Haller's Polish Army in France, translated & edited by Paul Valasek, 80-149, United States of America: Whitehall Printing, 2006. Originally published in Stanislaw Nastal, *The Blue Division*. Cleveland, Polish Army Veterans' Association in America, 1922.
- Olson, D.R, Simonsen, L, Edelson, P.J, and Morse, S.S. "Epidemiological evidence of an early wave of the 1918 influenza pandemic in New York City." *Proceedings of the National Academy of Science U.S.A.* 102, no. 31 (2005):11059-63.

- Oxford, J.S., Sefton, A., Jackson, R., Innes, W., Daniels, R.S. and Johnson, N.P, "World War I may have allowed the emergence of "Spanish" influenza." *Lancet Infectious Disease* 2, no. 2 (2002):111-4.
- Patterson, K.D, Pyle, GF. "The geography and mortality of the 1918 influenza pandemic." *Bulletin of the History of Medicine* 65, no. 1(1991):4-21.
- Pliska, Stanley. "The "Polish-American Army" 1917-1921." *The Polish Review*, 10, no. 3 (1965):46-59.
- Robinson, J.L. "Polish Camp Hospital." Library and Archives Canada, November 21, 1918. Department of National Defense, Military District 2. RG 24. File Title: "Outbreak of Spanish Influenza" Vol2: File 15-2-73.
- Ruskoski, David Thomas. "The Polish Army in France: Immigrants in America, World War 1 Volunteers in France, Defenders of the Recreated State in Poland." PhD Diss, Georgia State University, 2006.
- Rzeczniowski, Andrzej. *The General Haller's Polish Army in France, 1917-1919.* Warsaw: *U.S. Army Military History Institute*, 1995.
- Shen, L.W. "Origins and spread of the 1918 influenza pandemic." In: *Anatomy of a Pandemic: The 1918 Influenza in Hamilton*, edited by D. Ann Herring, 5-15. Hamilton: Allegra Press, 2005.
- Skarżyński, Wincenty. "The Polish Army in Light of the Facts, " in Haller's Polish Army in France, translated and edited by Paul Valasek, 80-149, United States of America: Whitehall Printing, 2006. Originally published in *Armja Polska We*

Francji we Swietle Faktow. Warszawa: Tłoczono w Zakładach graficznych Straszewiczów, 1929.

Słociński, Jan. "Z Obozu Kosciuszki" *Dziennik Związkowy – Zgoda* Poniedziałek (26 November, 1917): 5.

Smallman-Raynor, M.R, Cliff , A.D. *War epidemics: an historical geography of infectious diseases in military conflict and civil strife, 1850-2000.* Oxford: Oxford, 2004.

Solomon, Brian, Schafer, Mike. *The New York Central Railroad.* St. Paul: MBI Publishing, 2007.

Soltau, B. "Note on a mild Pyrexial Epidemic, Resembling Influenza", National Archives of the United Kingdom (May 12, 1918), WO 95 47.

Swedlund, A. "Everyday mortality in the time of plague: ordinary people under Extraordinary circumstances in Massachusetts before and during the 1918 flu epidemic" in *Plagues and Epidemics: Infected Spaces Past and Present*, eds. Herring, D.A & Swedlund, A.C. New York: Berg, 2010:153-178.

Valasek, Paul, ed. "Medical Examination of Recruits," in *Haller's Polish Army in France.* United States of America: Whitehall Printing, 2006: 73-79

CHAPTER 4: CROSS PROTECTION BETWEEN THE FIRST AND SECOND WAVES OF THE 1918 INFLUENZA PANDEMIC AMONG SOLDIERS OF THE CANADIAN EXPEDITIONARY FORCE (CEF) IN ONTARIO

By: Kandace Bogaert

Article accepted with minor revisions on 28 August 2015 by the journal *Vaccine*, re-submitted with revisions on 15 September 2015 in the form presented here.

Abstract

Objectives

This research analyses morbidity and mortality during the 1918 influenza pandemic among Ontario soldiers in the Canadian Expeditionary Force (CEF). This paper asks: did exposure to influenza during the first wave confer protection against illness and death during the second wave of the pandemic?

Methods

Pneumonia and influenza (P&I) cases and deaths among Ontario soldiers were transcribed from the 1918 Admission and Discharge books for the CEF. Following the methods of Barry et al. (2008), hospital admission and mortality rates for P&I were compared for new recruits (<1 month service) and seasoned soldiers (> 1 month service) in order to assess the possibility of cross protection during successive waves of the pandemic.

Results

The first wave of the 1918 influenza pandemic occurred among between March and May of 1918, with the second wave erupting the following from September to December. Mortality in the second wave was more severe, with a case fatality rate of 4.3%, which was more than double the rate of 2.1% from March-May. Seasoned soldiers experienced 82% protection from illness due to P&I illness in the fall, and 84% protection from death.

Conclusions

The morbidity data for the soldier population of Ontario, data unavailable for civilians, confirms the presence of a herald wave in Ontario. The findings support the hypothesis that exposure to influenza during the first wave of the pandemic had a protective effect during the second more deadly wave in the fall. Regional heterogeneity characterized the pandemic among soldiers in Ontario. Conscription practices may have funneled vulnerable recruits, such as rural farmers, into training camps after the first wave of the pandemic, but prior to the second wave.

Introduction

The 1918-19 influenza pandemic spread around the globe in three pandemic waves and is considered to be the greatest demographic disaster of the 20th century [1,2]. Almost a century later, the relationship between the three waves, and the composition of the H1N1 virus associated with each wave, remain debated [3–7]. Some scholars suggest that in 1918, the fall wave of the epidemic, characterized by high mortality relative to the spring wave, may have resulted from an entirely distinct influenza virus [8]. Others argue that there were minor differences in the viruses and thus exposure to the spring virus conferred cross-protection against the virus circulating in the fall outbreak [9–11].

Influenza infection creates an immune response that protects against re-infection with the same virus, or from an antigenically similar strain of the virus [12]. This is the principle behind seasonal influenza vaccines. Natural immunity produced through infection is thought to produce a superior immune response compared to vaccination [12,13]. This immunity may be short-lived, however, as influenza viruses undergo frequent change through the processes of antigenic drift (through natural selection over time new antigenic variations occur), and antigenic shift (the segmented influenza genome allows for the exchange of RNA segments with human and animal viruses, whereby it acquires novel antigenic properties) [12,14].

Cross protection to influenza A viruses, sometimes called cross immunity, refers to the process in which the immune system draws on its history of previous infections to reduce the likelihood of infection with a similar strain of the virus, or hastens the response of the immune system to viral control in the host [15]. Evidence from several studies suggests that influenza illness during the first wave of the 1918 pandemic appears to have conferred protection from illness and death during the more deadly fall wave [9–11,16]. The number of infected individuals during the first wave of an influenza pandemic is

analogous to the number naturally “vaccinated” against a closely related strain of the virus [9].

To explore the issue of cross protection during the second wave of the 1918 influenza pandemic, this research relies on historical documents from Canada on morbidity and mortality among soldiers in the Canadian Expeditionary Force (CEF). Soldiers represent an ideal population within which to study the effects of pandemic influenza because military registrars recorded detailed information on morbidity and mortality [17,18]. Sick soldiers were obliged to report to the medical officer prior to morning roll call [17,19] and registrars at each hospital kept nominal records¹ of soldiers who fell ill, the date of onset of illness, length of illness, and treatments used. The Province of Ontario is a particularly fruitful place to examine this problem because it was home to the highest concentration of military camps and hospitals in Canada [20] and because detailed admission and discharge records (A&D) are available for analysis.

In addition, several researchers have identified the presence of the first wave of influenza in Ontario. Humphries [17] noted heightened admissions to military hospitals in the first half of 1918. A study of mortality in the Canadian Expeditionary Force (CEF) indicates that Ontario’s soldiers experienced the first wave of influenza between March and May of 1918 [18]. Korol’s [11] study of Ontario’s civilian death registry for 1918 found evidence in April and May for the presence of the first wave of influenza in many large cities, including Toronto, Hamilton and Ottawa. The latter two studies put the timing of the first wave in Ontario in line with the herald wave in New York City, and in the rest of the USA [21,22].

¹ Records that include the names (often first name and surname, or surname and initials) of patients admitted to the hospital.

Ontario's soldiers were also among the first Canadians affected by the second, more deadly wave of influenza that erupted in the fall [17,19,23]. Soldiers training and mobilizing for the war effort were central to the spread of influenza throughout Canada [17–19,23,24]. Describing the course of the pandemic as a dramaturgical event, Slonim aptly notes that, “all acts of this play were directed by the Great War”[24].

Studies of the 1918 pandemic in Canada have been constrained, however, by a lack of detailed morbidity data [11,18]. This is a significant drawback since most individuals who contracted influenza in 1918, especially during the first wave of the pandemic, did not die [25]. The A&D records for Ontario's military hospitals, which contain information on both soldier morbidity and mortality, present a rare and exciting opportunity to begin to fill this gap.

Materials

The data for this study come from Admission and Discharge records (A&D) for 26 military hospitals in fourteen locations in Ontario [26], all of which cluster along the U.S. border in close proximity to American training camps (Suppl. Table 1 & Suppl. Figure 1). CEF registrars kept separate books for “Canada Cases” and “Overseas Cases”. These refer, respectively, to soldiers stationed in Canada who were admitted to military hospitals and soldiers injured in the European theatre of war. This study is focused on the Canada Cases, not the pathologies of gun-shot wounds and amputations, which dominate the Overseas admissions.

The Ontario Admission and Discharge books for 1918 [26] were photographed at Library and Archives of Canada and cases and deaths from pneumonia and influenza (P&I) were transcribed into a Microsoft Excel database. Pneumonia is included because it was a common complication of influenza (P&I) during the pandemic year, contributing

to high mortality [25]. Sick soldiers were counted as cases of P&I whenever pneumonia and/or a variant of influenza, including 'flu, "Spanish influenza", or la grippe, occurred in the diagnosis. Information on the hospital, case number, unit, the soldier's regimental number, rank, age, and length of military service, along with date of admission, marital status, religion, result (or outcome, including discharge, transfer or death), transfer origins if applicable, and date of discharge were also transcribed.

Many registrars wrote in barely legible script that required lengthy scrutiny. Some hospital registrars included admissions collected from subsidiary hospitals. The registrar at Fleming Military Hospital in Ottawa, for example, recorded admissions at Ottawa's St. Luke's Military Hospital. It was necessary, therefore, to crosscheck each record to ensure there were no duplicates. After duplicates, transfers to other hospitals within Ontario, entries without a "result" of illness described, and entries missing the month or day of admission were excluded (n=646), a total of 5,560 soldiers were admitted to Ontario's military hospitals with P&I; 233 of them died from P&I (Suppl. Table 1).

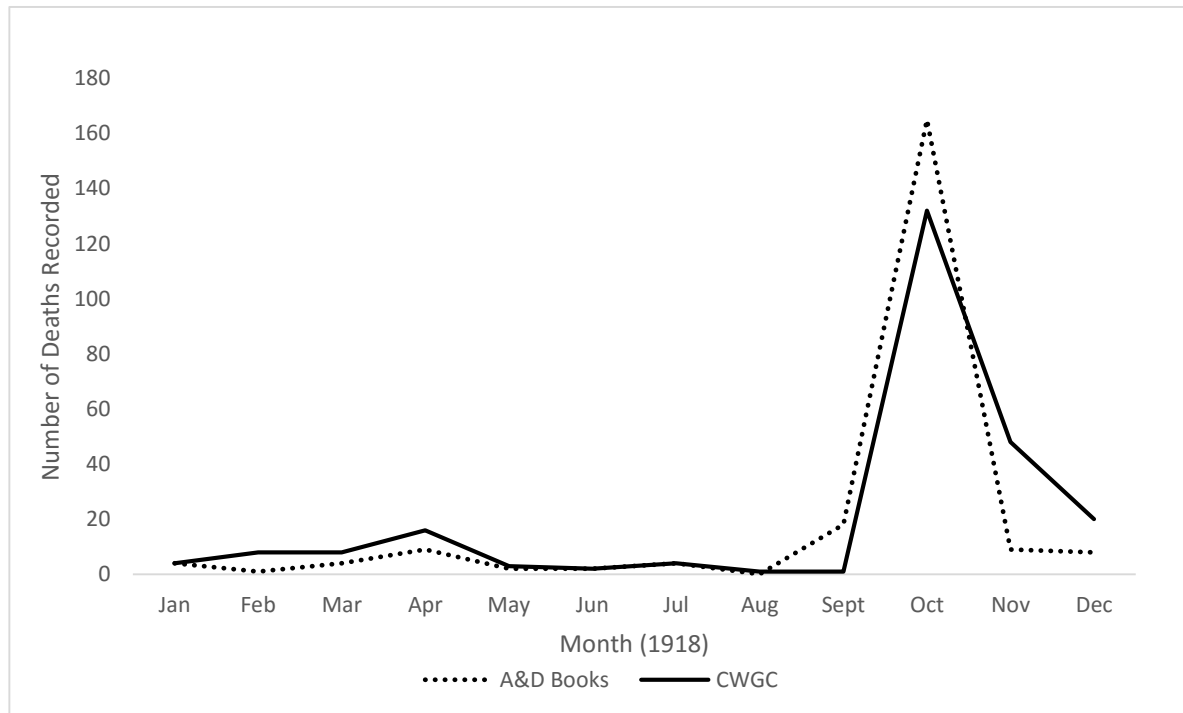
The median age for soldiers admitted to military hospitals for P&I was 23 years, with the youngest a private of 15 years, and the oldest a 57-year old. The modal age upon admission to hospital was 21 years, reflecting the young age at which soldiers enlisted. The majority of the admissions were male, with only 56 nursing sisters admitted to hospital for P&I. The vast majority (93.3%, n=5058) were members of the rank and file. In 1918, 37,220 new recruits to CEF in Ontario were conscripted via the Military Service Act; only 5,807 were volunteers and another 9,618 were from the USA [27].

Only some of the 26 military hospitals were in operation for the whole of 1918 (Table 1). St. Andrew's Military Hospital, for example, opened in November of 1918. Gaps in the A&D records are likely the result of the failure of military officials to forward books to the Department of Militia and Defense. Another factor to consider is that not all

soldiers in Ontario would have been hospitalized in military hospitals with P&I illness; soldiers on leave at home could convalesce at home, and those with mild illness may not have been hospitalized at all [16,18]. It is likely that rates of clinical under-reporting were higher for cases of mild illness during the first wave of the pandemic, where cases in general were less severe [16]. Soldiers sick and dying at home, or with mild illness are invisible to observation in hospital throughout 1918, and consequently these results most probably underestimate P&I morbidity and mortality during both waves of the pandemic.

That said, the P&I mortality curve generated from the A&D data is comparable to that generated for Ontario soldiers by Rewegan et al.[18] and Rewegan (unpublished communication), based on data derived from the Commonwealth War Graves Commission registry (CWGC) (Figure 1). Differences between the two sources reflect the fact that the CWGC death records include soldiers who died at home while on leave, whereas the A&D deaths all occurred in hospital. The A&D books also contain more deaths in October, owing to the transfer of members of the Royal Air Force (RAF) to CEF hospitals (n=69). The RAF was not part of the CEF and these sick soldiers added to the burden shouldered by the CEF hospital system in the fall [28]. In spite of these issues, the P&I mortality patterns derived from the A&D books are consistent with results for the rest of the country and continent [10,17,18,29].

Figure 1. Comparison of P&I deaths among soldiers in Ontario in the CWGC database (Rewegan et al., 2015 and Rewegan, unpublished) and the A&D records



Methods

In order to estimate monthly mortality² admission³ and case-fatality rates⁴ the number of admissions and deaths reported in the A&D books and the reported number of soldiers in the CEF in Ontario for 1918 were used [30,31]. Data on the number of

² $MR = \left(\frac{d_i}{p_i}\right)k$, where MR is the monthly mortality rate for P&I among soldiers in Ontario, d_i is the number of soldier deaths from P&I in a given month, and p_i is the number of soldiers at risk of dying from P&I in the same month in Ontario, and k is 1000.

³ $AR = \left(\frac{c_i}{p_i}\right)k$, where AR is the monthly admission rate for P&I among soldiers in Ontario, c_i is the number of P&I admissions among soldiers in Ontario in a given month, and p_i is the number of soldiers at risk of being admitted to hospital from P&I in the same month in Ontario, and k is 1000.

⁴ $CFR = \left(\frac{d_i}{c_i}\right)k$, where CFR is the case fatality rate from P&I among soldiers in Ontario, d_i is the number of soldier deaths from P&I in Ontario in a given time period and c_i is the number of P&I admissions in Ontario in a given time period and k is 100.

soldiers in the CEF in Ontario are only available for the months of July, August, September, November, and December (Suppl. Table 2), thus it was necessary to derive estimates for the rest of the year. On average, 33% of all soldiers training in Canada were stationed in Ontario. This proportion was used to estimate the strength of the CEF in Ontario for the remaining 7 months of 1918. In order to assess regional patterns of P&I, epidemic morbidity curves were compared for the military headquarters in London, Kingston, and Toronto.

In keeping with the observation that recent military recruits tend to be more susceptible to pneumonia-influenza [25,32,33], this study uses length of military service as a proxy for exposure to the first wave of the 1918 pandemic.⁵ The observation that recent military recruits tend to be more susceptible than ‘seasoned personnel’ to respiratory and other infectious diseases is not new, and by the end of the Second World War was well established [33–35].

Using length of service as a proxy for exposure to the first wave of influenza has limitations because it assumes that soldiers with longer service were exposed earlier than new recruits to pandemic influenza. It was impossible to track soldiers from the spring through the fall through the 1918 A&D records. Soldiers were highly mobile and only 29 unique regimental numbers were traceable from the first wave of the pandemic into the second. Length of service in the military, therefore, is likely is a better estimator of

⁵ Length of service was not always included in the A&D books. For example, soldiers in Ottawa were almost entirely excluded from the analysis of cross-protection because the registrars for Ottawa’s military hospitals failed to record this in their ledgers. The case-fatality rate among the omitted soldier group only slightly higher than the rest of the soldier population (4.9%, n=690 cases, n=33 deaths). It was impossible to omit new and seasoned recruits from Ottawa from the province’s population at risk because information on recruitment and the strength of the soldier population was not published at this level of detail. Therefore, it is likely that the data under-estimate cross-protection.

exposure to the herald wave of the pandemic. As noted by Barry et al. [10], some conscripts and volunteers may have been exposed to the first wave of influenza before enlisting. At the same time, conscription in Canada in 1918 drew disproportionately from rural farmers [36,37], who were less likely to have been exposed to influenza.

Another limitation of this methodology is that the case-fatality rates are calculated based upon hospitalized cases only, which may not be comparable to other estimates of case-fatality rates during the pandemic. As noted by Chowell and colleagues [16] mild cases that did not require medical treatment were unlikely to have been admitted or diagnosed with influenza in hospital. Soldiers admitted to military hospitals with P&I were likely suffering from more severe illness, and therefore represent individuals who were more likely to have died during the pandemic. Furthermore, since mild cases were less likely to be diagnosed and admitted to hospital, the true number of P&I cases is probably underestimated. Both of these factors may contribute to higher estimates of case-fatality rates than would be expected in the general population.

In order to assess cross-protection between the first two waves of the pandemic, this study replicates the methodology published by Barry and colleagues [10]. P&I cases were partitioned into two groups: soldiers with less than 1 month's service (new recruits) and soldiers with more than 1 month's service ('seasoned' recruits). The number of new recruits in Ontario was extracted from a report on CEF enlistments (Suppl. Table 2)[27] and the number of new recruits was subtracted from the total strength of the province each month to derive the number of seasoned recruits [30,31]. The relative risk (RR) of P&I illness and death, where RR is the percentage of seasoned recruits affected by P&I divided by the percentage of new recruits affected by P&I, was calculated for the second wave (September to December) of the pandemic. The effect of cross-protection was estimated as $1 - RR$ [10].

Results

The A&D morbidity records clearly show the presence of the spring wave of influenza among CEF soldiers training in Ontario (Figure 2). P&I morbidity began to rise in March and then peaked in April, with 34 admissions per 1000 soldiers. Resurging P&I morbidity in September (37.9 P&I admissions per 1000 soldiers) indicates the emergence of the second wave of the pandemic. In October, P&I admissions soared to 136.2 admissions per 1000 soldiers. In this month alone, 72% of all of the P&I deaths (n=167) were recorded, completely dwarfing mortality during the rest of the year (Figure 3).

The vast majority of soldiers survived their illness. Overall, the P&I case-fatality rate for 1918 was low at only 4.4% (n=233) (Table 1). The second wave of the pandemic (September to December), however, was more severe, resulting in a case fatality rate of 4.7%, double the 2.3% case fatality rate during the spring wave.

Figure 2. P&I admission rate per 1000 soldiers in Ontario, 1918.

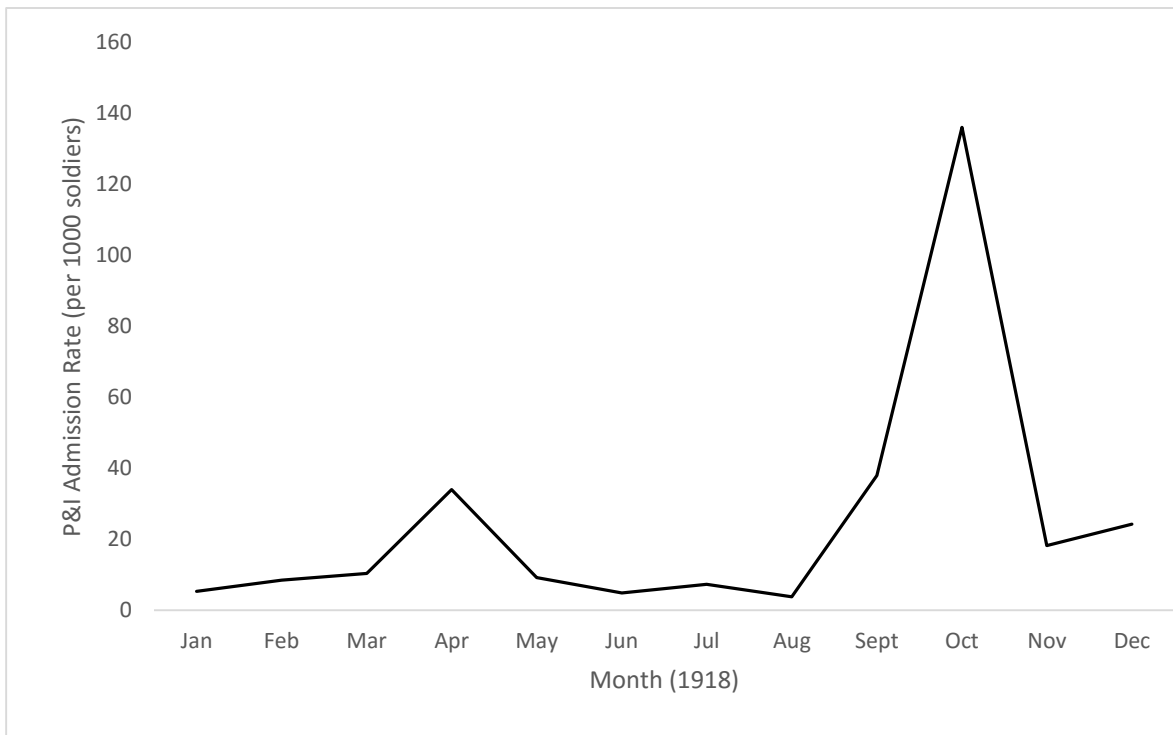


Figure 3. P&I mortality rates per 1000 soldiers in Ontario, 1918.

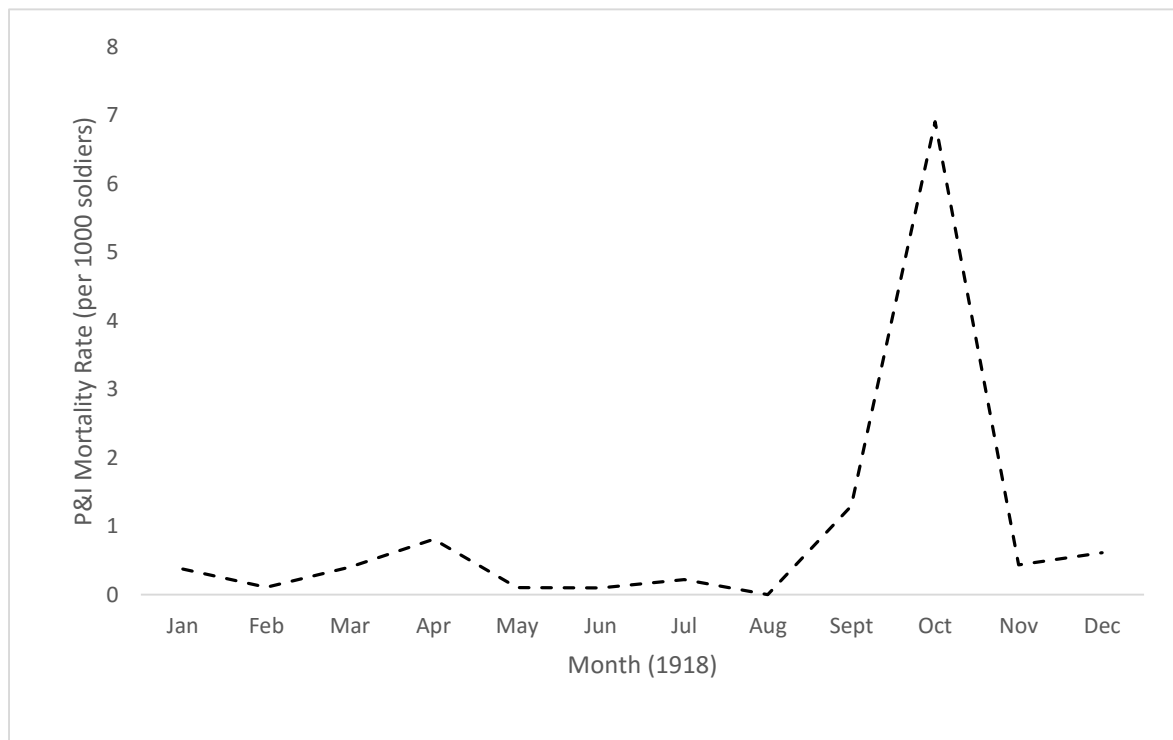


Table 1. P&I case fatality rate by pandemic wave among soldiers in Ontario.

Pandemic Wave	Case Fatality Rate, percent	95% Confidence Interval, percent
1 st Wave (March-May)	2.3%	1.2% - 3.5%
2 nd Wave (September-December)	4.7%	4.0% - 5.3%
Total	4.4%	3.8% - 5.0%

Throughout 1918, Toronto's sick soldiers dominate Ontario's P&I morbidity profile, accounting for 45% (n=2516) of all cases (Figure 4). The spring and fall waves are evident among soldiers in both Toronto and London, but not Kingston (Figure 4). These 3 locations account for 63.9% of the provincial total (n=3555).

Exposure to influenza during the spring wave appears to have had a protective effect against illness and death during the fall wave. The A&D data show that during the fall wave, soldiers with more than one month's military service experienced 82.5% protection from illness due to P&I (95% CI, 81.0%-83.4%) and 84% protection from death from P&I (95% CI, 77.5%-88.7%), compared to new recruits with less than 1 month of military service (Table 2).

Figure 4. P&I admissions by month in the military headquarters of Ontario.

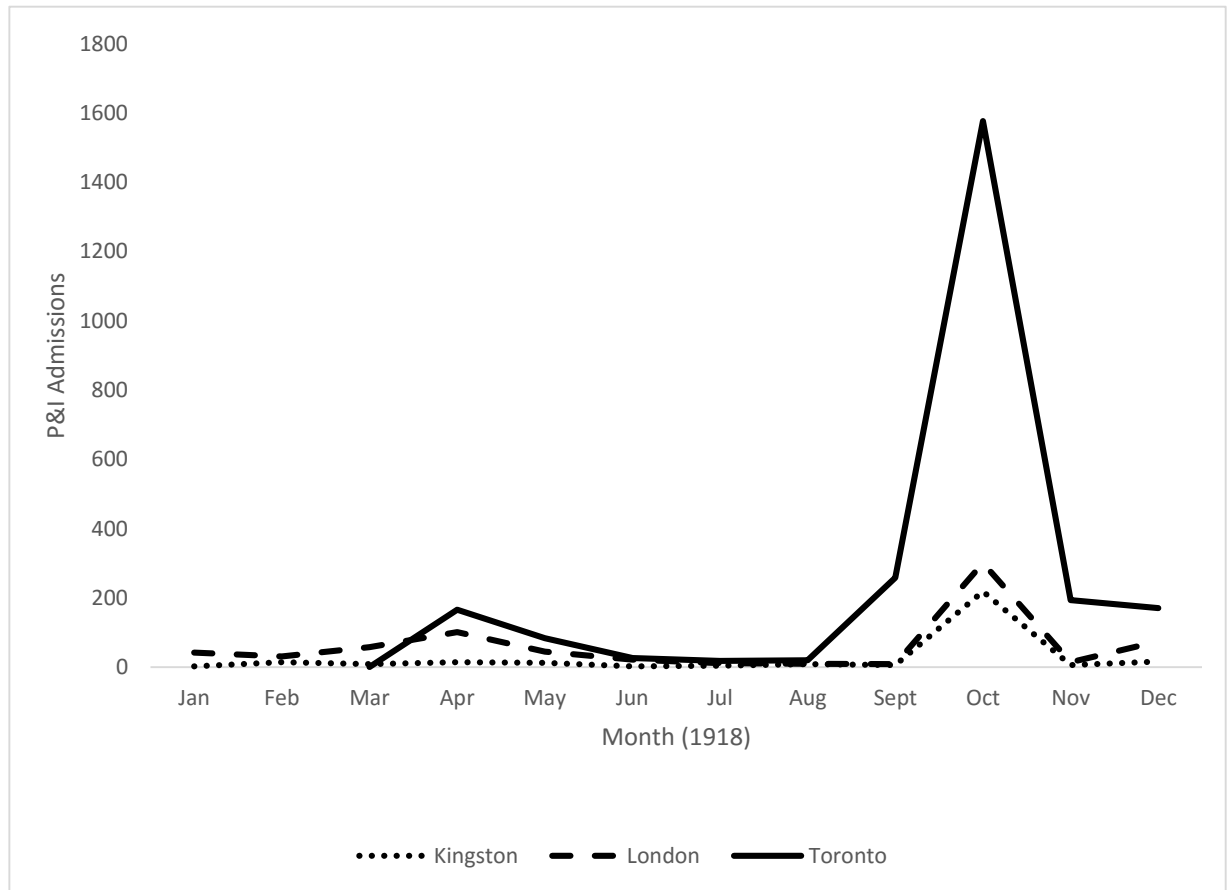


Table 2. P&I morbidity and mortality among soldiers in Ontario during the second wave (Sept-Dec) of the pandemic, according to length of service in the army.

Outcome Measured During Fall Wave	> 1 Month (seasoned troops), proportion (%)	< 1 Month (new recruits), proportion (%)	Protective Effect ^a (95% CI)
Death	123/67597 (0.2)	44/3860 (1.1)	84.0% (77.5%-88.7%)
Illness	2721/67597(4.0)	876/3860 (22.7)	82.5% (81.0%-83.4%)

^a Protective effect was calculated as 1-RR where RR is the percentage of seasoned recruits affected by P&I divided by the percentage of new recruits affected by P&I (Barry et al. 2008).

Discussion

The 1918 A&D morbidity records for Ontario's soldiers supports the growing body of evidence that the mild herald wave of influenza was present in Canada [11,17,18]. Soldiers mingled freely with civilians [23], so it is unlikely that the spring epidemic was confined to Ontario's training camps. The spring wave may have gone unnoticed precisely because of the lower morbidity and mortality rates that characterized this pandemic wave. Another possibility is that the military suppressed the release of epidemic news [24].

The A&D morbidity records support the findings of Korol [11] and Barry et al. [10] that exposure during the first wave offered protection against illness and death during the second wave. Seasoned recruits treated in Ontario's military hospitals were estimated to be 84% protected from death, and 82.5% protected from illness due to P&I during the fall wave of the pandemic (see Table 2). According to Barry et al. [10], this level of cross protection falls within the range of protection provided by modern vaccinations (70%-80% effective).

Cross-protection is an indication that the virus circulating in the fall of 1918 was closely related to the virus that circulated during the spring of 1918 [9–11,22,38]. Studies of the virus also suggest that a similar virus was circulating in vastly different geographic areas and at different times that year [4,39]. Further study of viral material from different places and times could help elucidate the relationship between pandemic waves around the globe.

Taken together, these findings emphasize the importance played by socio-environmental, host circumstances and imperceptible (to date) changes in the virus itself in the excess morbidity and mortality that occurred during the fall wave of the pandemic [40–42]. The importance of environmental factors (like temperature changes), and other

social factors (such as the closing of schools over the summer and re-opening in the fall), as well as behavioural responses (including restrictions on human contact), are significant factors affecting the transmission of pandemic influenza [43].

During WWI in Canada, soldiers daily lives in military training camps were ideal for the transmission of an airborne respiratory infection like influenza [17,23]. Soldiers were crowded on troop trains en route to the camps, where messing, training and sleeping were also done en masse. The fall of 1918 was particularly cold and wet, and many recruits were housed in tents sleeping up to eight men at once [23]. Recruitment and conscription continued throughout the pandemic, ensuring a continuous supply of potentially susceptible individuals to sustain local epidemics within military camps [23,44].

Since soldiers were highly mobile, future research could focus on tracking individual soldiers who were diagnosed with P&I illness in Ontario's military camps during the first wave of the pandemic into the second wave of the pandemic when they were potentially overseas. This could be accomplished using the Service Files of the First World War housed at the Library and Archives of Canada.

Co-infections, beyond the well-understood relationship with pneumonia, may also have affected soldiers' vulnerability and risk of death due to P&I [41,45]. Brundage & Shanks [25] and Sheng et al. [4], argue that secondary bacterial infections causing death during the Spanish flu cannot be ignored. Shanks et al.[46] hypothesize that individuals new to their environments (such as soldiers in training camps) were more likely to be exposed to novel bacterial strains to which they lacked protective antibodies, while convalescing from flu. Recruits encountering a demanding military environment may also have been exposed to physical and psychological stressors that can contribute to depressing the immune response to infection, which may also have increased

vulnerability to P&I [47]. Noymer & Garenne [48] argue that tuberculous individuals, particularly males, were disproportionately affected by influenza, although this has been challenged by other scholars [49,50]. Tuberculosis was a leading cause of death among soldiers on the Canadian home front during the First World War (WWI), and in spite of medical examinations upon enlistment, many men managed to enlist, only to develop active cases of TB [51].

On the other hand, soldiers in the CEF likely had access to better medical care relative to civilians in that they received prompt hospital treatment from physicians and nurses. Since there was no cure for influenza at the time, good nursing care was the only effective treatment [24]. Soldier health was closely monitored, and soldiers who were ill were required to report to a medical officer upon morning roll call. In Canada in 1918, there was no comparable monitoring of the health of civilians, for whom there is very little morbidity data available during the pandemic [17].

Soldier morbidity and mortality may also have been mediated by nutrition. Soldiers' diets were considered to be a marked improvement over those of the majority of lower socio-economic status Canadians at the time [52], and if service in the war did not lead to death in the trenches, overall, service in the military had a surprisingly positive effect on health [36].

Conclusion

Detailed morbidity data for soldiers training in Ontario shows the presence of both waves of the 1918 influenza pandemic. This adds to the evidence from other studies that civilians and soldiers across Canada were affected by the first wave of influenza [11,17,18]. Mortality from P&I was low overall, but proved to be twice as high during the second wave of the pandemic, when the military hospital system was over-taxed. The

transfer of recruits from different branches of the service, and from other military hospitals, highlights the military's lack of preparedness to deal with a pandemic. Overall, both morbidity and mortality were highest in Toronto in October of 1918, highlighting the regional variability of the pandemic experience [53], and the importance of soldiers training in Toronto to the war effort.

This research further supports the theory that soldiers exposed to the herald wave of the pandemic through their longer military service were less vulnerable to illness and death than their new comrades when the second wave erupted in the fall. The social circumstances created by the war, including conscription practices, may have played a significant role in soldiers' experiences of the pandemic, resulting in a large number of vulnerable recruits congregating in military camps across the province.

Acknowledgements

This research was supported in part by the Social Sciences and Humanities Research Council of Canada (#752-2013-2670) and McMaster University's Department of Anthropology. Special thanks to Ann Herring and Tina Moffat whose insightful comments helped revise this paper. Ann Herring, Alex Rewegan and Melissa Yan graciously shared their database of CWGC deaths to compare with the A&D database.

Thanks are owed to two anonymous reviewers who helped to improve this work.

Conflicts of interest: the author has no conflict of interest related to this research. The funding institutions had no part in study design or decision to publish results.

References Cited

- [1] Phillips H, Killingray D. The Spanish influenza pandemic of 1918-19: new perspectives. Routledge; 2003.
- [2] Johnson N, Mueller J. Updating the accounts: global mortality of the 1918-1920 “Spanish” influenza pandemic. *Bull Hist Med* 2002.
- [3] Reid A, Fanning TG, Hultin J V, Taubenberger J. Origin and evolution of the 1918 “Spanish” influenza virus hemagglutinin gene. *Proc Natl Acad Sci U S A* 1999;96:1651–6. doi:10.1073/pnas.96.4.1651.
- [4] Sheng Z-M, Chertow D, Ambroggio X, McCall S, Przygodzki RM, Cunningham RE, et al. Autopsy series of 68 cases dying before and during the 1918 influenza pandemic peak. *Proc Natl Acad Sci* 2011;108:16416–21. doi:10.1073/pnas.1111179108.
- [5] Zimmer SM, Burke DS. Historical Perspective — Emergence of Influenza A (H1N1) Viruses. *N Engl J Med* 2009;361:279–85. doi:10.1056/NEJMra0904322.
- [6] Taubenberger J, Morens D. 1918 Influenza: the mother of all pandemics. *Rev Biomed* 2006.
- [7] Reid A, Taubenberger J. The origin of the 1918 pandemic influenza virus: A continuing enigma. *J Gen Virol* 2003;84:2285–92. doi:10.1099/vir.0.19302-0.
- [8] Chertow D, Cai R, Sun J. Influenza Circulation in US Army Training Camps Before and During the 1918 Influenza Pandemic: Clues to Early Detection of Pandemic Viral Emergence. *Open Forum Infect Dis* 2015.
- [9] Rios-Doria D, Chowell G. Qualitative analysis of the level of cross-protection between epidemic waves of the 1918-1919 influenza pandemic. *J Theor Biol* 2009;261:584–92. doi:10.1016/j.jtbi.2009.08.020.
- [10] Barry JM, Viboud C, Simonsen L. Cross-protection between successive waves of the 1918-1919 influenza pandemic: epidemiological evidence from US Army camps and from Britain. *J Infect Dis* 2008;198:1427–34. doi:10.1086/592454.
- [11] Korol E. The 1918 influenza pandemic in Ontario : impact of the Herald Wave on autumn mortality. McMaster University, 2011.
- [12] Cox RJ, Brokstad K a., Ogra PP. Influenza Virus: Immunity and Vaccination Strategies. Comparison of the Immune Response to Inactivated and Live, Attenuated Influenza Vaccines. *Scand J Immunol* 2004;59:1–15. doi:10.1111/j.0300-9475.2004.01382.x.

- [13] Hasegawa H, van Reit E, Kida H. Mucosal Immunization and Adjuvants. In: Oldstone MB., Compans RW, editors. *Influ. Pathog. Control Vol. II*, Springer International Publishing; 2015, p. 371–80. doi:10.1007/978-3-319-11158-2.
- [14] Ahmed R, Oldstone MBAM, Palese P. Protective immunity and susceptibility to infectious diseases: lessons from the 1918 influenza pandemic. *Nat Immunol* 2007;8:1188–93. doi:10.1038/ni1530.
- [15] Nuño M, Castillo-Chavez C, Feng Z, Martcheva M. Mathematical models of influenza: The role of cross-immunity, quarantine and age-structure. In: Brauer F, van den Driessche P, Wu J, editors. *Math. Epidemiol.*, vol. 1945, Springer Berlin Heidelberg; 2008, p. 349–64. doi:10.1007/978-3-540-78911-6_13.
- [16] Chowell G, Ammon CE, Hengartner NW, Hyman JM. Transmission dynamics of the great influenza pandemic of 1918 in Geneva, Switzerland: Assessing the effects of hypothetical interventions. *J Theor Biol* 2006;241:193–204. doi:10.1016/j.jtbi.2005.11.026.
- [17] Humphries M. *The last plague: Spanish influenza and the politics of public health in Canada*. University of Toronto Press; 2013.
- [18] Rewegan A, Bogaert K, Yan M, Gagnon A, Herring D. The first wave of the 1918 influenza pandemic among soldiers of the Canadian expeditionary force. *Am J Hum Biol* 2015;00:n/a – n/a. doi:10.1002/ajhb.22713.
- [19] Humphries M. The Horror at home: The Canadian military and the “great” influenza pandemic of 1918. *J Can Hist Assoc La Société Hist Du Canada* 2005.
- [20] Love D. *A call to arms: the organization and administration of Canada’s military in World War One*. Bunker to Bunker Books; 1999.
- [21] Patterson K, Pyle G. The geography and mortality of the 1918 influenza pandemic. *Bull Hist Med* 1991.
- [22] Olson DDR, Simonsen L, Edelson PJ, Morse SS. Epidemiological evidence of an early wave of the 1918 influenza pandemic in New York City. *Proc Natl Acad Sci U S A* 2005;102:11059–63.
- [23] Bogaert K, van Koevorden J, Herring D. Tracing “the Trail of Infected Armies”: Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19. In: Baskerville P, Inwood K, editors. *Lives Transit. Longitud. Anal. from Hist. Sources*, McGill Queens University Press; 2015, p. 274–91.

- [24] Slonim K. "Send only your serious cases"--delivering flu to Toronto: an anthropological analysis of the 1918-19 influenza epidemic in Toronto, Ontario, Canada. University of Missouri - Columbia, 2010.
- [25] Brundage J, Shanks G. Deaths from bacterial pneumonia during 1918–19 influenza pandemic. *Emerg Infect Dis* 2008.
- [26] Library and Archives of Canada. Admission & Discharge Books 12, 14, 15, 17, 21, 23, 26, 28, 44, 46, 47, 48, 57, 59, 60, 64, 65, 68, 69, 70, 72, 73, 81, 83, 90, 91, 93, 96, 115, 116, 118, 122, 130, 131, 135, 148, 151, 152, 166, 181, 183, 186, 199, 208, 216, 218, 220, 227, 239, 241, 243, 1918:RG 9 II – L – 1, Volumes 1–9.
- [27] Library and Archives of Canada. Canadian Expeditionary Force Enlistments by Military District n.d.:RG 38 – D – 10, Volume 444.
- [28] Hunt C. *Dancing in the Sky: The Royal Flying Corps in Canada*. Dundurn Press; 2009.
- [29] Crosby A. *America's forgotten pandemic: the influenza of 1918*. 2003.
- [30] Library and Archives of Canada. Strength Returns, CEF 1918:RG 24 – G – 3–1 – a, Volume 18568, File 133.009.
- [31] Library and Archives of Canada. Returns and Statistics of the Canadian Expeditionary Force and Canadian Siberian Expeditionary Force n.d.:RG 24 – C – 6 – e, Volume 1842 File Pt 1, File GAQ – 10–45.
- [32] Shanks G, MacKenzie A. Mortality risk factors during the 1918–1919 influenza pandemic in the Australian army. *J Infect Dis* 2010.
- [33] Byerly CR. *Fever of War: The Influenza Epidemic in the U.S. Army During World War I*. NYU Press; 2005.
- [34] Sartwell P. Common respiratory disease in recruits. *Am J Epidemiol* 1951.
- [35] Bernstein S. Observations on the effects of housing on the incidence and spread of common respiratory diseases among Air Force recruits. *Am J Epidemiol* 1957.
- [36] Kirk-Elleker A. *A Measure of Well-being: An Anthropometric Study of Living Conditions in Canada at the Turn of the Twentieth Century*. University of Guelph, 2008.
- [37] Granatstein J, Hitsman J. *Broken promises: A history of conscription in Canada*. Oxford University Press; 1977.
- [38] Chowell G, Viboud C, Simonsen L, Miller MA, Acuna-Soto R. Mortality patterns associated with the 1918 influenza pandemic in Mexico: evidence for a spring herald

wave and lack of preexisting immunity in older populations. *J Infect Dis* 2010;202:567–75. doi:10.1086/654897.

[39] Taubenberger J, Reid A, Janczewski T a, Fanning TG. Integrating historical, clinical and molecular genetic data in order to explain the origin and virulence of the 1918 Spanish influenza virus. *Philos Trans R Soc Lond B Biol Sci* 2001;356:1829–39. doi:10.1098/rstb.2001.1020.

[40] Herring D, Korol E. The north-south divide: Social inequality and mortality from the 1918 influenza pandemic in Hamilton, Ontario. In: Farhni M, Jones E, editors. *Epidemic Encount. Infl. Soc. Cult.*, UBC Press; 2012, p. 97–112.

[41] Herring D, Sattenspiel L. Social contexts, syndemics, and infectious disease in northern Aboriginal populations. *Am J Hum Biol* 2007.

[42] Mamelund S. Geography may explain adult mortality from the 1918–20 influenza pandemic. *Epidemics* 2011;3:46–60.

[43] He D, Dushoff J, Day T, Ma J, Earn DJD. Inferring the causes of the three waves of the 1918 influenza pandemic in England and Wales. *Proc Biol Sci* 2013;280:20131345. doi:10.1098/rspb.2013.1345.

[44] Humphries M. The limits of necessity: public health, dissent, and the war effort during the 1918 influenza pandemic. In: Fahrni M, Jones EW, editors. *Epidemic Encount. Infl. Soc. Cult. Canada*, Toronto: UBC Press; 2012, p. 21–47.

[45] Singer M, Clair S. Syndemics and public health: reconceptualizing disease in bio-social context. *Med Anthropol Q* 2003;17:423–41.

[46] Shanks G, Brundage J. Pathogenic responses among young adults during the 1918 influenza pandemic. *Emerg Infect Dis* 2012.

[47] Balicer R, Zarka S, Levine H, Klement E. Control of *Streptococcus pneumoniae* serotype 5 epidemic of severe pneumonia among young army recruits by mass antibiotic treatment and vaccination. *Vaccine* 2010.

[48] Noymer A, Garenne M. The 1918 Influenza Epidemic's Effects on Sex Differentials in Mortality in the United States. *Popul Dev Rev* 2000;26:565–81. doi:10.1111/j.1728-4457.2000.00565.x.

[49] Sawchuk LA. Brief communication: Rethinking the impact of the 1918 influenza pandemic on sex differentials in mortality. *Am J Phys Anthropol* 2009;139:584–90.

[50] Hallman S. *The Demographic Links Between the 1890 and 1918 Influenza Pandemics in Ontario*. University of Western Ontario, 2015.

[51] Dickin-McGinnis J. From health to welfare: federal government policies regarding standards of public health for Canadians, 1919-1945. University of Alberta, 1981.

[52] Clarke N, Cranfield J, Inwood K. FightingFit? Diet, Disease, and Disability in the Canadian Expeditionary Force, 1914–18. *War Soc* 2014;33:80–97. doi:10.1179/0729247314Z.00000000033.

[53] Sattenspiel L. Regional patterns of mortality during the 1918 influenza pandemic in Newfoundland. *Vaccine* 2011;29:2–7. doi:10.1016/j.vaccine.2011.02.046.

Supplementary Figures and Tables

Supplementary Table 1. P&I admissions by military hospital and city, Ontario, 1918.

City & military hospital	P&I admissions	Records available (1918)
Borden		
Special Hospital Camp Borden	50	15 July – 4 November
Brockville		
Base Military Hospital	2	1 January – 15 April
Burlington		
Brant Military Hospital	118	12 March – 31 December
Deseronto		
Camp Mohawk Military Hospital	36	1 January – 31 March
Guelph		
Guelph Camp Military Hospital	22	3 May – 13 December
Hamilton		
Hamilton Military Hospital	539	19 March – 31 December
Kapuskasing		
Kapuskasing Station Hospital	97	1 January – 31 December
Kingston*		
Hotel Dieu Hospital	5	9 February – 8 December
Ongwandada Military Hospital	115	1 January – 31 December
Queen's University Military Hospital	198	11 January – 31 December
London*		
CAMC Hospital	147	1 January – 31 March, 6 June – 2 July
London Military Convalescent Hospital ^a	112	1 January – 28 December
Wolseley Barracks Hospital	462	1 April 1918 – 31 December
Niagara-on-the-Lake		
Niagara Camp Hospital	322	7 August – 3 November
Ottawa		
Fleming Military Hospital and Convalescent Home	205	1 April – 31 December
General Protestant Hospital	91	16 March – 31 December
St. Luke's Base Hospital	336	1 January – 31 December
Petawawa		
Military Hospital Petawawa Camp	121	13 May – 6 October
Toronto*		
Base Military Hospital	2038	1 April – 31 December

Exhibition Camp Hospital	163	6 November – 31 December
Spadina Military Hospital	10	1 January – 31 December
St. Andrews Military Hospital	71	4 November – 31 December
Toronto General Hospital	234	12 February – 31 December
Whitby		
Whitby Military Hospital	66	3 January – 23 June, 13 August – 31 December
Grand Total	5560	

^a Includes 23 cases treated in the civilian hospital in London.

* Indicates district headquarters.

Supplementary Table 2. Strength of the CEF in Canada and Ontario, and monthly enlistments in Ontario, 1918.

Month	Strength in Canada	Strength in Ontario	Enlistments in Ontario
Jan	32063	10687*	5598
Feb	27269	9089*	5080
Mar	29854	9951*	4299
Apr	33300	11100*	5411
May	57654	19217*	15951
Jun	61432	20477*	6238
Jul	50755	18106	3377
Aug	45719	16602	2831
Sept	41807	13888	1562
Oct	71653	23884*	1703
Nov	66441	20628	529
Dec	42939	13057	66

* Estimated based on the fact that Ontario comprised on average 33% of the strength of the CEF in Canada in the five months that this level of detail is available

Supplementary Figure 1. Location of Ontario's military camps and district headquarters (red). Adapted from Martin et al. (1919: 271)



CHAPTER 5: MILITARY AND MARITIME EVIDENCE OF PANDEMIC INFLUENZA IN CANADA DURING THE SUMMER OF 1918

By: Kandace Bogaert

Article submitted 28 July 2015 for peer review to the journal *War and Society*.

Abstract

Analysis of archival correspondence, the daily logs of troopships transporting soldiers to Europe, and the Commonwealth War Graves Commission database for soldier deaths from pneumonia and influenza across Canada indicate that influenza was more common during the summer of 1918 than previously thought. Evidence of pandemic influenza so close to the outbreak of the fall wave calls into question the storyline of a mutated virus causing the emergence of the fall wave of the 1918 influenza pandemic. This highlights the significance of other host, social and environmental circumstances, many related to the first world war, that may have contributed to the severity and timing of pandemic waves in Canada.

Keywords

1918 influenza pandemic, first world war, troopships, social conditions, pandemic waves

Introduction

Once aptly named the “forgotten” pandemic,¹ the past 40 years of research on the 1918 influenza pandemic has been characterized by a steady growth in the scholarly literature.² Contrary to what the name might suggest, the 1918 flu pandemic was not a single outbreak but was experienced in three waves: a mild “herald” wave in the spring or summer, followed by the deadly fall wave, and often by a recurrence in the winter.³ In some places, the 1918 flu circulated into 1920.⁴ According to Howard Phillips, the historiography of this pandemic also occurred in waves.⁵ The first wave of research focused on four different conceptions of the pandemic: as an epidemiological event, high drama, a social or public health crisis and as scientific adventure.⁶ In the “second wave” of scholarship, which is currently underway, scholars from diverse, interdisciplinary backgrounds examine the pandemic from multiple perspectives.⁷

The Canadian scholarship on the 1918 influenza pandemic has followed a similar trajectory. Building largely upon the early influential work of Janis Dickin-McGinnis⁸ and Eileen Pettigrew,⁹ the literature on the Canadian experience of this pandemic has also

¹ A. Crosby, *America's Forgotten Pandemic: The Influenza of 1918* (New York: Cambridge University Press, 2003), p. xiv.

² H. Phillips, ‘The Re-appearing shadow of 1918: trends in the historiography of the 1918-19 influenza pandemic,’ *Canadian Bulletin of Medical History/Bulletin canadien d'histoire de la médecine* 21.1 (2010), 121-134.

³ The milder spring/summer wave of the 1918 influenza pandemic has become known as the ‘herald wave’. See, N. P. Johnson and J. Mueller, ‘Updating the accounts: Global mortality of the 1918-1920 ‘Spanish’ influenza pandemic,’ *Bulletin of the History of Medicine*, 76 (2002), 105-115.

⁴ Johnson & Mueller, p. 107.

⁵ H. Phillips, ‘The Recent Wave of ‘Spanish’ Flu Historiography,’ *Social History of Medicine*, 27 (2014), 789-808.

⁶ Phillips, ‘The Recent Wave,’ p. 790.

⁷ Phillips, ‘The Recent Wave,’ p. 790.

⁸ J. P. Dickin McGinnis, ‘The impact of epidemic influenza: Canada, 1918-1919,’ *Historical Papers/Communications historiques* 12, no. 1 (1977), 120-140.

⁹ E. Pettigrew, *The silent enemy: Canada and the deadly flu of 1918* (Saskatoon: Western Producer Prairie Books, 1983).

entered a “second wave” of historiography. Research has diversified, focusing on different regions of Canada from the remote Northern communities of Norway House, Oxford House and God’s Lake in Manitoba,¹⁰ to Newfoundland,¹¹ New Brunswick,¹² Saskatchewan,¹³ British Columbia,¹⁴ Quebec,¹⁵ and Ontario,¹⁶ reflecting the geographic heterogeneity of the pandemic experience.¹⁷ The connections between the spread of pandemic influenza and the movements of soldiers at the expense of public health,¹⁸ the gendered roles of women volunteers, along with the salient issues of social class, racism and quarantine, have become part of the expanding scope of research on the Canadian experience.¹⁹ Other scholars have taken up questions regarding the syndemic nature of influenza,²⁰ why certain individuals were more likely to die during the 1918 pandemic,²¹

¹⁰ L. Sattenspiel and D. A. Herring, ‘Simulating the effect of quarantine on the spread of the 1918-19 flu in central Canada,’ *Bulletin of Mathematical Biology*, 65 (2003), 1-26.

¹¹ L. Sattenspiel, ‘Regional Patterns of mortality during the 1918 influenza pandemic in Newfoundland,’ *Vaccine*, 29 (2011), B33-37.

¹² J. E. Jenkins, ‘Baptism of fire: New Brunswick’s public health movement and the 1918 influenza epidemic,’ *Canadian Bulletin of Medical History/Bulletin canadien d’histoire de la médecine*, 24 (2007), 317-342.

¹³ M. K. Lux, ‘The Bitter Flats: The 1918 influenza Epidemic in Saskatchewan,’ *Saskatchewan History*, 49 (1997), 3-13.

¹⁴ M. E. Kelm, ‘British Columbia First Nations and the Influenza Pandemic of 1918-19,’ *BC Studies*, 122 (1999), 23-48.

¹⁵ S. Zhang, et al., ‘Transmissibility of the 1918 pandemic influenza in Montreal and Winnipeg of Canada,’ *Influenza and other respiratory viruses*, 4 (2010), 27-31.

¹⁶ D. A. Herring and S. Carraher, eds., *Recurrence and resilience: the third wave of the 1918-19 influenza pandemic in Hamilton* (Hamilton: McMaster University Department of Anthropology, 2010).

¹⁷ Sattenspiel, ‘Regional Patterns of mortality,’ p. B36.

¹⁸ M. O. Humphries ‘The Horror at Home: The Canadian Military and the ‘Great’ Influenza Pandemic of 1918.’ *Journal of the Canadian Historical Association*, 16, no. 1 (2005), 235-260.

¹⁹ E. W. Jones ‘Co-operation in an All Human Endeavour’: Quarantine, and Immigrant Disease Vectors in the 1918-1919 Influenza Pandemic in Winnipeg,’ *Canadian Bulletin of Medical History/Bulletin canadien d’histoire de la médecine*, 22 (2005), 57-82; M. O. Humphries, *The last plague: Spanish influenza and the politics of public health in Canada*, (Toronto: University of Toronto Press, 2013).

²⁰ D. A. Herring and L. Sattenspiel, ‘Social contexts, syndemics, and infectious disease in northern Aboriginal populations,’ *American Journal of Human Biology*, 19 (2007), 190-202.

²¹ D. A. Herring and E. Korol, ‘The north-south divide: Social inequality and mortality from the 1918 influenza pandemic in Hamilton, Ontario,’ in *Epidemic Encounters: Influenza, Society and Culture in Canada, 1918-20* ed. by Magda Farni and Esyllt W. Jones (Vancouver: UBC Press, 2013), p. 97-112.

and the links between public health approaches during pandemic influenza in 1918 and SARS in 2003.²²

Most of the literature thus far has centered on understanding the experience of the second, deadly wave of the 1918 pandemic. Almost nothing has been written about the first and third waves of the pandemic in Canada, despite the recognition that the three waves, and the impact they had on sickness and death, were inextricably linked.²³ The purpose of this paper is to contribute new evidence for the presence of influenza among soldiers of the Canadian Expeditionary Force (CEF) prior to the deadly outbreak in the fall of 1918. Focusing on sickness and death among the CEF troops during the summer of 1918, this study supports the analyses of Humphries,²⁴ Rewegan et al.²⁵ and Korol²⁶ which indicate that pandemic influenza was circulating in Canada well before the fall wave erupted in September of 1918.

This discussion is based on military and government correspondence regarding influenza, the daily logs of troopships transporting soldiers to Europe, and data on soldier mortality collected from the Commonwealth War Graves Commission's online database.²⁷ Analysis of these documents indicates that the extent of influenza in the

²² H. MacDougall, 'Toronto's health department in action: Influenza in 1918 and SARS in 2003,' *Journal of the History of Medicine and Allied Sciences*, 62 (2007), 56-89.

²³ Johnson & Mueller, p. 105, 107, 109.

²⁴ Humphries, 'The Last Plague,' p. 68-77.

²⁵ Rewegan et al., 'The First Wave of the 1918 Influenza Pandemic among Soldiers of the Canadian Expeditionary Force (CEF),' *American Journal of Human Biology* (February 2015). DOI: 10.1002/ajhb.22713, n.p.

²⁶ E. Korol, 'The 1918 influenza pandemic in Ontario: impact of the Herald Wave on autumn mortality,' (HSL Master's Thesis, McMaster University, 2011).

²⁷ Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, memorandum Outbreak of Influenza; Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12; Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150-1, 'Daily Orders' series, volume 274, file 'Hospital Ships'; 'Find War Dead,' Commonwealth War Graves Commission database on-line. <<http://www.cwgc.org/find-war-dead.aspx>>; 'Canada, War Graves Registers (Circumstances of Casualty), 1914-1948' <Ancestry.com > database on-line. Provo, UT, USA: Ancestry.com Operations, Inc. Original

summer of 1918, on non-military transports and among soldiers on troopships coming from Canadian military camps, has been underestimated. The evidence shows that influenza was firmly established in a number of Canadian ports, on several troopships and on non-military vessels in July and August of 1918. These findings suggest that the current understanding of the introduction of influenza to Canada from the USA in the fall of 1918 deserves reconsideration and further investigation.

The First and Second Waves of the 1918 Influenza Pandemic

In 1918, pandemic influenza circulated the globe in multiple waves.²⁸ In most places, this meant a mild, spring or summer wave, sometimes called a “herald” or first wave, which was followed by the severe fall wave, and often by a recurrence in the winter of 1918-19.²⁹ Scholars continue to debate the nature of the relationship between the different waves of the pandemic. Some argue that the virus causing the first wave of the pandemic was clinically and epidemiologically distinct from the strain that circulated in the fall of 1918, based on the lower mortality rates and lower rates of post influenza complications.³⁰ Others contend that the virus responsible for the first wave of influenza is closely related, if not the same as, the strain that circulated in the fall. Proponents of the latter hypothesis point to the unique age pattern of high mortality among young adults that has been identified in the first two waves of the pandemic in Copenhagen, Mexico,

data available at Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150, accession 1992-1993/314, file ‘War Graves Registration and Supporting Documentation’ Boxes 145–238.

²⁸ K. D. Patterson and G. F. Pyle, ‘The Geography and Mortality of the 1918 Influenza Pandemic,’ *Bulletin of the History of Medicine*, 65 (1991), 4-22; Johnson & Mueller, p. 105-115.

²⁹ Patterson & Pyle, p. 4-22; Johnson & Mueller, p. 105-115.

³⁰ D. S. Chertow et al., ‘Influenza circulation in United States Army Training Camps Before and During the 1918 Influenza Pandemic: Clues to early detection of pandemic viral emergence,’ *Open Forum Infectious Diseases* 2 (2015), 1-9.

New York and Newfoundland.³¹ Hospitalization records from 37 U.S. Army camps and from Britain also suggest that influenza infection in the spring conferred some form of protective immunity against both clinical illness and death during the fall wave, which indicates a close genetic relationship between the strains of influenza virus circulating during the two waves.³²

Further support for the close relationship between waves of the 1918 influenza pandemic comes from clinical, pathological, bacteriological and virological analyses of the virus obtained from the lung tissue of soldiers who died from influenza in the four months prior to, and during, the fall wave of the epidemic.³³ These tissue samples confirm that the same virus was responsible for the mild herald wave and the deadly fall wave of influenza, and that it was circulating in the United States throughout the spring and summer of 1918.³⁴

Early evidence for the emergence of the first, herald wave comes from reports that epidemic influenza was present among soldiers of the American Expeditionary Force at Camp Funston, Kansas, beginning 5 March 1918.³⁵ Further epidemics were reported among recently drafted recruits at that camp in April and May.³⁶ The subsequent rapid

³¹V. Andreasen, C. Viboud, and L. Simonsen, 'Epidemiologic characterization of the 1918 influenza pandemic summer wave in Copenhagen: implications for pandemic control strategies,' *Journal of Infectious Diseases*, 197 (2008), 270-278; Chowell et al., 'Mortality patterns associated with the 1918 influenza pandemic in Mexico: evidence for a spring herald wave and lack of pre-existing immunity in older populations,' *Journal of Infectious Diseases* 202 (2010), 567-75; Olson et al., 'Epidemiological evidence of an early wave of the 1918 influenza pandemic in New York City,' *PNAS* 102 (2005), 11059-11063; Sattenspiel, 'Regional Patterns of mortality,' p. B35.

³²J. M. Barry, C. Viboud and L. Simonsen, 'Cross-Protection between Successive Waves of the 1918-1919 Influenza Pandemic: Epidemiological Evidence from US Army Camps and from Britain,' *Journal of Infectious Diseases* 198 (2008), 1427-34.

³³Z. M. Sheng, et al., 'Autopsy series of 68 cases dying before and during the 1918 influenza pandemic peak,' *Proceedings of the National Academy of Sciences of the United States of America* 108 (2011), 16416-16421.

³⁴Sheng et al., p. 16416-16421.

³⁵W. T. Vaughn, 'Influenza: An Epidemiological Study,' *American Journal of Hygiene*, Monograph Series (1921), p.70.

³⁶Vaughan, p.70.

spread of this first wave of influenza through other United States army camps is well documented.³⁷ The Fort Oglethorpe camps in Georgia, for example, reported 1468 cases sent to hospital, with 2900 cases in total occurring in an epidemic of influenza that began on 18 March 1918. Camp Sevier, South Carolina was the site of a similar epidemic, beginning 28 March 1918. The American Public Health Reports mention 18 cases and 3 deaths from a severe outbreak of influenza at Camp Haskell, Kansas on 30 March 1918. Camp Shelby, Mississippi, experienced about 2000 cases of influenza in April 1918.³⁸ A retrospective examination of influenza mortality from New York City Department of Health Records indicates that a wave of influenza occurred in the city between February and April 1918, indicating that the disease was not limited to military camps and that it had spread to the civilian population.³⁹

Writing in the immediate aftermath of the pandemic, W.T Vaughan described the first wave of pandemic influenza spreading across the United States and Europe, but does not mention Canada until the discussion turns to September 1918.⁴⁰ Canadian historians, including Sir Andrew MacPhail, also make no mention of influenza spreading in Canada in the spring or summer of 1918.⁴¹ The available data on the herald wave of influenza in Canada is scarce, since influenza was not a reportable disease in most provinces and municipalities until the fall of 1918.⁴² In spite of this limitation, there is a growing body of evidence that Canadians did not escape the spring wave of influenza.

³⁷ Barry et al., p.1427-1434.

³⁸ Vaughan, p.70-72.

³⁹ Olson et al., p.11059-11063.

⁴⁰ Vaughan, p. 58-65.

⁴¹ A. MacPhail, *Official History of the Canadian Forces in the Great War: The Medical Services* (Ottawa: F.A. Acland, 1925), p. 316-320.

⁴² J. McCullough, 'The Control of Influenza in Ontario,' *Canadian Medical Journal* (1918), 1084-1086.

Among soldiers in Canada, at least four military hospitals registered heightened numbers of admissions for influenza and pneumonia between February and April 1918.⁴³ Soldiers across the Province of Ontario experienced heightened morbidity, but low mortality, during the first wave of the pandemic. Deaths from pneumonia and influenza (P & I) rose significantly among soldiers of the CEF between March and April of 1918, affecting soldiers in the Central and Maritime regions of Canada.⁴⁴

Among civilians in Canada, Humphries notes that the public health records for British Columbia and Toronto point to heightened admissions for influenza-like illnesses in the first half of 1918.⁴⁵ A retrospective analysis of the Ontario Death Registry for 1918 also suggests a herald wave of influenza and pneumonia occurred in several communities, including the major urban centres of Toronto, Ottawa and Hamilton in April and May 1918. Some communities also experienced peaks, or secondary peaks, in influenza and pneumonia mortality in June, July and August.⁴⁶ Since the disease was very mild, caused few deaths, and was not reportable in most municipalities until the autumn,⁴⁷ it is likely that influenza simply escaped notice. The summer is not typically influenza season in Canada⁴⁸ and, coinciding as these deaths did with the circulation of the first wave of pandemic influenza in the United States, England and Newfoundland,⁴⁹ it is likely that pandemic influenza was present. The impact of the herald wave on mortality, however, has been reported as almost negligible.⁵⁰

⁴³ Humphries, 'The Last Plague,' p. 74-76.

⁴⁴ Rewegan et al., n.p.

⁴⁵ Humphries, 'The Last Plague,' p. 73-74.

⁴⁶ Korol, 'The 1918 influenza pandemic in Ontario.'

⁴⁷ Humphries 'The Last Plague,' p. 72.

⁴⁸ Barry et al., p.1427-1434; Sheng et al., p. 16416-16421.

⁴⁹ Olson et al., p.11059-11063; Barry et al., p.1427-1434; Sattenspiel, 'Regional Patterns of mortality,' p. B35.

⁵⁰ Korol, 'The 1918 influenza pandemic in Ontario,' p. 63.

By the end of April and May 1918, the first wave of the flu pandemic emerged among American troops stationed in France,⁵¹ where it spread to other armies. Initially labelled as ‘PUO’, pyrexia of unknown origin,⁵² by mid-May PUO was recognized to be a mild form of influenza,⁵³ identified by a high fever that lasted for several days, body aches, muscle and joint pain, headache, sore throat, sometimes leading to bleeding of the nasal membranes, and a cough that sometimes produced a thin, brownish mucus. In June and July of 1918, influenza epidemics were reported at several training camps in Britain, including the No. 12 Canadian General Hospital, attached to the Canadian training facility at Bramshott Camp.⁵⁴ This was an important site for training Canadian troops in Britain.⁵⁵ Port cities with military and naval installations, such as Liverpool, Southampton and Portsmouth, were among the first in Britain to report influenza epidemics in June; the disease soon became widespread across the country.⁵⁶

⁵¹ W.S. Thayer, ‘Discussion on Influenza,’ *Proceedings of the Royal Society of Medicine*, 12, Gen Rep (1919), 28.

⁵² D. A. Herring, and J. Padiak, ‘The geographical epicentre of the 1918 influenza pandemic,’ in *Written in Bone*, ed. by M. Smith and M. Brickley (London: Archaeopress, 2008), p. 1-18.

⁵³ B. Soltau, ‘Note on a mild Pyrexial Epidemic, Resembling Influenza,’ National Archives of the United Kingdom (May 12, 1918), WO 95 47. Quoted in Herring & Padiak, p. 4.

⁵⁴ O. H. Gotch, and H. E. Whittingham, ‘A REPORT ON THE ‘INFLUENZA’ EPIDEMIC OF 1918,’ *British Medical Journal* 2.3004 (1918), 82; as well as, C.E C. Cole, ‘Preliminary Report On The Influenza Epidemic At Bramshott In September-October, 1918,’ *British Medical Journal* 2.3021 (1918), 566; T.R Little, C. J. Garofalo, and P. A. Williams. ‘THE ABSENCE OF THE BACILLUS INFLUENZÆ IN THE EXUDATE FROM THE UPPER AIR-PASSAGES IN THE PRESENT EPIDEMIC,’ *The Lancet*, 192.4950 (1918), 34.

⁵⁵ D. Love, *‘A Call to Arms’ The Organization and Administration of Canada’s Military in World War One* (Winnipeg: Bunker to Bunker Books, 1999).

⁵⁶ Vaughan, p.75-6; and Library and Archives of Canada (LAC), Department of Health fonds, ‘Laboratory Centre for Disease Control’ series, file ‘Epidemiology – Miscellaneous influenza in Canada’, the Ministry of Health’s ‘Memorandum on Prevention of Influenza’.

Throughout the summer, influenza and pneumonia appeared on ships in North American ports.⁵⁷ Medical authorities at the time, such as Soper,⁵⁸ were of the opinion that the fall wave of influenza was brought on these ships from Europe to port cities in the United States, where it spread throughout the summer. More recently, historians have argued that influenza did not spread inland in the United States that summer. Instead, as Alfred Crosby maintains, the virus mutated to become more virulent, and a second wave of the 1918 flu pandemic arrived in North America in Boston, Massachusetts on 27 August at the Receiving Ship at Commonwealth Pier.⁵⁹ The disease then spread rapidly among the soldiers on the overcrowded Receiving Ship; within two weeks 2,000 soldiers in the First Naval District had come down with influenza.⁶⁰

The eruption of the second, deadly wave of influenza and its spread in Canada have also been linked to the movement of soldiers, although authorities disagree on when and how the disease arrived. Prior to the last decade, the fall wave of flu was generally understood to have been brought to Canada in the first half of July 1918 by soldiers returning from the European theatre on board the hospital ship *HMS Araguaya*, and

⁵⁷The *City of Exeter* arrived in Philadelphia from Liverpool on 22 June 1918, and 28 of the crew were taken to a civilian hospital inland. In June 1918, there were 76 cases of influenza on board the *USS Tallahassee* in Key West. The troopship, *Khiva*, also originating from Liverpool, experienced an outbreak of 'Spanish influenza', where thirty cases of influenza occurred prior to arrival in New York on 7 July (having stopped in Halifax first in order to avoid attack by a pursuing submarine). In August, the *New York Times* reported that the ships *Rochambeau* and *Nieuw Amsterdam* also experienced epidemics of influenza onboard. Likewise, the *Bergensfjord* arrived in New York en route from Norway (also having stopped in Halifax 5 August 1918) with cases that appeared throughout the voyage. Crosby, p. 29; G. A. Soper, 'The pandemic in the Army camps,' *Journal of the American Medical Association* 71, no. 23 (1918), 1907; *Annual Report of the Secretary of the Navy, 1919 -- Miscellaneous Reports* (Washington: Government Printing Office, 1919), 2414-2506; 'Canadian Passenger Lists, 1865-1935,' *Bergensfjord Passenger List, Halifax, Nova Scotia, 5 August 1918*, Ancestry.com [database on-line]. Provo, UT, USA: Ancestry.com Operations Inc, 2010. Original data source: Library and Archives Canada (LAC), Department of Employment and Immigration fonds, RG 76-C, 'Records of Entry' series, 1865-1935, microfilm T-479 to T-520, T-4689 to T-4874, T-14700 to T-14939, C-4511 to C-4542.

⁵⁸Soper, 'The Pandemic in Army Camps,' p.1907.

⁵⁹Crosby, p.39; C. Byerly, *Fever of war: the influenza epidemic in the US Army during World War I*, (New York: NYU Press, 2005), p. 73-74.

⁶⁰Crosby, p.39.

among the crews of the troopships *Nagoya* and *Somali*.⁶¹ Mark Humphries has argued, however, that influenza could not have spread from soldiers arriving from overseas since the *Araguaya* was the only hospital ship to ferry sick soldiers across the Atlantic in the summer of 1918, and the *Nagoya* and *Somali* were preparing to transport soldiers to Europe. Instead, he presents evidence that influenza was introduced to Canada in September by infected American soldiers headed to Ontario and Quebec for training and transport overseas, and by civilians destined for a Eucharistic congress in Quebec. Canadian soldiers, mobilizing for the Siberian and Canadian Expeditionary Forces (CEF), then carried the disease across the country.⁶² Humphries's theory also includes the idea that the virus mutated during the summer and re-appeared in a more virulent form in September, which is thought to explain the heightened mortality experienced during the second wave of the pandemic.⁶³

A Maritime Epidemic: Evidence for Influenza in Canada in the Summer of 1918

Most histories tracing the spread of influenza in Canada begin with the hospital transport ship *Araguaya*, which arrived in Halifax on 7 July 1918.⁶⁴ The *Araguaya* began loading invalid soldiers at Liverpool on 26 June 1918. The Officer Commanding (O.C) Troops and several officers onboard were ill with "PUO resembling influenza".⁶⁵ The hospital ship loaded 763 soldiers, including 13 officers and other ranks, 40 "mentals", 48

⁶¹Dickin McGinnis, p. 120-140; Pettigrew, p.8.

⁶² Humphries, 'The Horror at Home,' p. 235-260.

⁶³ Humphries 'The Last Plague,' p. 90.

⁶⁴Dickin McGinnis, p. 122; Pettigrew, p.8; Humphries, 'The Horror at Home' p. 239; and Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12, cable from Major General Jones (Halifax) to F. Montizambert, 8 July 1918.

⁶⁵ See Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 9 III-D-3, 'Canadian War Records Office' series, volume 5055, file 955 'Araguaya War Diary', p. 1-4, Confidential War Diary HM Hospital Ship 'Araguaya', 26 June – 9 September 1918.

“neurologicals”, 39 amputations and 77 patients with TB.⁶⁶ The other 546 patients on board were suffering from various conditions, which included gunshot wounds, venereal disease and other traumatic injuries.⁶⁷ On 27 June 1918, the *Araguaya* proceeded to sea, where more officers, patients, and crewmembers contracted influenza.⁶⁸ The disease spread rapidly among the convalescent troops, with incidence peaking on 1 July 1918, with 31 new cases of PUO.⁶⁹

By the time the *Araguaya* docked at Pier 2 in Halifax on 7 July 1918 after 11 days at sea, there were 175 cases of influenza onboard.⁷⁰ The hospital ship was quarantined overnight, and double guards were placed on the gangway to enforce the quarantine.⁷¹ On 8 July 1918, partial debarkation of invalid soldiers to the Clearing Hospital at Pier 2 took place,⁷² probably because there was only sufficient room in the Clearing Hospital for 700 individuals, and insufficient space for segregating patients.⁷³ Soldiers with influenza, tuberculosis, venereal disease and mental illness were left on the *Araguaya* until the quarantine was raised at noon on 10 July 1918.⁷⁴ This did not mark the end of influenza cases, however, as the O.C Troops relapsed with PUO on 12 July 1918.⁷⁵

⁶⁶ LAC, RG 9 III-D-3, Vol 5055, File 955.

⁶⁷ LAC, RG 9 III-D-3, Vol 5055, File 955.

⁶⁸ LAC, RG 9 III-D-3, Vol 5055, File 955.

⁶⁹ LAC, RG 9 III-D-3, Vol 5055, File 955.

⁷⁰ The telegram from Major General Jones to F. Montizambert notes that 23% of those on board the *Araguaya* were affected by influenza, which according to the *Araguaya*'s War Diary would be about 175 individuals out of a total of 763. LAC, RG 29, Vol 300, File 416-2-12; LAC, RG 9 III-D-3, Vol 5055, File 955.

⁷¹ LAC, RG 9 III-D-3, Vol 5055, File 955.

⁷² LAC, RG 9 III-D-3, Vol 5055, File 955.

⁷³ Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, letter 0-2-33 re: Epidemic of P.U.O resembling Influenza among patients aboard Hospital Ship *Araguaya*, A.D.M.S Embarkation to Director General of Medical Services, 7 July 1918.

⁷⁴ LAC, RG 9 III-D-3, Vol 5055, File 955.

⁷⁵ LAC, RG 9 III-D-3, Vol 5055, File 955.

At almost the same time as the *Araguaya* arrived in Halifax, the *Nagoya* and *Somali* gained the attention of military officials in Montreal's harbour because of the presence of influenza among their crews.⁷⁶ The *Somali* was expected to carry Canadian troops overseas on 12 July, but, on 11 July was sent instead to the quarantine station at Grosse Isle, Quebec for disinfection and fumigation.⁷⁷ Dr. Martineau, the Inspecting Physician at Grosse Isle, reported on 13 July there were 16 new cases of influenza from the *Somali*, making a total of 72 under quarantine in the hospital.⁷⁸ The *Nagoya* arrived in Montreal on 4 July and was slated to carry American soldiers overseas from Montreal on 12 July, but was quarantined instead.⁷⁹ The 100 sick mariners on board were treated in unnamed civilian hospitals in Montreal.⁸⁰ The quarantine of the *Nagoya* and *Somali* delayed the embarkation of troops from Quebec until 21 July 1918 and final embarkation from Halifax until at least 24 July.⁸¹

Unable to ignore the presence of influenza, by 22 July 1918 Dr. Montizambert, Director General of Public Health in charge of quarantine, advised quarantine officials that the "Spanish influenza" was now a reportable, quarantinable disease at quarantine

⁷⁶ Humphries, 'The Horror at Home,' p. 235-260.

⁷⁷ Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, Memo 4-21-85 S. W. Morres Commander Naval Secretary to Military Secretary Interdepartmental Committee, 10 July 1918; Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, letter 54-5-69_a OUTBREAK OF INFLUENZA, Transports in Port – Montreal, Lt Col Piche, A/D.O.C to Secretary Militia Council, 9 July 1918.

⁷⁸ Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12, telegram Dr. Martineau to W.W Cory Esq Grosse Isle Quebec, 12 July 1918.

⁷⁹ LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter 54-5-69_a; Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, 'Royal Canadian Navy Headquarters Central Registries' series, volume 3729, file 1048-21-90 'Somali, Ship Details'.

⁸⁰ LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter 54-5-69_a.

⁸¹ LAC, RG 24, Vol 3729, File 1048-21-90.

stations in Canada.⁸² After discussing influenza on board these three troopships and the federal recognition of influenza as a reportable disease, Canadian histories move on to discuss the more deadly fall wave of influenza.⁸³

Military and government reports, correspondence, and daily logs

However, military and government correspondence suggests that influenza, in fact, was present on other ships in the summer of 1918 and was not limited to the *Araguaya*, *Nagoya* and *Somali*.⁸⁴ Early in July 1918, a number of other ships were under the scrutiny of military officials in Montreal. On 9 July 1918 the Deputy Director-General of Medical Services (DDGMS) received a telephone call from Assistant Director of Medical Services (ADMS) for Military District 4, notifying him that an epidemic of influenza had broken out among the crews of several steamships in the Port of Montreal.⁸⁵ In addition to the *Nagoya* and *Somali*, military officials were concerned about influenza on the troop transports *Montaban*, *Agana* and *Commonwealth*, as well as another un-named ship in Montreal's harbour.⁸⁶

The *Agana* was scheduled to carry American troops overseas from Montreal.⁸⁷ En route to Europe, it was common practice for sick recruits (American or Canadian) to be

⁸² See for example, Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12, letter Director General of Public Health to G.E. Martineau, 22 July 1918.

⁸³ For a discussion of influenza on troopships in the fall, see M.O. Humphries, 'The Limits of Necessity: Public Health, Dissent, and the War Effort during the 1918 Influenza Pandemic,' in *Epidemic Encounters: Influenza, Society and Culture in Canada, 1918-20*, ed. by Magda Farni and Esyllt W Jones (Vancouver: UBC Press, 2013) p. 21-47; for more details on the fall wave of the pandemic throughout Canada, see Pettigrew, 'The silent enemy,'; McGinnis, 'The impact of epidemic influenza,' p.122-140.

⁸⁴ LAC, RG 24, volume 2557, file HQS 2529; LAC, RG 29, volume 300, file 416-2-12.

⁸⁵ Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, memorandum Outbreak of Influenza, Troopships Montreal, from D.D.G.M.S to A/A.G, 9 July 1918.

⁸⁶ LAC, RG 24, Vol 2557, File HQS 2529 – File Part 1, memorandum Outbreak of Influenza; Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, letter 54-5-69b, Outbreak of Influenza, Transports in Port – Montreal from Major A. Hutchinson Lt. Col. A/D.O.C. to Secretary Militia Council, 11 July 1918.

⁸⁷ LAC, RG 24, Vol 2557, File HQS 2529 - Vol 1, letter 54-5-69a.

left at Canadian ports of embarkation, since it was the last stop prior to final embarkation for Europe. For example, the Port of Halifax was overwhelmed in the summer of 1918 when 5000 U.S. troops and a whole ship load were suddenly disembarked suffering from influenza.⁸⁸ It is unclear how many cases occurred on the *Agana*, but the ship was being monitored after the discovery of four cases of influenza on 6 July 1918.⁸⁹ Likewise, the *Commonwealth* and *Montaban* apparently reported cases on the trip to Canada across the Atlantic, but had developed no new cases after coming under the attention of the ADMS.⁹⁰ To address the threat of epidemic influenza on troopships, the Director General of Medical Services and the Chief of General Staff agreed on 12 July 1918 that, prior to embarking troops, 5 days should elapse after the last case of influenza developed.⁹¹ This directive was confirmed by 20 July 1918.⁹² The creation of this directive suggests that, prior to the summer of 1918, influenza on troopships had not been perceived to be a significant problem for Canadian soldiers embarking for Europe, since there appears to have been no military policy regarding influenza on troopships to this point.

Unofficial reports also stated that freighters in Montreal's harbour were stricken with influenza⁹³ and Dr. Martineau's telegraphs from Grosse Isle support the idea that military transports were not the only ships passing through the St. Lawrence from Europe with influenza cases on board. On 13 July 1918, the steamer *Rajno* from Liverpool was

⁸⁸ S. M. Hunt, *Nova Scotia's part in the Great War* (Halifax: Nova Scotia's Veteran Pub. Co., 1920), p. 7.

⁸⁹ LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter 54-5-69a.

⁹⁰ LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter 54-5-69a.

⁹¹ Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, letter R.A.S Vilnier Brigadier General for the Chief of General Staff to Quartermaster General, 12 July 1918.

⁹² LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter R.A.S Vilnier; Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, letter Major General for acting Director General of Medical Services for Adjutant General to O.C Clearing Service Command, 20 July 1918.

⁹³ LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter 54-5-69a.

stopped after three deaths and 15 cases occurred on board.⁹⁴ Later, on the 16 and 17 July 1918, the steamships *Kaloo*, from Plymouth, and *Athol*, respectively, were stopped for disinfection.⁹⁵ Nearly everyone on board the *Kaloo* was reported to have had influenza in Plymouth, and some were reportedly convalescing on the voyage.⁹⁶ On 22 July 1918 Martineau detained the steamer *Fanad Head* from Pt. Talbot with four sick crewmembers, along with two crewmembers of the local steamer *Alice*.⁹⁷

While the *Araguaya* may have been the only hospital transport to return invalid soldiers to Canada in the summer of 1918, other non-hospital transports, such as the *Agana*, *Commonwealth* and *Montaban* reported cases of influenza en route to Canada that summer.⁹⁸ The *Nagoya* and *Agana* were scheduled to transport American troops from Montreal, indicating that the same military networks credited with spreading flu in the fall⁹⁹ were also present in the summer of 1918, when the disease was circulating in American Army Camps.¹⁰⁰ Other vessels not engaged in transporting troops, like *Rajno*, *Kaloo*, *Fanad Head* and *Athol*, arrived in Canada with influenza on board. Taken together, reports of influenza on these vessels emphasize that the maritime presence of influenza in Canada in the summer of 1918 was a more pressing issue than previously

⁹⁴ Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12, telegram J.E Martineau to F Montizambert Esq, Grosse Isle, Quebec, 13 July 1918.

⁹⁵ It should be noted that these cases of influenza were directly linked in these telegrams to the epidemic of influenza that was occurring in England at the same time, which was undoubtedly 'Spanish Influenza'; Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12, telegram Dr. Martineau to F Montizambert re. Steamship Athol, Grosse Isle, PQ, 17 July 1918; Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12, telegram to F Montizambert re. steamship Kaloo, 16 July 1918.

⁹⁶ LAC, RG 29, Vol 300, File 416-2-12, telegram re. steamship Kaloo.

⁹⁷ Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12, telegram G.E Martineau to F Montizambert, Grosse Isle PQ, 21 July 1918.

⁹⁸ LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter 54-5-69_a; LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter 54-5-69_b.

⁹⁹ Humphries, 'The Horror at Home,' p. 241.

¹⁰⁰ Sheng et al., p.16416-16421.

recognized. Because of cases on these ships, military officials suspected that the disease was brought to Canada from overseas ports¹⁰¹, but the foregoing discussion shows that Canadian ships also carried the disease overseas on several troopships.¹⁰²

Scrutiny of the daily logs of several Canadian transports reveals that cases and deaths due to influenza and pneumonia, a common complication of the 1918 flu pandemic often credited with heightening mortality,¹⁰³ occurred throughout the summer of 1918. The Adjutant, who was also often the Captain or O.C Troops, kept a daily record of promotions, disciplinary actions, admissions and discharges from the ship's hospital as well as a record of increases or decreases in the number of soldiers. Between 9 June and 25 August 1918, at least five troopships, *HMT Cassandra*, *HMT Nellore*, *HMT Pannonia*, *HMT Kia Ora* and *HMT Atreus* reported cases of influenza/pneumonia among the soldiers en route to England.¹⁰⁴

Of these outbound transports, the epidemic of influenza on *HMT Pannonia*, sailing from Halifax, was the most severe (Figure 1).¹⁰⁵ The Ship's Adjutant recorded 151 influenza and pneumonia cases on *HMT Pannonia*, and 83 soldiers were admitted to the ship's hospital before final embarkation on 4 August 1918.¹⁰⁶ By the time *HMT Pannonia* disembarked troops at Liverpool, four deaths from pneumonia had occurred, two while the ship was within the Port of Liverpool.¹⁰⁷ The other four transports reported

¹⁰¹ LAC, RG 24, Vol 2557, File HQC 2529 - Vol 1, letter 54-5-69_a.

¹⁰² LAC, RG 150-1, volume 274, file 'Hospital Ships'.

¹⁰³ John F. Brundage, G. Dennis Shanks, 'What really happened during the 1918 influenza pandemic? The importance of bacterial secondary infections,' *Journal of Infectious Diseases*, 196 (2007), 1717-1718.

¹⁰⁴ LAC, RG 150, Vol 274, File 'Hospital Ships'.

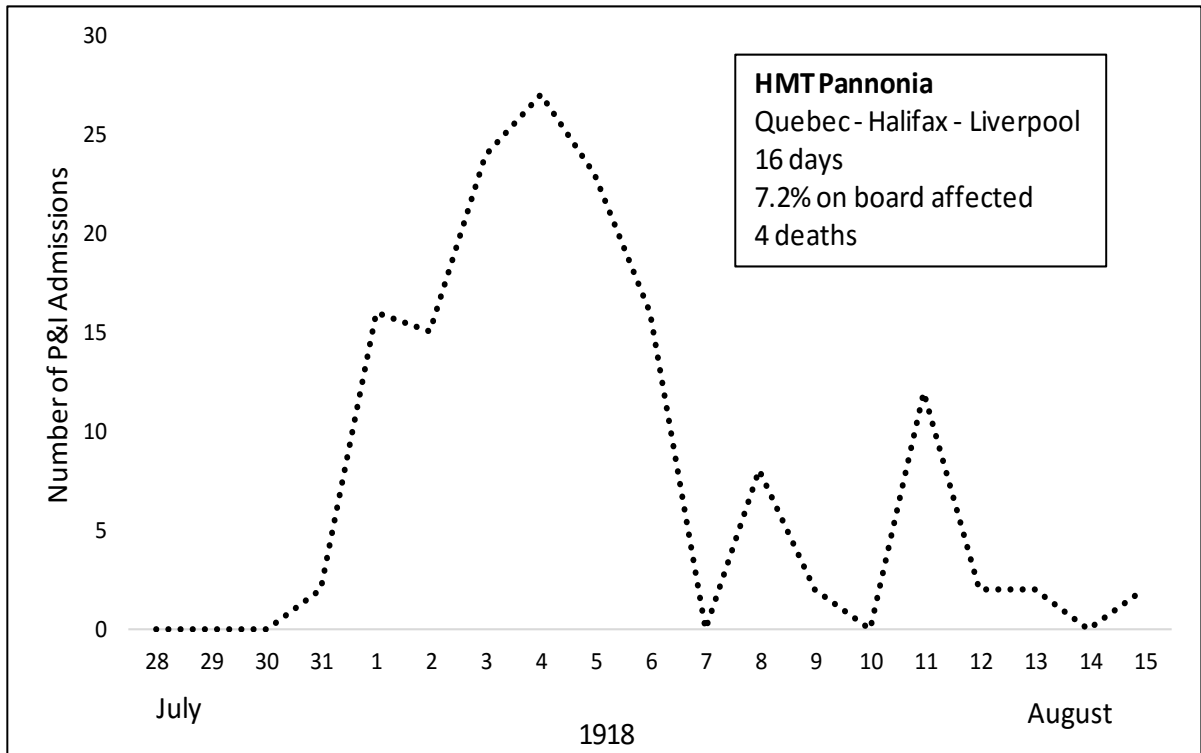
¹⁰⁵ Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150-1, 'Daily Orders' series, volume 274, file 'Hospital Ships', Daily Orders Part II HMT Pannonia, JFF Allen, Capt, Ship's Adjutant, 29 July – 15 August 1918; Library and Archives of Canada (LAC), Department of Veterans Affairs fonds, RG 38-D-10, 'War Service Records Division' series, volume 444, file 'Sailings from Canada to all Theatres First World War Canadian Expeditionary Force, File Part of War Service Records Divisions (R1183-30-5-E)'.

¹⁰⁶ LAC, RG 150, Vol 274, File 'Hospital Ships', Daily Orders Part II HMT Pannonia.

¹⁰⁷ LAC, RG 150, Vol 274, File 'Hospital Ships', Daily Orders Part II HMT Pannonia.

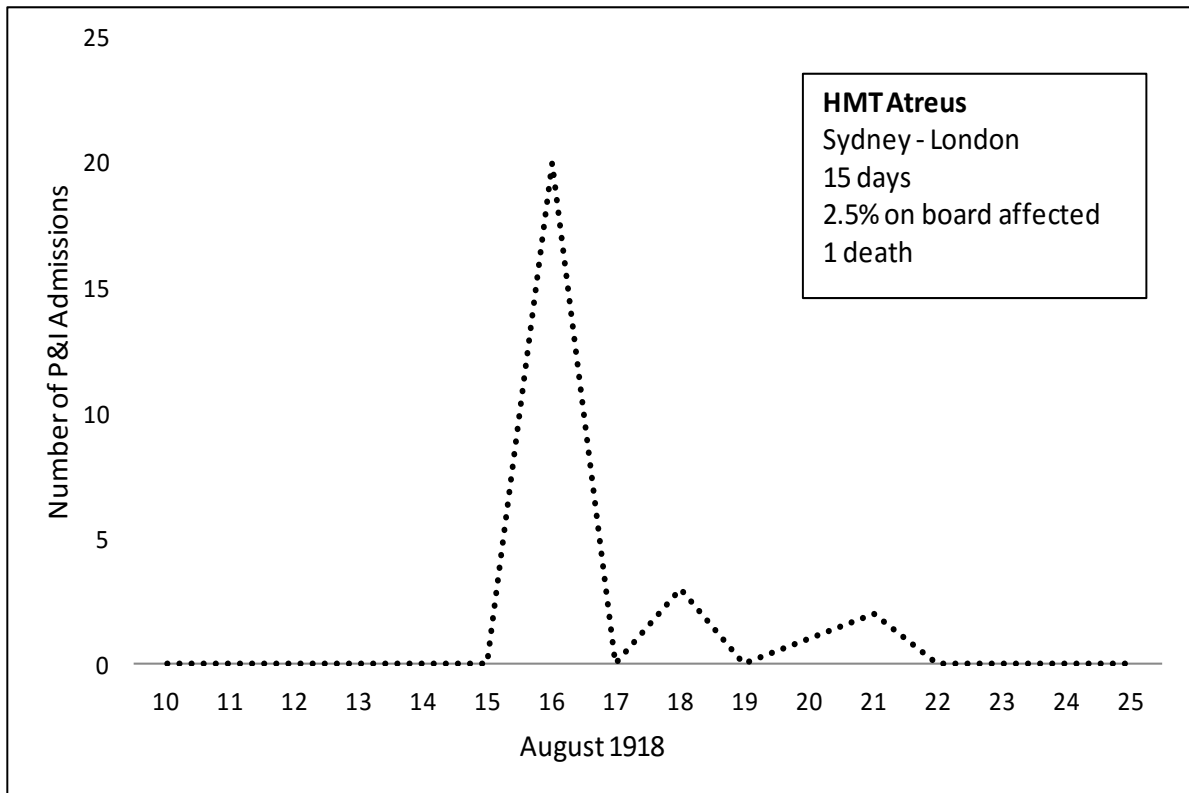
between 3 and 26 cases of influenza and pneumonia, with few deaths (Figure 2 and Table 1).¹⁰⁸ It is important to note that the soldiers on these troopships were coming from Canadian military camps, not from Europe.

Figure 1. Number of cases reported daily on *HMT Pannonia*, 28 July – 15 August 1918.



Source: Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150-1, 'Daily Orders' series, volume 274, file 'Hospital Ships', Daily Orders Part II HMT Pannonia, JFJ Allen, Capt, Ship's Adjutant, 29 July – 15 August 1918.

¹⁰⁸ LAC, RG 150, Vol 274, File 'Hospital Ships'.

Figure 2. Number of cases reported daily on *HMT Atreus*, 10 – 25 August 1918.

Source: Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150-1, 'Daily Orders' series, volume 274, file 'Hospital Ships', Daily Orders Part II HMT Atreus, R.D Blandford, Lieut., Ship's Adjutant, 10 – 25 August 1918.

Commonwealth War Graves Commission (CWGC) Records

Further evidence for pandemic influenza among soldiers in Canada during the summer of 1918 can be found in the records of the Commonwealth War Graves Commission (CWGC). The CWGC is a rich source of detailed information on all the soldiers from the Commonwealth who died in World War I and World War II. This information includes each soldier's name, date of death, regimental number, and place of

commemoration.¹⁰⁹ The CWGC website allows users to search by branch of military service, country of commemoration and dates of death.¹¹⁰ Searching the CWGC database for soldiers in the Canadian Expeditionary Force who were commemorated in Canada from 1 June to 31 August for 1917 and 1918 yielded a database of 485 deaths. In order to determine which deaths were caused by influenza and pneumonia, the records were manually linked using name, date of death and regiment numbers, to the Circumstances of Casualty database in Ancestry.com, which lists an exact cause of death.¹¹¹ Removing the records for soldiers commemorated on large memorials (e.g the Halifax Memorial) or who did not die in Canada (n=119), and those for whom a cause or place of death could not be established (n=90), resulted a final database of 276 soldiers who died in Canada during the summer months of 1917 and 1918.

A comparison of pneumonia and influenza mortality in the CEF for 1917 and 1918 is instructive. In the summer of 1917, pneumonia and influenza caused fewer than ten soldier deaths, whereas in 1918 this number increased five-fold to 40 deaths (Table 2). In 1917, influenza and pneumonia deaths represented under 7% of all deaths during the summer, whereas at the same time in 1918 these causes were responsible for nearly 25% of all deaths. A chi-square test for association comparing pneumonia and influenza and other causes of death for the two years shows that the high number of pneumonia and influenza deaths in the summer of 1918 is statistically significant ($X^2 = 14.94$, $p = 0.0001$). The difference in the number of soldier deaths in the two years suggests that influenza and pneumonia were not a significant problem among Canadian soldiers

¹⁰⁹ 'Find War Dead,' Commonwealth War Graves Commission database on-line. <<http://www.cwgc.org/find-war-dead.aspx>>

¹¹⁰ 'Find War Dead,' Commonwealth War Graves Commission.

¹¹¹ 'Canada, War Graves Registers (Circumstances of Casualty), 1914-1948' <Ancestry.com > database on-line. Provo, UT, USA: Ancestry.com Operations, Inc. Original data available at Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150, accession 1992-1993/314, file 'War Graves Registration and Supporting Documentation' Boxes 145-238.

training to embark overseas in the summer of 1917, but the situation had changed dramatically by the summer of 1918.

Shipboard cases of influenza were not confined to the transports, as sick soldiers and their contacts were discharged to military hospitals en route to the final embarkation points of Sydney and Halifax, Nova Scotia. For example, on 31 July 1918, one Private sick with pneumonia, and three others sick with mumps, were discharged from *HMT Pannonia* to the No. 6 Station Hospital in Halifax.¹¹² The transport was not quarantined and continued its journey overseas to England.¹¹³ Likewise, before *HMT Cassandra* left Canada on 6 June 1918, a soldier with influenza and another with pneumonia were discharged to the military hospital in Halifax.¹¹⁴ On the same day, another Private with septic pneumonia died in the ship's hospital.¹¹⁵

¹¹² LAC, RG 150, Vol 274, File 'Hospital Ships', Daily Orders Part II HMT Pannonia.

¹¹³ LAC, RG 150, Vol 274, File 'Hospital Ships', Daily Orders Part II HMT Pannonia.

¹¹⁴ Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150-1, 'Daily Orders' series, volume 274, file 'Hospital Ships', Daily Orders Part II HMT Cassandra, 5 June – 20 June 1918.

¹¹⁵ LAC, RG 150-1, Vol 274, File 'Hospital Ships', Daily Orders Part II No 14 HMT Cassandra.

Table 1. Summary of troopships reporting cases of influenza & pneumonia (P&I) in the summer of 1918.

Date	Vessel	Description of Route, Number of P&I Cases
6 June -14 June	<i>Cassandra</i>	Transporting Canadian soldiers to England. 13 cases of pneumonia/influenza on voyage.
7 July	<i>Araguaya</i>	Hospital transport quarantined in Halifax, arriving from Liverpool. 175 cases of influenza on board upon arrival in Halifax.
9 July	<i>Nagoya</i>	Crew only onboard, treated at civilian hospitals in Montreal. Preparing to carry American troops. 100 cases of influenza among personnel.
9 July	<i>Somali</i>	11 cases of influenza found 9 & 10 July in Montreal's harbour sent to Grosse Isle for quarantine 11 July 1918. Intended to carry Canadian troops from Quebec.
9 July	<i>Commonwealth</i>	Last case discharged 3 July under surveillance in Montreal's harbour. Had "a few" cases crossing the Atlantic from Liverpool, but no new cases after last discharge.
9 July	<i>Agana</i>	4 cases of influenza after 6 July under surveillance in Montreal's harbour. Intended to carry American troops.
9 July	<i>Montaban</i>	Had a couple of cases en route to Canada from England.
29 July – 9 August	<i>Nellore</i>	Transporting Canadian soldiers from Montreal, Quebec City & Halifax to England. Part of the same trans-Atlantic convoy as the <i>Pannonia</i> . Only 4 cases of pneumonia/influenza recorded.
29 July – 15 August	<i>Pannonia</i>	Transporting Canadian soldiers from Montreal & Halifax to England. Most cases occurred between Quebec City and Halifax. 151 cases of pneumonia/influenza, with 4 deaths.
10 – 25 August	<i>Atreus</i>	Transporting Canadian soldiers from Sydney to England. 26 cases of pneumonia/influenza, with 1 death.
10 – 25 August	<i>Kia Ora</i>	Transporting Canadian soldiers from Sydney to England. Only 3 cases pneumonia/influenza.

Source: Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150-1, 'Daily Orders' series, volume 274, file 'Hospital Ships'; Library and Archives Canada (LAC), Department of National Defence fonds, RG 24, '1903 Headquarters Central Registry' series, volume 2557, file HQS 2529 – File Part 1, memorandum Outbreak of Influenza; Library and Archives Canada (LAC), Department of Health fonds, RG 29, 'Laboratory Centre for Disease Control' series, volume 300, file 416-2-12.

Whether the infections aboard ship were mild with few cases, or deadly and frequent, the presence of influenza on these troopships places the disease in Canadian waters throughout the summer of 1918 (Table 2). Influenza was also on land in Canadian military camps as sick soldiers and their contacts were discharged to military and civilian hospitals in Canada prior to final embarkation for England.

Table 2. Summer mortality from influenza/pneumonia and other causes in the Canadian Expeditionary Force, 1917 & 1918.

June-August	1917		1918	
	Pneumonia/Influenza	Other Causes	Pneumonia/Influenza	Other Causes
Number of Soldier Deaths in Canada	8	107	40	121
Percent of Total	6.96	93.04	24.84	75.16

Source: 'Find War Dead,' Commonwealth War Graves Commission database on-line. <<http://www.cwgc.org/find-war-dead.aspx>>; 'Canada, War Graves Registers (Circumstances of Casualty), 1914-1948' <Ancestry.com > database on-line. Provo, UT, USA: Ancestry.com Operations, Inc. Original data available at Library and Archives Canada (LAC), Ministry of the Overseas Military Forces of Canada fonds, RG 150, accession 1992-1993/314, file 'War Graves Registration and Supporting Documentation' Boxes 145-238.

As the correspondence, military reports, ships' logs, and CWGC records have revealed, influenza was in Canada in the summer of 1918 – in Montreal's harbour, in civilian, military and quarantine hospitals, and on troopships leaving the country for Europe. Influenza cases were not limited to those reported on board the hospital ship *Araguaya* and the troopships *Nagoya* and *Somali*. The presence of influenza among soldiers on outbound troopships, and the high number of deaths among soldiers from pneumonia and influenza in the summer, demonstrates that pandemic influenza was

already present in Canadian military camps. The soldiers on board *HMT Pannonia*, for example, were being transported from Canadian military camps, including St. Jean, Quebec, as well as from London and Ottawa, Ontario, and the majority of cases of influenza occurred before the transport ever left Halifax.¹¹⁶

It is clear that influenza was also epidemic on board *HMT Atreus* and *HMT Pannonia*, consistent with outbreaks on other ships at the same time. Troopship epidemics followed a predictable course: the number of cases usually peaked in 3 to 10 days after the voyage began, with recurring secondary cycles of cases that correspond roughly to the four day serial interval of the disease.¹¹⁷ The epidemics on the *HMT Atreus* and *Pannonia* followed this pattern (Figures 1 & 2).

In the summer of 1918, influenza was clinically mild and caused very few deaths, at least compared to the fall wave of influenza.¹¹⁸ In the British Grand Fleet in Scotland, 11 per cent of sailors were affected by influenza-like illnesses between April and May 1918, whereas in the Imperial Japanese Navy, only 5 per cent of sailors were affected between April and July 1918. In the American and Royal British Navy, high mortality was limited to the fall wave of the pandemic.¹¹⁹ Likewise, during the fall of 1918, morbidity and mortality on Canadian troopships was much higher. When *HMT Hunstend*, *Victoria* and the *City of Cairo* left Canada for England, hundreds of soldiers became ill with influenza, and dozens died on the Atlantic crossing.¹²⁰ The crowded quarters on troopships during WWI were ideal for facilitating the spread of the disease.¹²¹

¹¹⁶ LAC, RG 150, Vol 274, File 'Hospital Ships', Daily Orders Part II HMT Pannonia.

¹¹⁷ M. Smallman-Raynor and A. Cliff, *War Epidemics: An Historical Geography of Infectious Diseases in Military Conflict and Civil Strife, 1850-2000* (Oxford: Oxford University Press 2004), p. 589.

¹¹⁸ LAC, RG 29, Vol 186, File 310-10-1; G. D. Shanks et al., 'Determinants of mortality in naval units during the 1918-19 influenza pandemic,' *Lancet Infectious Diseases* 11 (2011), 793-99.

¹¹⁹ Shanks et al., 'Determinants of mortality,' p. 793-794.

¹²⁰ Humphries 'The Limits of Necessity', p. 27-29.

¹²¹ Humphries 'The Limits of Necessity,' p. 29; and J. Summers, 'Pandemic Influenza Outbreak on a Troopship – Diary of a Soldier in 1918,' *Emerging Infectious Diseases*, 18:11 (2012), 1900- 1903.

The events on *HMT Pannonia* and *HMT Atreus* during the summer of 1918 foreshadowed the experience of Canadian soldiers on board *HMT Huntsend*, *Victoria*, and the *City of Cairo* in the following September and October. Once conditions onboard the *Huntsend*, *Victoria* and *City of Cairo* became known and a public outcry ensued, military officials held an inquiry. The outcome of the inquiry justified military officials' decision to put the war project ahead of the health of the soldiers. The military courts argued that troops were needed overseas, the epidemic was just as severe inland, and in light of "military exigency", there was little that could have been done to prevent these deaths.¹²² In contrast, the summer outbreak of influenza in the Port of Montreal and epidemics on board troopships like *HMT Pannonia* provoked no alarm and seem to have escaped notice altogether. Perhaps the summer troopship cases and deaths were overlooked because the disease appeared to be mild and, in line with the European summer wave and American spring wave of flu, there were far fewer fatalities resulting from the disease than later that fall.

Implications for the Deadly Fall Wave of the 1918 Influenza Pandemic

This research underscores the complex constellation of circumstances that likely contributed to the deadly fall wave of the 1918 influenza pandemic in Canada. As more is learned about the first wave of influenza, it is becoming more difficult to accept the idea that the deadly second wave of the disease was introduced to Canada in September of 1918. As was the case in the USA and elsewhere, epidemic influenza was already present in mild form in Canada during the spring,¹²³ and as this research demonstrates, the virus was also circulating during the summer of 1918: soldiers and civilians were falling sick and dying from it.

¹²² Humphries, 'The Limits of Necessity', p. 28-29.

¹²³ Korol, 'The 1918 influenza pandemic in Ontario,'; Humphries 'The Last Plague,' p. 68-90.

The importance of this ‘pre-seeding of the virus’¹²⁴ can be discounted by claiming that the heightened mortality from influenza during the fall wave occurred because the spring virus had mutated into a more deadly, virulent strain.¹²⁵ The genome of the 1918 influenza virus has been reconstructed and it was undoubtedly a virulent strain;¹²⁶ however, there is little genetic evidence to date to support the mutation theory. As discussed earlier in this paper, comprehensive analyses of tissue samples from American soldiers who died in the spring and fall waves of the 1918 influenza have failed to demonstrate that the strains associated with the first two waves of the pandemic were substantially different.¹²⁷ Taubenberger & Morens, moreover, have asked whether it is likely that such an evolutionary event could occur that quickly, observing that “Acquiring viral drift sufficient to produce new influenza strains capable of escaping population immunity is believed to take years of global circulation, not weeks of local circulation. And having occurred, such mutated viruses normally take months to spread around the world.”¹²⁸ Studies of historical documents in Europe and North America also indicate that exposure to the strain circulating during the first wave of the pandemic conferred cross-protection against the strain circulating during the fall wave.¹²⁹

¹²⁴ J.S. Oxford, ‘Influenza A pandemics of the 20th century with special reference to 1918: virology, pathology and epidemiology,’ *Reviews in Medical Virology* (2000) 10: 119-133.

¹²⁵ Crosby, p. 37; Humphries, ‘The Last Plague,’ p. 4, 93.

¹²⁶ D. Kobasa et al., ‘Enhanced virulence of influenza A viruses with the haemagglutinin of the 1918 pandemic virus,’ *Nature*, 431 (2004), 703-707; T. Tumpey et al., ‘Characterization of the reconstructed 1918 Spanish influenza pandemic virus,’ 310, *Science* (2004), 77-80; D. Kobasa et al., ‘Aberrant innate immune response in lethal infection of macaques with the 1918 influenza virus,’ 445, *Nature* (2007), 319-323.

¹²⁷ Sheng et al., p. 16416-16421.

¹²⁸ J. Taubenberger and D. Morens, ‘1918 Influenza: the mother of all pandemics,’ *Emerging Infectious Diseases*, 12 (2006), 17.

¹²⁹ V. Andreasen, C. Viboud, and L. Simonsen, ‘Epidemiologic characterization of the 1918 influenza pandemic summer wave in Copenhagen: implications for pandemic control strategies,’ *Journal of Infectious Diseases*, 197 (2008), 270-278; Barry et al., p.1427-1434; D. Rios-Doria and G. Chowell, ‘Qualitative analysis of the level of cross-protection between epidemic waves of the 1918-1919 influenza pandemic,’ *Journal of Theoretical Biology*, 261 (2009), 584-592; Korol, ‘The 1918 influenza pandemic in Ontario.’

Efforts to explain the high mortality associated with the fall wave of the 1918 pandemic have tended to place a great deal of weight on the influenza virus itself. Yet, as increasingly detailed and sophisticated studies are conducted on the genetics of pathogens, including the H1N1 virus associated with the 1918 pandemic,¹³⁰ the answer to why some epidemics have been especially deadly does not always lie solely in the pathogen. Recent research on pathogens, such as *Yersinia pestis* (the Black Death in medieval Europe), *Vibrio cholerae* (19th century epidemics of cholera in Philadelphia), and Influenza A H1N1 (1918 influenza pandemic) highlight the fact that genomic sequences may not reveal specific virulence signatures that explain high mortality.¹³¹ Not all questions can be answered based on examination of the pathogen;¹³² pathogens are necessary but not sufficient causes of epidemics. Even if the 1918 influenza pandemic virus mutated between the first and second waves of the pandemic, other host, social and environmental factors would still be part of the complex array contributing to the prevalence and severity of the outbreak.¹³³

In Canada, for example, the conditions created by WWI in the spring and fall of 1918 have been directly linked to the spread of the virus, as well as social conditions that may have increased morbidity and mortality; investigation of these underlying social determinants is warranted.¹³⁴ For instance, it was not the demobilization of troops from Europe that spread influenza (as once believed), but the *mobilization* of troops for the

¹³⁰ Kobasa et al., 'Enhanced virulence of influenza A viruses,' p.703-707; Sheng et al., p. 16416-16421; J. Taubenberger et al., 'Reconstruction of the 1918 influenza virus: unexpected rewards from the past,' *mBio*, 3 (2012), 1-5.

¹³¹ K. Bos et al., 'A draft genome of *Yersinia pestis* from victims of the Black Death,' *Nature*, 478 (2011), 506-510; Sheng et al., p. 16416-16421; A. Devault, 'Genomics of Ancient Pathogenic Bacteria: Novel Techniques & Extraordinary Substrates,' (PhD diss., McMaster University, 2014).

¹³² Taubenberger & Morens, '1918 Influenza,' p. 75.

¹³³ Taubenberger & Morens, '1918 Influenza,' p. 75; Bos et al., p. 506-510.

¹³⁴ Humphries, 'The Horror at Home,' p. 235-260; E. Jones, *Influenza 1918: Disease, Death, and Struggle in Winnipeg* (Toronto: University of Toronto Press, 2007); Herring & Korol, 'The North-South Divide,' p. 97-112.

Siberian Expeditionary Force and the movement of soldiers across Canada for the CEF.¹³⁵ Soldiers would have been especially vulnerable to influenza that was circulating at the time, in part, because the crowded living conditions in military camps facilitated the spread of all airborne infectious diseases. The composition of newly recruited soldiers in the CEF had also changed. In 1917, recruiting for the CEF had slowed to a near standstill (with fewer than 2000 soldiers per month volunteering for service in the entire country). However, in 1918 the enactment of the Military Service Act (MSA) meant that between April and July of 1918 the number of new recruits swelled to nearly 75,117.¹³⁶ Every aspect of recruits' lives was conducted en masse, including sleeping, eating, training, and entertainment.¹³⁷ Other factors that facilitated the spread of influenza from military camp to camp, and eventually to civilians, include rapid transport across the country via crowded troop trains and to Europe on troop ships.¹³⁸

Other demographic processes affected Canadians on the home front, along with the mobilization of troops. The war industry drew thousands of rural people into large urban centres.¹³⁹ Thousands of Canadian farmers were conscripted into the army after farmers' exemptions were revoked in April of 1918.¹⁴⁰ This may have had a significant effect on the transmission of influenza by introducing a huge number of susceptible

¹³⁵ Humphries, 'The Horror at Home,' p. 235-260.

¹³⁶ H. Machin, *Report of the director of the Military service branch to the Honourable the minister of justice on the operation of the Military service act, 1917*, (Ottawa: J. de L. Taché printer to the King, 1919), p. 88, 124.

¹³⁷ K. L. Bogaert, J. van Koeverden, D. A. Herring, 'Tracing "the Trail of Infected Armies": Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19' in *Lives in Transition: Longitudinal Analysis from Historical Sources*, ed. by P. Baskerville and K. Inwood (Kingston: McGill Queen's University Press, 2015), p. 274-291.

¹³⁸ Humphries, 'The Horror at Home,' p. 235-260; Humphries, 'The Limits of Necessity,' p. 27-29; Bogaert et al., p. 274-291.

¹³⁹ N. Dreisziger, ed., *Mobilization for Total War: The Canadian, American and British Experience 1914-1918, 1939-1945* (Waterloo: Wilfred Laurier University Press, 1981), p. 7.

¹⁴⁰ J. Granatstein and J. Hitsman, *Broken promises: A history of conscription in Canada* (Oxford: Oxford University Press, 1977).

individuals, civilian and military, to urban centres where they would have encountered pathogens to which they had not been exposed in a rural setting. During the 1890 Russian influenza pandemic, for example, rural towns at a distance from rail lines appear to have escaped the pandemic altogether; similarly, not all communities in Ontario experienced the first, herald wave of the 1918 influenza pandemic.¹⁴¹ This is important because people in rural communities may have lacked antibodies to the first wave of the 1918 influenza pandemic, and to other respiratory complications like bacterial pneumonia, and thus been more vulnerable to viral and bacterial strains circulating during the fall wave of the pandemic.¹⁴²

There is also a link between stress and a depressed immune response to pathogens like influenza.¹⁴³ Canadians were undoubtedly “war weary” from the war effort when the 1918 influenza pandemic struck, including the social stress of anxiety over family members whose lives were at risk overseas, inflation, coal shortages, and conscription.¹⁴⁴ Malnutrition has also been linked to increased susceptibility to infectious disease.¹⁴⁵ Canadians experienced food shortages because of the military’s demand for food for the troops abroad, and farm labour shortages on the home front compromised the nutritional status of many Canadians, which may have had serious consequences during the pandemic.¹⁴⁶

¹⁴¹ Korol, ‘The 1918 influenza pandemic in Ontario,’; D.A. Herring and S. Carraher, eds., *Miasma to Microscopes: The Russian Influenza Pandemic in Hamilton*, (McMaster University, 2011).

¹⁴² S. Mamelund, ‘Geography May Explain Adult Mortality from the 1918-20 Influenza Pandemic,’ *Epidemics*, 3 (2011), 46-60.

¹⁴³ S. Pressman et al., ‘Loneliness, social network size, and immune response to influenza vaccination in college freshmen,’ *Health Psychology*, 24 (2005), 27-306.

¹⁴⁴ S. Hallman, ‘The Effect of Pandemic Influenza on Infant Mortality in Toronto, Ontario, 1917-1921,’ (MA thesis, McMaster University, 2009); K. Slonim, “‘Send only your serious cases’ – delivering flu to Toronto: an anthropological analysis of the 1918-19 influenza epidemic in Toronto, Ontario, Canada,’ (PhD diss., University of Missouri – Columbia, 2010).

¹⁴⁵ P. Bhaskaram, ‘Micronutrient malnutrition, infection, and immunity: an overview,’ *Nutrition Reviews*, 60 (2002), 540-545.

¹⁴⁶ Slonim, p. 131.

The war effort also resulted in a widening of the gap between the developed and underdeveloped parts of Canada.¹⁴⁷ Low socioeconomic status, which characterized working class and immigrant neighbourhoods, was found to be inexorably linked to higher mortality in urban centres like Hamilton, Ontario and Winnipeg, Manitoba during the pandemic.¹⁴⁸ Coal shortages in the winter of 1918 would have further exacerbated the situation among the urban poor of the country.¹⁴⁹

Temperature and humidity can also have an effect on pandemic influenza transmission. During the 1918 influenza pandemic in England and Wales, for example, a 10° rise in temperature was estimated to have reduced the transmission rate of the disease by as much as 43%.¹⁵⁰ Weather may have enhanced the severity of the pandemic in Canada as well. When the fall wave of the pandemic erupted in southern Ontario, for example, the weather was miserable, unseasonably cold and made worse by frequent heavy rains.¹⁵¹ In fact, there were stark differences between August and September 1918 in this region. Temperatures reached an all time high in August for the period between 1917-1921; in contrast, September was the coldest and wettest month recorded in 79 years in parts of the province.¹⁵² Adding to this, crowding together indoors to avoid the cold and rain would have been another significant factor affecting the spread of an airborne infectious disease.¹⁵³

The structure of the school year may have facilitated the spread of the epidemic in the fall of 1918. School opening (for example, when children return to school in

¹⁴⁷ Dreisziger, p. 7.

¹⁴⁸ Jones, 'Influenza 1918: Disease, Death, and Struggle,'; Herring & Korol, 'The North-South Divide.'

¹⁴⁹ Slonim, p. 136.

¹⁵⁰ D. He et al., 'Inferring the causes of the three waves of the 1918 influenza pandemic in England and Wales,' *Proceedings of the Royal Society B*, 280 (2013) no. 1766.

¹⁵¹ Bogaert et al., p. 274-291.

¹⁵² Hallman, p. 22; Slonim, p. 137.

¹⁵³ Hallman, p. 22.

September) and closing (when children are let out of school for summer, Christmas and Easter holidays) have been found to be significant determinants of the spread of influenza during pandemics.¹⁵⁴ Other social distancing measures, including quarantine and the closing of churches and banning public gatherings, can also affect the transmission and spread of influenza.

Taken together with the genetic evidence that the spring/summer and fall strains were likely one and the same, and that a hyper-virulent strain of influenza was not suddenly introduced in the fall of 1918,¹⁵⁵ it is plausible that the founding influenza virus, which was mild, spread within the general population long before September.¹⁵⁶ This pre-seeding of the virus¹⁵⁷ may have helped capacitate the fall outbreaks initiated in September by American soldiers headed to Ontario and Quebec for training and transport overseas, and by civilians destined for a Eucharistic congress in Quebec.¹⁵⁸ The findings of this study challenge researchers to look more closely at the social and environmental circumstances¹⁵⁹ that faced soldiers and civilians on the home front during the twilight of World War I.

Acknowledgements

Thanks are owed to Dr. Ann Herring, Alex Rewegan and Melissa Yan, for their valuable discussion and comments, and for sharing their data on soldier mortality collected from the Commonwealth War Graves Registry. Tina Moffat and Mark Humphries's comments assisted greatly in improving this work. I would also like to

¹⁵⁴ D. He et al., 'Inferring the causes of the three waves.'; D. J. D. Earn et al., 'Effects of school closure on incidence of pandemic influenza in Alberta, Canada,' *Annals of Internal Medicine*, 156 (2012), 173-181.

¹⁵⁵ Sheng et al., p. 16416-16421.

¹⁵⁶ Sheng et al., p. 16416-16421.

¹⁵⁷ Oxford, p. 119-133.

¹⁵⁸ Humphries, 'The Horror at Home,' p. 235-260.

¹⁵⁹ D. He et al., 'Inferring the causes of the three waves.'

thank the family of Eileen Pettigrew for allowing access to her personal archives, which stimulated my interest on the topic of military transports and influenza. This research was funded in part by the McMaster Department of Anthropology Travel Funding, Ontario Graduate Scholarships and the Social Sciences and Humanities Research Council of Canada (#752-2013-2670).

CHAPTER 6: DISCUSSION AND CONCLUSIONS

The three papers that make up this thesis were inspired by three major questions:

1. In what ways did the war effort intersect with pandemic influenza to affect soldiers in the Polish Army Camp at Niagara-on-the-Lake, across Ontario, and on troopships bound for Europe? 2. What patterns of morbidity and mortality characterize the first two waves of the pandemic in Ontario's military hospitals? 3. Were all soldiers equally vulnerable to illness and death from influenza? Exploring these questions from a biocultural and syndemics perspectives in this thesis has produced a body of work that contributes to larger debates and discussions within anthropology and in the literature on the 1918 influenza pandemic.

One of the most heavily debated topics in the Canadian literature is the nature of the intersection between the 1918 influenza pandemic and the war effort. Humphries (2005; 2012) has argued that the need for soldiers overseas superseded concerns for the health of individual soldiers and civilians. Did the need for troops overseas trump concerns over individual soldier's health? Based on detailed ethnographic data collected on the experience of the fall wave of the pandemic at the Polish Army Camp at Niagara-on-the-Lake, and my examination of the pandemic on troopships in the summer of 1918, the answer to this question is equivocal – both yes and no – which I explain in greater depth below. I argue that any understanding of the pandemic requires considering how cultural understandings of disease shaped the military response to it, as illustrated by the way in which military authorities treated other infectious diseases in the CEF.

The findings of this research also speak to the debate about whether the 1918 influenza was a 'democratic disease' in which everyone was equally vulnerable to illness and death (Mamelund 2011; Herring and Korol 2012; Herring 2009). In this study, a

soldier's vulnerability proved to be mediated by several factors, including length of service in the CEF and geographic location. Influenza, like other infectious diseases, was and is not, a democratic disease. This observation has important implications for pandemic planning and vaccination strategies amidst the current pre-occupation with the coming plague, "viral panic", and recent initiatives aimed at developing a 'universal' influenza vaccine (Barry, Viboud, and Simonsen 2008; D. Herring 2009; Impagliazzo et al. 2015; Yassine et al. 2015). I expand on these themes below.

Pandemic Influenza and the War Effort in Canada

In Canada, historians have always linked the arrival of influenza in Canada with the movement of soldiers during WWI (Dickin-McGinnis 1977; Pettigrew 1983; Humphries 2005). Until 2005, in fact, Canadian histories had long maintained that pandemic influenza arrived in Canada with soldiers returning from the European theatre of war in July (Dickin-McGinnis 1977; Pettigrew 1983). Mark Humphries's (2005; 2013) research resulted in a significant shift in the narrative about the spread of influenza in Canada. Humphries (2005) argues that influenza did not spread from returning Canadian soldiers; rather, the disease spread from the U.S. along with American recruits headed for the Niagara-on-the-Lake training camp for the Polish Army in France, and with delegates to a Eucharistic congress in Québec (Humphries 2005). Using military hospital admission and discharge books from across the country, Humphries (2005) illustrates how, in September, the fall wave of the pandemic subsequently spread across Canada with soldiers headed to Europe and westward with the Siberian Expeditionary Force (SEF). Humphries (2012) argues that the need to ship soldiers overseas in the fall of 1918 trumped concerns over soldiers' and the public's health during the pandemic. In the fall of 1918 the Canadian military was focused on getting as many soldiers overseas

as quickly as possible to replace the devastating losses the CEF had suffered at the Second Battle of Ypres, Vimy Ridge and Passchendaele (Humphries 2012). Much of the research on this question in Canada has addressed on a national scale how the war effort and the actions of the CEF, or SEF, as a whole, influenced the spread of the 1918 influenza pandemic (Humphries 2005).

In Chapter 3 of this thesis, my research explored the intersection between the military and influenza on a local level, highlighting how the war effort was prioritized at the Polish Army Camp at Niagara-on-the-Lake, one of the epicenters of the fall wave of the pandemic in Canada. Military officials decided that stopping recruitment and the transport of recruits to Niagara-on-the-Lake (even recruits from places known to be experiencing influenza epidemics) would be too heavy a blow to the Polish Army in France. As a result, recruits continued to arrive at the camp from infected cities in the United States, and many were found to be sick with influenza upon arrival. Even after quarantine measures were implemented at the Polish Army Camp, they were ineffective and porous. Visiting military officials and hospital workers were allowed to enter and leave the camp – virtually ensuring that the epidemic would spread elsewhere.

On the other hand, the use of sealed military trains, and the fact that a quarantine was established at all, indicates clearly that authorities attempted to stop the spread of disease. Furthermore, once the influenza epidemic at the Polish Army camp was established, Lieut-Col. LePan worked tirelessly to ensure that sick recruits were well cared for in the camp hospital. He sought volunteer nurses to care for recruits and procured extra food supplies for the hospital patients. Spending extra money on eggs, milk and other food supplies for sick recruits during the epidemic resulted in LePan being investigated by a military court – however he was resolute in the need to care for the Polish soldiers. While LePan's response to the pandemic may have defied convention, on

this local level it can be argued that instead of putting the need for soldiers overseas ahead of the health of individual soldiers and the public's health, LePan was trying to balance these needs: the need to send soldiers to the battlefield, to care for sick soldiers, and to protect the public's health from sick soldiers by sealing troop trains and instituting quarantine measures.

Humphries (2012) has further argued that the need to ship as many soldiers overseas as quickly as possible took precedence over both the health of soldiers and civilians, as evidenced by the decisions to let *HMT Huntsend*, *Victoria* and the *City of Cairo* depart from Canada for England, whereupon hundreds of soldiers became ill with influenza, and dozens died on the Atlantic crossing. Most military vessels were crowded and poorly equipped to deal with influenza epidemics (Pettigrew 1983; Summers et al. 2010; Summers 2012; Schuck-Paim et al. 2013). Troopship hospitals were small and did not have adequate medical supplies. "Cramped quarters, reduced air space, and shared accommodations all helped the virus spread" (Humphries 2012:29).

Most histories of the 1918 influenza pandemic in Canada discuss shipboard epidemics in passing, and tend to focus on outbreaks during the second, fall wave of the epidemic. Chapter 5 of this thesis examines in detail the events on board *HMT Pannonia* and *HMT Atreus* during the summer of 1918, showing how these influenza outbreaks foreshadowed the experience of Canadian soldiers on board *HMT Huntsend*, *Victoria*, and *City of Cairo* in the following September and October. This adds important contextual background to the decisions made by military officials in the fall of 1918. In the summer of 1918, the Canadian army established a pattern of transporting sick soldiers overseas, in spite of clear policies that were created regarding influenza. Very few soldiers died during these summer outbreaks, which could help explain the decisions of military officials during the fall (see Humphries 2012).

Social Understandings of Infectious Disease

The social perception of influenza undoubtedly informed the military's response to pandemic influenza in 1918. Within the anthropological literature on infectious disease, one of the central tenets is that culture has a profound effect on the perception, treatment and experience of disease (Inhorn and Brown 1990; Trostle 2005). The ways in which individuals and societies respond to an epidemic depend on previous experiences and perceptions of infectious disease. Mary-Ellen Kelm (2012), for example, interprets the media response to pandemic influenza in British Columbia as following the classic narrative of an epidemic outlined by Charles Rosenberg (1989), beginning with the recognition of the threat of disease, and moving on to the search for meaning or answers, which often involves blame, or stigmatization of "others". The 1918 influenza pandemic was portrayed in newspapers across BC as a threat to health (the identification of the threat), but at the same time, one that could be managed by modern medicine (the answer) and as a disease that disproportionately affected "others" or outsiders (the stigmatization of outsiders, or those already marginalized by society)(Kelm 2012). The Canadian military's response can also be framed in this way.

As Humphries (2012) argues, military officials had been warned of the threat that epidemic influenza posed by the fall of 1918. While there was no way to know how deadly the pandemic of 1918 would ultimately be or that individual decisions would be weighed against the mortality toll of "the mother of all pandemics" (Taubenberger and Morens 2006), reports had reached Canada about influenza causing soldier deaths in Europe and the U.S. (Humphries 2012). However, it is clear from the military response outlined in Chapter 5 that the threat was interpreted as coming from outside of the country – initial responses focused on the quarantine of incoming ships, after all (Humphries 2013). Quarantine policy in Canada had been developed from experiences

with epidemics of cholera arriving with overseas immigrants to the country (Bliss 1991; Humphries 2013). This could explain why outgoing ships with epidemics of influenza on board in the summer, such as *HMT Pannonia*, did not raise an alarm.

On top of the classic belief in Canada that infectious disease threats come from somewhere else¹, by 1918 the CEF had dealt with seasonal epidemics among recruits training in military camps since the start of the war – influenza was certainly a familiar disease in this setting. Influenza resulted in CEF soldier deaths in Canada throughout the year, causing 24% (n=271) of all soldier deaths in Canada between 1 January 1917 and 31 August 1918 (Rewegan et al. 2015). P&I deaths occurred each month (except September 1917) and the seasonal epidemic which occurred in January of 1917 caused some 25 soldier deaths (Rewegan et al. 2015). Against this backdrop of normal influenza activity, it seems plausible that influenza was understood as a familiar threat that might result in a few deaths, rather than a potentially widespread, deadly infection.

In between the Russian influenza pandemic of 1890 and the pandemic of 1918, influenza was endemic in North America (Bristow 2012). Bristow (2012) argues that by 1918, social perceptions of influenza had changed, linked to the public's acceptance of the germ theory of disease and advances in medical bacteriology and public health. Byerly (2005) highlights a similar belief among American medical officers, who were overly optimistic about their abilities to control infectious disease in light of novel vaccination strategies and diagnostic techniques. While it was still recognized as an epidemic disease with the potential to kill, influenza had become a familiar sickness. Prior to the pandemic of 1918, influenza was considered by most to be a largely harmless, every day infection (Bristow 2012).

¹Some have interpreted the name “Spanish influenza” as blaming Spaniards for the origin of the pandemic (Johnson 2006).

The perception of risk due to influenza is often anchored to knowledge or past experience with the disease (Barnett and Vasileion 2014). Anchoring is the process of making sense of a new disease by connecting it with familiar events, metaphors and symbols (Herring 2009). During seasonal influenza outbreaks, and also during the 1891 pandemic, the mortality curve was u-shaped – meaning that the very young, and very old were at the highest risk of dying from the disease (Morens and Fauci 2007). Based on past experience with seasonal influenza, and the last pandemic in memory (1890), soldiers would not have been expected to be at high risk of dying from influenza.

Management of influenza by military officials can be understood by considering how other infectious diseases, which had very different moral baggage attached to them, were handled. The military's treatment of soldiers with venereal disease is a case in point.

Venereal Disease and the War Effort in Canada

Venereal disease has been credited with the highest number of hospitalizations among Canadian soldiers during WWI, and was considered to be the greatest public health problem faced by the CEF (Morton 1993). A comparison of the treatment of venereal disease and influenza in the military illustrates how the social perception of disease affected the way different infectious diseases were managed. Soldiers diagnosed with venereal diseases were confined in hospital for weeks on end, in spite of the fact that this was not medically necessary, and in the face of the pressing need for soldiers overseas. The lengthy and painful treatment regime employed by the CEF was seen as the just reward for moral transgression (Morton 1993; Cassel 1987).

During WWI, the major recognized venereal diseases (now referred to as sexually transmitted infections (STIs)) were syphilis, gonorrhea, and chancroid (Cassel 1987). Bacteria cause all three of these diseases, namely *Treponema pallidum* (syphilis),

Neisseria gonorrhoeae (gonorrhea), and *Haemophilus ducreyi* (chancroid) and sexual contact is the primary mode of transmission. The early twentieth century in Canada was a period in which ideas about citizenship were entangled with moral reform, eugenics and racialism: venereal diseases were seen as symptoms of social disorder (Valverde 1991).

Gonorrhea was treated medically with a number of washes and solutions, such as silver nitrate and potassium permanganate that were painfully forced through the urethra. In 1910 the first truly effective treatment for syphilis, the arsenic compound Salvarsan, or 606, became available (Cassel 1987; MacDougall 1990). Specific treatment regimens with Salvarsan varied, but generally involved a series of injections spread over two months, or as long as it took for a Wassermann test to return a negative result (Cassel 1987). The official policy was to treat men in segregation until they were cured (Bates 1918). Soldiers were segregated in military hospitals, such as the Base Hospital in Toronto, where they faced either an extremely painful course of treatment (for gonorrhea) or one that could take months to be effective (syphilis).

The overarching goal of military officials was to reduce the number of men in hospital for venereal disease, and thereby increase the number of men in training camps who could be sent overseas for military service (Cassel 1987). The need for more soldiers began early in the war in Canada, with the pool of volunteers for military service drying up as early as 1916, as the Canadian Expeditionary Force suffered devastating losses on the European front, such as occurred during the battle for the Somme in 1916 (a loss of a staggering 24,000 soldiers) (Cook 2008). Stagnant recruitment at home, and depleting manpower in Europe, meant that it became imperative to treat cases of venereal disease found among the ranks of the army.

Influenza simply did not have the same moral baggage as venereal disease. Venereal disease was seen as the reward for immoral behavior, and lengthy painful

treatment regimes in hospital were seen as punishment for this behavior. This was not lost on patients in the venereal ward of Toronto's Military Base Hospital, whose personal letters express this knowledge (Cassel 1987; Morton 1993; Bogaert 2015). The public really only became aware of the threat of venereal disease when a large number of Canadian soldiers were found to be infected (Dickin-McGinnis 1981). To a shocked public, venereal disease was a multi-faceted threat to the Canadian population and the war effort, in terms of reducing the strength of the army in the field, presenting an affront to standards of morality and impeding replenishment of the population after the war (Cassel 1987).

The social perception of disease can have profound effects on the treatment of a disease (Trostle 2005), as evidenced by the differential treatment of venereal disease and influenza. Both diseases threatened the strength of the army in the field, but the venereal disease epidemic was considered far more serious. It emerged as a threat to public health during the war (a 'new' disease), whereas influenza had already been established as a normal, everyday infection which commonly resulted in deaths among the very young and old (Cassel 1987; Morens and Fauci 2007; Bristow 2012). Canadian military officials seemed to operate under this belief, as evidenced by the choice to continue the recruitment and transport of soldiers throughout the 1918 influenza pandemic. Placed against the backdrop of previous experiences with influenza, this decision does not automatically constitute a lack of concern for soldiers' or the public's health.

Influenza: a Democratic Disease?

This research also speaks to the idea that the 1918 influenza pandemic was not a democratic disease (Jones 2007; Herring 2009; Swedlund 2010; Mamelund 2011; Herring and Korol 2012; Sattenspiel and Mamelund 2013; Mamelund, Sattenspiel, and Dimka

2013). As Jones and Farhni (2012:13) observe, “Scholars who insist on the socially democratic nature of influenza point to the fact that it felled the wealthy as well as the poor, the socially prominent as well as the unknown, and that it swept through tree-lined residential enclaves as well as urban slums.”

There is mounting evidence that influenza in Canada in 1918 was influenced by social inequality, where heightened mortality characterized the experience of Indigenous groups (Herring 1993; Lux 1997; Kelm 1999a; Sattenspiel and Mamelund 2013; Mamelund, Sattenspiel, and Dimka 2013), along with impoverished working class immigrant neighborhoods in urban centers (Jones 2007; Swedlund 2010; Herring and Korol 2012). During the second wave of the 1918 influenza pandemic in Ontario, Toronto newspapers focused on reports of the epidemic among soldiers, noting the severity of the fall wave of the pandemic at army camps (Slonim 2010). As discussed in Chapter 4, soldier admissions and deaths from P&I were concentrated in the military district headquarters, and new recruits were more vulnerable to both illness and death than their seasoned counterparts. Geography and recent enlistment helped mediate vulnerability in Ontario. New recruits may have been more vulnerable because conscription drew predominantly from rural farmers (Granatstein and Hitsman 1977), who would have been less likely to have been exposed to the first wave of the pandemic, exposure which may have provided some protection during the second wave of the pandemic (Barry, Viboud, and Simonsen 2008). Along with acquired immunity to influenza viruses, soldiers with longer service in the military may also have acquired immunity to bacterial pneumonias endemic in army camps which caused a significant number of deaths during the pandemic (Shanks et al. 2010).

Part of the reason influenza is seen as a democratic disease may be because of the high mortality caused by the pandemic, which has been used as an anchor to bolster fears

about the modern threat influenza poses (Herring 2009). “Viral panic” is the term coined by Nancy Tomes, to describe contemporary American culture’s obsession with the next pandemic (Tomes 2000). For example, the threat of an emerging avian influenza virus has been anchored to the 1918 influenza pandemic, which is itself anchored to the Black Death, the classic image of plague, serving to enhance the climate of viral panic (Herring 2009). While the case fatality rate of P&I among soldiers in Ontario during the fall wave was higher than in the spring, it is important to remember that the majority of soldiers who contracted P&I survived their infection. Viral panic can obscure who is actually vulnerable during a pandemic, which is mediated by social, economic and environmental factors (Herring 2009).

There is also a tendency in the literature on the 1918 influenza pandemic to attribute heightened mortality during the second wave of the pandemic to a genetic mutation in the virus (Crosby 2003; Humphries 2013). As discussed in Chapters 4 and 5, pandemic influenza was already present in Canada well in advance of the outbreak of the fall wave. Chapter 4 provides novel evidence in Ontario that soldiers who were likely exposed to P&I during the spring of 1918 by virtue of their military service were protected from illness and death during the second wave of the pandemic, which suggests a close relationship between the circulating strains of influenza (Barry, Viboud, and Simonsen 2008; Rios-Doria and Chowell 2009; Korol 2011). Furthermore, analysis of the preserved lung tissues of American soldiers who died of P&I four months prior to, and during the fall wave of the pandemic, suggests that the same virus was responsible for both pandemic waves (Sheng et al. 2011). While it is possible that an as yet undetected change in the virus resulted in heightened viral virulence, it is implausible that this was the sole determining factor contributing to heightened mortality during the second wave of the pandemic. The importance of a complex array of social, economic and

environmental factors operating during the second wave, such as temperature and humidity facilitating the spread of influenza, along with crowding in major urban centres associated with poverty, and congregating indoors to avoid cold weather, and the opening and closing of schools, deserve consideration (Hallman 2009; Slonim 2010; Earn et al. 2012; He et al. 2013; Sattenspiel and Mamelund 2013; Mamelund, Sattenspiel, and Dimka 2013).

Focusing narrowly on influenza is also problematic because a host of other infectious diseases interacted syndemically with the influenza virus (Singer and Clair 2003; Herring and Sattenspiel 2007; Brundage and Shanks 2008; Sattenspiel and Mamelund 2013; Mamelund, Sattenspiel, and Dimka 2013). The social conditions that make certain individuals more susceptible to influenza (lower socio-economic status, leading to crowding is a prime example) are also ideal for the spread of other respiratory infectious diseases, such as tuberculosis. Tuberculosis in particular is thought to have contributed to the high mortality rates experienced during the 1918 influenza pandemic (Noymer and Garenne 2000), although recent scholarship has challenged this association (Sawchuk 2009; Hallman 2015). Other co-circulating infections, measles and smallpox, and the impact of chronic conditions such as nutritional deficiencies should not be ignored (Mamelund, Sattenspiel, and Dimka 2013; Sattenspiel and Mamelund 2013).

As scientists get closer to developing a universal influenza vaccine² (Yassine et al. 2015; Impagliazzo et al. 2015), it is important to remember that not everyone is equally vulnerable to influenza. As in 1918, influenza does not exist in a vacuum, other infectious diseases, such as tuberculosis and measles, along with deleterious social conditions, exacerbate chronic conditions like malnutrition and affect vulnerability and

² Impagliazzo et al. (2015: 1) describe the development of a vaccine that protects against different influenza strains and subtypes, known as a universal influenza vaccine, as the “ultimate goal of influenza vaccinology.”

the risk of infection and death (Singer and Clair 2003; Herring and Sattenspiel 2007; Mamelund, Sattenspiel, and Dimka 2013; Sattenspiel and Mamelund 2013). Furthermore, access to vaccination and treatment are often skewed against the most vulnerable segments of society (Herring 2009).

Conclusions

Using an overarching biocultural and syndemics perspective, and a variety of archival sources at different levels of observation, I have examined the 1918 influenza pandemic in Canada from the local setting of the Polish Army Camp at Niagara-on-the-Lake, to military camp hospitals across Ontario, and troopships bound for Europe. At the Polish Army Camp, the Polish soldiers' journey to France was interrupted when the camp became one of the epicenters of the fall outbreak of the 1918 influenza pandemic in Ontario – which was prompted by the decision to continue to recruit and transport troops in spite of the threat of pandemic influenza. Likewise, the troopships *Pannonia* and *Atreus* were allowed to proceed overseas from Halifax in the summer of 1918 in spite of influenza epidemics on board and recently established regulations designed to guard against influenza on troopships.

However, the Polish Army Camp was quarantined, troops were transported on sealed military trains, and the Camp Commandant made every effort to ensure that the Polish soldiers were taken care of during the epidemic. This close ethnographic reading of the events during the pandemic on a local scale reveals that the health of soldiers was a primary concern for Lieut-Col. Arthur D'Orr LePan. LePan's diary reveals that he authorized extra expenditures for the camp hospital, and worked tirelessly to secure nursing aid for the sick soldiers.

It is also important to recognize that by 1918, influenza had been established as a common, everyday infection that caused a number of soldier deaths each year in Canada (Rewegan et al. 2015), and therefore it is also possible that influenza was not perceived as a threat. As a case in contrast, venereal diseases were treated through confinement in hospital for weeks on end, in spite of the need for soldiers overseas and the fact that confinement and bed rest were not medically necessary for a cure. The social perception of infectious diseases can have a profound effect on the reaction to an outbreak (Trostle 2005).

To my knowledge, this is the first systematic study of both morbidity and mortality records covering both the first and second waves of the pandemic in Ontario. This is an important contribution to the literature because mortality registries represent only a small percentage of the total disease burden caused during the pandemic (Olson et al. 2005; Chowell et al. 2010; Sattenspiel 2011; Korol 2011; Rewegan et al. 2015). The study of soldier admission and discharge records during the first two waves of the pandemic in Ontario revealed that not all soldiers were equally vulnerable; morbidity and mortality were concentrated in the military district headquarters, and seasoned recruits were protected from both illness and death during the second wave of the pandemic. Seasoned recruits were probably protected from illness and death because of exposure to the herald wave of the pandemic during their tenure in the military, combined with acquired immunity to bacterial infections like pneumonia (Barry, Viboud, and Simonsen 2008; Brundage and Shanks 2008). This research contributes to the growing body of literature that confirms influenza was not a democratic disease in 1918 (Jones 2007; Mamelund 2011; Herring and Korol 2012; Sattenspiel and Mamelund 2013; Mamelund, Sattenspiel, and Dimka 2013).

This thesis underscores the importance of a syndemic and biocultural approach to the study of infectious disease. Pathogens alone cannot account for epidemics – a complex array of bio-social factors are always at play. In 1918, the biological processes at hand included the interaction of multiple pathogens in conjunction with influenza, such as pneumonia and tuberculosis (Singer and Clair 2003; Herring and Sattenspiel 2007; Brundage and Shanks 2008; Sattenspiel and Mamelund 2013; Mamelund, Sattenspiel, and Dimka 2013), and environmental factors such as temperature and humidity (He et al. 2013). Significant social, cultural economic and political factors included human behavioral responses to the pandemic, such as the implementation of quarantine, seasonal patterns of behavior, the availability of resources such as medical care, food and housing, and other factors such as the movement of people in conjunction with the war effort (Sattenspiel and Herring 2003; Herring and Sattenspiel 2007; Humphries 2005; Humphries 2012; Sattenspiel and Mamelund 2013). While future genetic research may help clarify the relationship between the different waves of the 1918 influenza pandemic circulating around the world at different places and times, further research should also be directed towards exploration of the social, environmental and other host factors that may have made the second wave of the pandemic so deadly.

This thesis also highlights several gaps in the literature on the 1918 influenza pandemic in Canada where the bulk of research concentrates exclusively on the fall wave of the pandemic, and focuses on influenza as a single epidemic, to the exclusion of other infectious diseases and illnesses. Future research should be directed towards detailed ethnographic, locally specific analyses of morbidity data, the first and third waves of the pandemic, and on Canadian soldiers further afield and on troopships, along with civilian data, if possible.

Future Directions

There are many questions that remain unanswered about the 1918 influenza pandemic among soldiers. In this section of the thesis I present some of the most pressing questions that merit future research.

Mamelund and Sattenspiel (2013) found that co-infections, aside from the standard consideration of pneumonia, and regional disease experiences (e.g. recent measles epidemics) were important determinants of morbidity and mortality during the 1918 influenza pandemic in Labrador and Alaska. This begs the question, aside from pneumonia, what other infectious diseases may have affected the experience of pandemic influenza among soldiers in Ontario and Canada? Another question stemming from this line of inquiry would be: how did infectious diseases fit within the profile of non-infectious diseases and other illnesses, such as mental illness? The A&D books of the CEF, and the CWGC registry of soldier deaths are extensive, and represent an unparalleled avenue for future research on soldier health in Canada. For example, many military hospitals have records that extend from 1914 to 1919 and could be used to examine patterns of P&I, and other causes of morbidity and mortality throughout WWI. Further transcription and epidemiological analysis of all-cause morbidity and mortality records for CEF hospitals in Canada would help contextualize the 1918 influenza pandemic experience, and could highlight the importance of other illnesses and infectious diseases during the pandemic.

Other questions that could be further tested are: was mortality higher among conscripts? And were the majority of conscripts rural farmers? While it is known that in 1918 the majority of soldiers recruited were conscripts, and that the majority of conscripts reported farming as their occupation (Granatstein and Hitsman 1977; Machin 1919), there was some speculation that farming may have been listed as an occupation with the intent

to avoid service in the military (Machin 1919). Record linking individual soldier's admission or death records to their Attestation papers and service files held at the Library and Archives of Canada in Ottawa could help to answer these questions. These files would indicate whether each soldier who died was drafted under the Military Service Act (MSA) as well as provide detail on each soldier's medical history, including a record of previous hospitalizations for P&I. This would also provide important demographic information, such as place of residence and occupation that could allow for a further analysis of the environmental and socio-economic factors that have been linked to heightened mortality during this pandemic, like rurality and socio-economic status (Mamelund 2011; Herring and Korol 2012). Service files with records of hospitalization could also be used to concretely identify which soldiers were admitted to hospital with a definitive diagnosis of P&I during the first wave of the pandemic. These soldiers could then be tracked through their service files and the A&D books of the CEF into the second and third waves of the pandemic. Since there was no comparable monitoring of the health of civilians during WWI (Humphries 2013), the records of the CEF present an enticing opportunity to examine the health of Canadians during WWI.

REFERENCES CITED

- Adalja, A, and D Henderson. 2010. "Original Antigenic Sin and Pandemic (H1N1) 2009." *Emerging Infectious Diseases* 16 (6): 1028–29.
- Ahmed, R, MBA Oldstone, and P Palese. 2007. "Protective Immunity and Susceptibility to Infectious Diseases: Lessons from the 1918 Influenza Pandemic." *Nature Immunology* 8 (11): 1188–93. doi:10.1038/ni1530.
- Ancestry.com. n.d. "Canada War Graves Registers (Circumstances of Casualty), 1914-1948." <http://search.ancestry.ca/search/db.aspx?dbid=1973>.
- Andreasen, V, C Viboud, and L Simonsen. 2008. "Epidemiologic Characterization of the 1918 Influenza Pandemic Summer Wave in Copenhagen: Implications for Pandemic Control Strategies." *The Journal of Infectious Diseases* 197 (2): 270–78. doi:10.1086/524065.
- Archives of Ontario. 1918. "Lincoln County Registration of Deaths." Toronto: Volume 23, MS 935, Reels 244-245.
- Barnett, J, and K Vasileion. 2014. "Making Sense of Risk: The Role of Social Representations and Identity." In *Identity Process Theory: Identity, Social Action and Social Change*, edited by R Jaspal and G.M Breakwell, 357–77. Cambridge University Press.
- Barry, JM, C Viboud, and L Simonsen. 2008. "Cross-Protection between Successive Waves of the 1918-1919 Influenza Pandemic: Epidemiological Evidence from US Army Camps and from Britain." *The Journal of Infectious Diseases* 198 (10): 1427–34. doi:10.1086/592454.
- Bernard, HR. 2011. *Research Methods in Anthropology: Qualitative and Quantitative Approaches*. Lanham: Rowman Altamira.
- Bernstein, SH. 1957. "Observations on the Effects of Housing on the Incidence and Spread of Common Respiratory Diseases among Air Force Recruits." *American Journal of Hygiene* 65 (2): 162–71.
- Bliss, M. 1991. *Plague: A Story of Smallpox in Montreal*. Vol. 1st. Toronto: HarperCollins Publishers.
- Bogaert, K. 2015. "Segregation of Soldiers in Toronto's Military Base Hospital during

- the First World War.” In *International Network for the History of Hospitals, Segregation and Integration in the History of Hospitals Conference*, April 10–11. Dubrovnik, Croatia.
- Bogaert, K, J van Koeverden, and DA Herring. 2015. “Tracing ‘the Trail of Infected Armies’: Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19.” In *Lives in Transition: Longitudinal Analysis from Historical Sources*, edited by Peter Baskerville and Kris Inwood, 274–91. Kingston: McGill Queens University Press.
- Bristow, NK. 2012. *American Pandemic: The Lost Worlds of the 1918 Influenza Epidemic*. New York: Oxford University Press, USA.
- Brundage, JF, and GD Shanks. 2007. “What Really Happened during the 1918 Influenza Pandemic? The Importance of Bacterial Secondary Infections.” *The Journal of Infectious Diseases* 196 (11): 1717–18; author reply 1718–19. doi:10.1086/522355.
- . 2008. “Deaths from Bacterial Pneumonia during 1918 – 19 Influenza Pandemic.” *Emerging Infectious Diseases* 14 (8): 1193–99. doi:10.3201/eid1408.071313.
- Busch, BC. 2003. *Canada and the Great War: Western Front Association Papers*. Kingston: McGill-Queen’s University Press.
- Byerly, CR. 2005. *Fever of War: The Influenza Epidemic in the U.S. Army During World War I*. New York: NYU Press.
- . 2010. “The U.S. Military and the Influenza Pandemic of 1918-1919.” *Public Health Reports* 125 Suppl: 82–91.
- Cassel, J. 1987. *The Secret Plague: Venereal Disease in Canada 1838-1939*. Toronto: University of Toronto Press.
- CBC News Canada. 2010. “Canada’s Last WW I Veteran Dies.” <http://www.cbc.ca/news/canada/canada-s-last-ww-i-veteran-dies-1.909280>.
- Chertow, D, R Cai, and J Sun. 2015. “Influenza Circulation in US Army Training Camps Before and During the 1918 Influenza Pandemic: Clues to Early Detection of Pandemic Viral Emergence.” *Open Forum Infectious Diseases* 2 (2): 1–9.
- Chowell, G, C Ammon, NW Hengartner, and JM Hyman. 2006. “Transmission Dynamics of the Great Influenza Pandemic of 1918 in Geneva, Switzerland: Assessing the Effects of Hypothetical Interventions.” *Journal of Theoretical Biology* 241 (2): 193–204. doi:10.1016/j.jtbi.2005.11.026.

- Chowell, G, C Viboud, L Simonsen, MA Miller, and R Acuna-Soto. 2010. "Mortality Patterns Associated with the 1918 Influenza Pandemic in Mexico: Evidence for a Spring Herald Wave and Lack of Preexisting Immunity in Older Populations." *The Journal of Infectious Diseases* 202 (4): 567–75. doi:10.1086/654897.
- Commission for Environmental Cooperation. 2011. "Political Boundaries." *Data File*. http://www.cec.org/Page.asp?PageID=122&ContentID=2312&SiteNodeID=497&BL_ExpandID.
- Commonwealth War Graves Commission database online. n.d. "Find War Dead." <http://www.cwgc.org/find-war-dead.aspx>.
- Cook, T. 2007. *At the Sharp End: Canadians Fighting the Great War, 1914-1916. Volume 1*. Toronto: Viking Canada.
- Cox, N, and K Subbarao. 2000. "Global Epidemiology of Influenza: Past and Present." *Annual Review of Medicine* 51 (January): 407–21. doi:10.1146/annurev.med.51.1.407.
- Cox, RJ, K a. Brokstad, and PP Ogra. 2004. "Influenza Virus: Immunity and Vaccination Strategies. Comparison of the Immune Response to Inactivated and Live, Attenuated Influenza Vaccines." *Scandinavian Journal of Immunology* 59 (1): 1–15. doi:10.1111/j.0300-9475.2004.01382.x.
- Crerar, A. 2005. "Ontario and the Great War." In *Canada and the First World War: Essays in Honour of Robert Craig Brown*, edited by D Mackenzie, 230–71. Toronto: University of Toronto Press.
- Crosby, A. 2003. *America's Forgotten Pandemic: The Influenza of 1918*. Cambridge University Press.
- Dennis, P. 2012. "A Canadian Conscript Goes to War—August 1918: Old Myths Re-Examined." *Canadian Military History* 18 (1): 1–16.
- Dickin-McGinnis, J. 1981. "From Health to Welfare: Federal Government Policies Regarding Standards of Public Health for Canadians, 1919-1945." *PhD Thesis*. University of Alberta.
- Dickin-McGinnis, JP. 1977. "The Impact of Epidemic Influenza: Canada, 1918-1919." *Historical Papers* 12 (1): 120. doi:10.7202/030824ar.
- Djebabla, M. 2013. "'Fight or Farm': Canadian Farmers and the Dilemma of the War Effort in World War 1 (1914-1918)." *Canadian Military Journal* 13 (2): 57–67.

- Dubois, F, J Thouez, and D Goulet. 2012. "A Geographical Analysis of the Spread of Spanish Influenza in Quebec, 1918-20." In *Epidemic Encounters: Influenza, Society, and Culture in Canada 1918-20*, edited by M Fahrni and E Jones, 142–63. Vancouver: UBC Press.
- Earn, DJD, D He, MB Loeb, K Fonseca, BE Lee, and J Dushoff. 2012. "Effects of School Closure on Incidence of Pandemic Influenza in Alberta, Canada." *Annals of Internal Medicine* 156 (3): 173–81. doi:10.7326/0003-4819-156-3-201202070-00005.
- Fahrni, M, and E Jones, eds. 2012. *Epidemic Encounters: Influenza, Society, and Culture in Canada, 1918-20*. Vancouver: UBC Press.
- Francis, T. 1960. "On the Doctrine of Original Antigenic Sin." *Proceedings of the American Philosophical Society* 104 (6): 572–78. doi:10.1016/S0016-0032(38)92229-X.
- Gage, TB, SN DeWitte, and J Wood. 2012. "Demography Part 1: Mortality and Migration." In *Human Biology: An Evolutionary and Biocultural Perspective*, edited by Sara Stinson, Barry Bogin, and Dennis O'Rourke, Second, 695–756. Hoboken: Wiley-Blackwell.
- Gagnon, A, JE Acosta, J Madrenas, and MS Miller. 2015. "Is Antigenic Sin Always 'Original?' Re-Examining the Evidence Regarding Circulation of a Human H1 Influenza Virus Immediately Prior to the 1918 Spanish Flu." *PLOS Pathogens* 11 (3): e1004615. doi:10.1371/journal.ppat.1004615.
- Gagnon, A, MS Miller, S Hallman, R Bourbeau, DA Herring, DJD Earn, and J Madrenas. 2013. "Age-Specific Mortality during the 1918 Influenza Pandemic: Unravelling the Mystery of High Young Adult Mortality." *PloS One* 8 (8): e69586. doi:10.1371/journal.pone.0069586.
- Gail, MH, and J Benichou. 2000. *Encyclopedia of Epidemiologic Methods*. Vol. 2. New York: John Wiley & Sons.
- Granatstein, J. 2011. *Canada's Army: Waging War and Keeping the Peace*. Toronto: University of Toronto Press.
- Granatstein, J, and J Hitsman. 1977. *Broken Promises: A History of Conscription in Canada*. Oxford: Oxford University Press.
- Hallman, S. 2009. "The Effect of Pandemic Influenza on Infant Mortality in Toronto, Ontario, 1917-1921." *MA Thesis*. McMaster University.

- . 2015. “The Demographic Links Between the 1890 and 1918 Influenza Pandemics in Ontario.” *PhD Thesis*. University of Western Ontario.
- Hasegawa, H, E van Reit, and H Kida. 2015. “Mucosal Immunization and Adjuvants.” In *Influenza Pathogenesis and Control Volume II*, edited by Michael B A Oldstone and Richard W. Compans, 371–80. Springer International Publishing. doi:10.1007/978-3-319-11158-2.
- He, D, J Dushoff, T Day, J Ma, and DJD Earn. 2013. “Inferring the Causes of the Three Waves of the 1918 Influenza Pandemic in England and Wales.” *Proceedings. Biological Sciences / The Royal Society* 280 (1766): 20131345. doi:10.1098/rspb.2013.1345.
- Herring, DA. 1993. “‘There Were Young People and Old People and Babies Dying Every Week’: The 1918-1919 Influenza Pandemic at Norway House.” *Ethnohistory* 41 (1): 73–105.
- . 2009. “Viral Panic, Vulnerability and the Next Pandemic.” In *Health, Risk, and Adversity*, edited by Catherine Panter-Brick and Augustin Fuentes, 78–97. New York: Berghahn Books.
- Herring, DA, S Carraher, MK Lim, M Mrmak, K Hancock, et al. 2011. *Miasma To Microscopes : The Russian Influenza Pandemic in Hamilton*. Hamilton: McMaster University.
- Herring, DA, S Carraher, E Waugh, A Hughes-Jones, BM Edwards, LL Koskocky, H McGilly, et al. 2010. *Recurrence and Resilience: The Third Wave of the 1918 Influenza Pandemic in Hamilton*. Edited by D.A Herring and S Carraher. Hamilton: Department of Anthropology, McMaster University.
- Herring, DA, and E Korol. 2012. “The North-South Divide: Social Inequality and Mortality from the 1918 Influenza Pandemic in Hamilton, Ontario.” In *Epidemic Encounters: Influenza, Society, and Culture*, edited by M Farhni and EW Jones, 97–112. Vancouver: UBC Press.
- Herring, DA, and J Padiak. 2008. “The Geographical Epicentre of the 1918 Influenza Pandemic.” In *Written in Bone*, edited by M Smith and M Brickley, 1–18. London: Archaeopress.
- Herring, DA, and L Sattenspiel. 2007. “Social Contexts, Syndemics, and Infectious Disease in Northern Aboriginal Populations.” *American Journal of Human Biology* 19 (2): 190–202. doi:10.1002/ajhb.

- Hopkins, J. 1919. *The Province of Ontario in the War : A Record of Government and People*. Toronto: Warwick & Rutter.
- Humphries, MO. 2005. "The Horror at Home: The Canadian Military and the 'Great' Influenza Pandemic of 1918." *Journal of the Canadian Historical Association* 16 (1): 235. doi:10.7202/015733ar.
- . 2012. "The Limits of Necessity: Public Health, Dissent, and the War Effort during the 1918 Influenza Pandemic." In *Epidemic Encounters: Influenza, Society, and Culture in Canada*, edited by Magda Fahrni and Esyllt W. Jones, 21–47. Vancouver: UBC Press.
- . 2013. *The Last Plague: Spanish Influenza and the Politics of Public Health in Canada*. Toronto: University of Toronto Press.
- Hunt, C. 2009. *Dancing in the Sky: The Royal Flying Corps in Canada*. Toronto: Dundurn Press.
- Impagliazzo, a., F Milder, H Kuipers, M V. Wagner, X Zhu, RMB Hoffman, R van Meersbergen, et al. 2015. "A Stable Trimeric Influenza Hemagglutinin Stem as a Broadly Protective Immunogen." *Science* 349 (6254): 1301–6. doi:10.1126/science.aac7263.
- Inhorn, M, and P Brown. 1990. "The Anthropology Of Infectious Disease." *Annual Review of Anthropology* 19 (1): 89–117. doi:10.1146/annurev.anthro.19.1.89.
- Inhorn, MC, L Kobeissi, AA Abu-Musa, J Awwad, MH Fakih, N Hammoud, AB Hannoun, D Lakkis, and Z Nassar. 2009. "Male Infertility and Consanguinity in Lebanon: The Power of Ethnographic Epidemiology." In *Anthropology and Public Health*, edited by Robert A. Hahn and Marcia C. Inhorn, 165–95. Oxford: Oxford University Press. doi:DOI:10.1093/acprof:oso/9780195374643.003.0007.
- Johnson, N. 2006. *Britain and the 1918-19 Influenza Pandemic: A Dark Epilogue*. New York: Routledge.
- Johnson, N, and J Mueller. 2002. "Updating the Accounts: Global Mortality of the 1918-1920 'Spanish' Influenza Pandemic." *Bulletin of the History of Medicine* 76 (1): 105–15. doi:10.1353/bhm.2002.0022.
- Jones, EW. 2007. *Influenza 1918: Disease, Death, and Struggle in Winnipeg*. Toronto: University of Toronto Press.
- Kelm, ME. 1999a. "British Columbia First Nations and the Influenza Pandemic of 1918-

- 1919.” *BC Studies*, no. 122: 23–48.
- . 1999b. *Colonizing Bodies: Aboriginal Health and Healing in British Columbia, 1900-50*. Vancouver: UBC Press.
- . 2012. “Flu Stories: Engaging with Disease, Death, and Modernity in British Columbia, 1918-19.” In *Epidemic Encounters: Influenza, Society, and Culture in Canada*, 167–92. Vancouver: UBC Press.
- Kirk-Elleker, A. 2008. “A Measure of Well-Being: An Anthropometric Study of Living Conditions in Canada at the Turn of the Twentieth Century.” *MA Thesis*. University of Guelph.
- Kobasa, D, SMS Jones, K Shinya, J Kash, J Copps, H Ebihara, Y Hatta, et al. 2007. “Aberrant Innate Immune Response in Lethal Infection of Macaques with the 1918 Influenza Virus.” *Nature* 445 (7125): 319–23. doi:10.1038/nature05495.
- Korol, E. 2011. “The 1918 Influenza Pandemic in Ontario : Impact of the Herald Wave on Autumn Mortality.” MSc Thesis. McMaster University.
- Leatherman, T, and AH Goodman. 2011. “Critical Biocultural Approaches in Medical Anthropology.” In *A Companion to Medical Anthropology*, edited by Merrill Singer and Pamela I Erickson, 29–47. Malden: Wiley-Blackwell.
- Library and Archives of Canada. n.d. “Canadian Expeditionary Force Enlistments by Military District.” War Service Records Division series, RG 38-D-10, Volume 444.
- . n.d. “Returns and Statistics of the Canadian Expeditionary Force and Canadian Siberian Expeditionary Force.” RG 24-C-6-e, Volume 1842 File Pt 1, File GAQ-10-45.
- . 1916. “Base Hospital - Toronto.” Ottawa: National Defence fonds, RG 24 Volume 4385 File MD2-34-7-136.
- . 1918a. “File ‘Hospital Ships.’” Ottawa: Ministry of the Overseas Military Forces of Canada fonds, RG 150-1, “Daily Orders” series, Volume 274.
- . 1918b. “Influenza on Troopships, Boxes 2557-2558.” Ottawa: National Defence fonds, RG 24 Volume 2557 File Part 1.
- . 1918c. “Quarantine & Immigration - Spanish Influenza - General.” Ottawa: Department of National Health & Welfare fonds, RG 29 Volume 300 File 416-2-12.
- . 1918d. “Sailings From Canada To All Theatres First World War - Canadian

- Expeditionary Force.” Ottawa: Department of Veterans Affairs fonds, RG 38-D-10, War Service Records Division series, V.
- . 1918e. “Strength Returns, CEF.” RG 24-G-3-1-a, Volume 18568, File 133.009.
- . 2008. “Description Found in Archives: Arthur D’Orr LePan Fonds.” http://collectionsCanada.gc.ca/pam_archives/index.php?fuseaction=genitem.displayItem&lang=eng&rec_nbr=102887&rec_nbr_list=102887,4302736,128575,191639.
- Love, D. 1999. *A Call to Arms: The Organization and Administration of Canada’s Military in World War One*. Winnipeg: Bunker to Bunker Books.
- Lux, M. 1997. “‘The Bitter Flats’: The 1918 Influenza Epidemic in Saskatchewan.” *Saskatchewan History* 49 (1): 3–13.
- Ma, J, J Dushoff, and DJD Earn. 2011. “Age-Specific Mortality Risk from Pandemic Influenza.” *Journal of Theoretical Biology* 288 (November): 29–34. doi:10.1016/j.jtbi.2011.08.003.
- Machin, H. 1919. *Report of the Director of the Military Service Branch to the Honourable the Minister of Justice on the Operation of the Military Service Act, 1917*. Ottawa: J. de L. Taché printer to the King.
- Macphail, A. 1925. *Official History of the Canadian Forces in the Great War, 1914-1919, The Medical Services*. Ottawa: F. A. Acland.
- Mamelund, S. 2011. “Geography May Explain Adult Mortality from the 1918–20 Influenza Pandemic.” *Epidemics* 3 (1): 46–60.
- Mamelund, S, L Sattenspiel, and J Dimka. 2013. “Influenza-Associated Mortality during the 1918-1919 Influenza Pandemic in Alaska and Labrador: A Comparison.” *Social Science History* 37 (2): 53. doi:10.1215/01455532-2074420.
- Mann, S. 2001. “Where Have All The Bluebirds Gone? On The Trail of Canada’s Military Nurses, 1914-1918.” *Atlantis*, 35–43.
- Mathers, G. 1917. “The Bacteriology of Acute Respiratory Infections Commonly Called Influenza.” *Journal of Infectious Diseases* 21 (1): 1–8.
- Ministry of Municipal Affairs and Housing. 2015. “Municipal Boundaries.” *Data File*. <http://www.ontario.ca/data/municipal-boundaries>.
- Moffat, T. 2010. “The ‘Childhood Obesity Epidemic’: Health Crisis of Social Construction?” *Medical Anthropology Quarterly* 24 (1): 1–21. doi:10.1111/j.1548-

1387.2010.01082.x.

Morens, D, and A Fauci. 2007. "The 1918 Influenza Pandemic: Insights for the 21st Century." *Journal of Infectious Diseases* 195 (7): 1018–28.

Morton, D. 1993. *When Your Number's up: The Canadian Soldier in the First World War*. Toronto: Random House of Canada.

———. 2004. *Fight Or Pay: Soldiers' Families in the Great War*. Vancouver: UBC Press.

Noymer, A, and M Garenne. 2000. "The 1918 Influenza Epidemic's Effects on Sex Differentials in Mortality in the United States." *Population and Development Review*. doi:10.1111/j.1728-4457.2000.00565.x.

Nuño, M, C Castillo-Chavez, Z Feng, and M Martcheva. 2008. "Mathematical Models of Influenza: The Role of Cross-Immunity, Quarantine and Age-Structure." In *Mathematical Epidemiology*, edited by Fred Brauer, Pauline van den Driessche, and Jianhong Wu, 1945:349–64. Springer Berlin Heidelberg. doi:10.1007/978-3-540-78911-6_13.

Olson, DDR, L Simonsen, PJ Edelson, and SS Morse. 2005. "Epidemiological Evidence of an Early Wave of the 1918 Influenza Pandemic in New York City." *Proceedings of the National Academy of Sciences of the United States of America* 102 (31): 11059–63.

Parrish, CR, PR Murcia, and EC Holmes. 2015. "Influenza Virus Reservoirs and Intermediate Hosts: Dogs, Horses, and New Possibilities for Influenza Virus Exposure of Humans." *Journal of Virology* 89 (6): 2990–94. doi:10.1128/JVI.03146-14.

Pettigrew, E. 1983. *The Silent Enemy: Canada and the Deadly Flu of 1918*. Regina: Western Producer Prairie Books.

Polskie Radio. 2014. "Msza Za Ojczyznę I Wojsko Polskie. 'Nie Wystarczy Codzienny Patriotyzm.'" *Wiadomości*. <http://www.polskieradio.pl/5/3/Artykul/1203111,Msza-za-Ojczyzne-i-Wojsko-Polskie-Nie-wystarczy-codzienny-patriotyzm>.

Reid, A, T Fanning, J Hultin, and J Taubenberger. 1999. "Origin and Evolution of the 1918 'Spanish' Influenza Virus Hemagglutinin Gene." *Proceedings of the National Academy of Sciences of the United States of America* 96 (4): 1651–56. doi:10.1073/pnas.96.4.1651.

- Reid, A, J Taubenberger, and T Fanning. 2004. "Evidence of an Absence: The Genetic Origins of the 1918 Pandemic Influenza Virus." *Nature Reviews. Microbiology* 2 (11): 909–14. doi:10.1038/nrmicro1027.
- Rewegan, A, K Bogaert, M Yan, A Gagnon, and DA Herring. 2015. "The First Wave of the 1918 Influenza Pandemic among Soldiers of the Canadian Expeditionary Force." *American Journal of Human Biology* 00 (February): n/a – n/a. doi:10.1002/ajhb.22713.
- Rios-Doria, D, and G Chowell. 2009. "Qualitative Analysis of the Level of Cross-Protection between Epidemic Waves of the 1918-1919 Influenza Pandemic." *Journal of Theoretical Biology* 261 (4). Elsevier: 584–92. doi:10.1016/j.jtbi.2009.08.020.
- Rosenberg, C. 1989. "What Is an Epidemic? AIDS in Historical Perspective." *Daedalus* 118 (2): 1–17.
- Sackett, DL, W. Richardson, W. Rosenberg, and R. Haynes. 1997. *Evidence-Based Medicine: How to Practice and Teach EBM*. New York: Churchill Livingstone.
- Sartwell, PE. 1951. "Common Respiratory Disease in Recruits." *American Journal of Hygiene* 53 (2): 224–35.
- Sattenspiel, L. 2011. "Regional Patterns of Mortality during the 1918 Influenza Pandemic in Newfoundland." *Vaccine* 29 (SUPPL. 2): 2–7. doi:10.1016/j.vaccine.2011.02.046.
- Sattenspiel, L, and DA Herring. 2003. "Simulating the Effect of Quarantine on the Spread of the 1918-19 Flu in Central Canada." *Bulletin of Mathematical Biology* 65 (1): 1–26. doi:10.1006/bulm.2002.0317.
- Sattenspiel, L, and S Mamelund. 2013. "Cocirculating Epidemics, Chronic Health Problems, and Social Conditions in Early 20th Century Labrador and Alaska." *Annals of Anthropological Practice* 36 (2): 402–21.
- Sawchuk, LA. 2009. "Brief Communication: Rethinking the Impact of the 1918 Influenza Pandemic on Sex Differentials in Mortality." *American Journal of Physical Anthropology* 139 (4): 584–90.
- Sawchuk, LA, and S Burke. 2003. "The Ecology of a Health Crisis: Gibraltar and the 1865 Cholera Epidemic." In *Human Biologists in the Archives: Demography, Health, Nutrition, and Genetics in Historical Populations*, edited by DA Herring and A Swedlund, 178–215. Cambridge: Cambridge University Press.

- Schuck-Paim, C, GD Shanks, FEA Almeida, and WJ Alonso. 2013. "Exceptionally High Mortality Rate of the 1918 Influenza Pandemic in the Brazilian Naval Fleet." *Influenza and Other Respiratory Viruses* 7 (1): 27–34. doi:10.1111/j.1750-2659.2012.00341.x.
- Shanks, GD, A Mackenzie, R McLaughlin, M Waller, P Dennis, S-E Lee, and J Brundage. 2010. "Mortality Risk Factors during the 1918-1919 Influenza Pandemic in the Australian Army." *The Journal of Infectious Diseases* 201 (12): 1880–89. doi:10.1086/652868.
- Shanks, GD, M Waller, A Mackenzie, and J Brundage. 2011. "Determinants of Mortality in Naval Units during the 1918-19 Influenza Pandemic." *The Lancet. Infectious Diseases* 11 (10): 793–99. doi:10.1016/S1473-3099(11)70151-7.
- Sheng, Z-M, D Chertow, X Ambroggio, S McCall, RM Przygodzki, RE Cunningham, O Maximova, J Kash, D Morens, and J Taubenberger. 2011. "Autopsy Series of 68 Cases Dying before and during the 1918 Influenza Pandemic Peak." *Proceedings of the National Academy of Sciences* 108 (39): 16416–21. doi:10.1073/pnas.1111179108.
- Singer, M, and S Clair. 2003. "Syndemics and Public Health: Reconceptualizing Disease in Bio-Social Context." *Medical Anthropology Quarterly* 17 (4): 423–41.
- Singer, M, PI Erickson, L Badiane, R Diaz, D Ortiz, T Abraham, and AM Nicolaysen. 2006. "Syndemics, Sex and the City: Understanding Sexually Transmitted Diseases in Social and Cultural Context." *Social Science & Medicine* 63 (8): 2010–21. doi:10.1016/j.socscimed.2006.05.012.
- Singer, M, DA Herring, J Littleton, and M Rock. 2011. "Syndemics in Global Health." In *A Companion to Medical Anthropology*, edited by M Singer and PI Erickson, 159–77. Oxford: John Wiley & Sons.
- Slonim, K. 2010. "'Send Only Your Serious Cases'--Delivering Flu to Toronto: An Anthropological Analysis of the 1918-19 Influenza Epidemic in Toronto, Ontario, Canada." *PhD Thesis*. University of Missouri - Columbia.
- Smallman-Raynor, M, and A Cliff. 2004. *War Epidemics: An Historical Geography of Infectious Diseases in Military Conflict and Civil Strife, 1850-2000*. Oxford: Oxford University Press.
- Soper, GA. 1918. "The Pandemic in the Army Camps." *Journal of the American Medical Association* 71 (23): 1899–1909. doi:10.1001/jama.1918.26020490001010.

- Summers, J, N Wilson, MG Baker, and GD Shanks. 2010. "Mortality Risk Factors for Pandemic Influenza on New Zealand Troop Ship, 1918." *Emerging Infectious Diseases* 16 (12): 1931–37. doi:10.3201/eid1612.100429.
- Summers, JA. 2012. "Pandemic Influenza Outbreak on a Troop Ship-Diary of a Soldier in 1918." *Emerging Infectious Diseases* 18 (11): 1900–1903. doi:10.3201/eid1811.AD1811.
- Swedlund, A. 2010. "Everyday Mortality in the Time of Plague: Ordinary People in Massachusetts before and during the 1918 Influenza Epidemic." In *Plagues and Epidemics: Infected Spaces Past and Present*, edited by DA Herring and Swedlund A, 153–77. Oxford: Berg Publishers.
- Taubenberger, J. 1997. "Initial Genetic Characterization of the 1918 'Spanish' Influenza Virus." *Science* 275 (5307): 1793–96. doi:10.1126/science.275.5307.1793.
- Taubenberger, J, and D Morens. 2006. "1918 Influenza: The Mother of All Pandemics." *Emerging Infectious Diseases* 12 (1): 15–22. doi:10.3201/eid1201.050979.
- Taubenberger, J, A Reid, T Janczewski, and T Fanning. 2001. "Integrating Historical, Clinical and Molecular Genetic Data in Order to Explain the Origin and Virulence of the 1918 Spanish Influenza Virus." *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* 356 (1416): 1829–39. doi:10.1098/rstb.2001.1020.
- Tomes, N. 2000. "The Making of a Germ Panic, Then and Now." *American Journal of Public Health* 90 (2): 191–98.
- Trostle, J. 2005. *Epidemiology and Culture*. Cambridge: Cambridge University Press.
- Tumpey, TM, CF Basler, P V Aguilar, H Zeng, A Solórzano, DE Swayne, N Cox, et al. 2005. "Characterization of the Reconstructed 1918 Spanish Influenza Pandemic Virus." *Science* 310 (5745): 77–80.
- Tunnell, AL. 1969. *Canadian Who's Who : A Biographical Dictionary of Notable Living Men and Women, 1967-1969*. Volume 11. Toronto: Who's Who Canadian Publications.
- Worobey, M, G-Z Han, and A Rambaut. 2014. "Genesis and Pathogenesis of the 1918 Pandemic H1N1 Influenza A Virus." *Proceedings of the National Academy of Sciences of the United States of America* 111 (22): 8107–12. doi:10.1073/pnas.1324197111.

Yassine, HM, JC Boyington, PM McTamney, C-J Wei, M Kanekiyo, W-P Kong, JR
Gallagher, et al. 2015. "Hemagglutinin-Stem Nanoparticles Generate Heterosubtypic
Influenza Protection." *Nature Medicine* advance on (August). doi:10.1038/nm.3927.

APPENDICES

Appendix A

Figure 1. Letter of Permission from McGill Queen's University Press, expressing consent to publish the book chapter in this thesis.

Permissions Department
McGill-Queen's University Press
1010 Sherbrooke Street West, Suite 1720
Montreal, QC H3A 2R7
Fax: (514) 398-4333
Email: permissions.mqup@mcgill.ca

June 2nd, 2015

Dear Permissions Department,

I am completing a Ph.D. thesis at McMaster University, tentatively titled "The 1918 Influenza Pandemic among Ontario's Soldiers". I would like to ask your permission, to reprint the following book chapter in full in my thesis:

Chapter 13: Tracing "The Trail of Infected Armies": Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19
pg. 274

Authors: Kandace Bogaert, Jane van Koeverden, and D. Ann Herring

In:

Lives in Transition: Longitudinal Analysis from Historical Sources

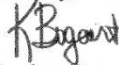
Edited by Peter Baskerville and Kris Inwood

Published in 2015

I also request that you grant irrevocable, nonexclusive license to McMaster University and to the National Library of Canada to reproduce this material as part of the thesis. Proper acknowledgement of your copyright of the reprinted material will be given in the thesis.

If these arrangements meet with your approval, please sign below and return this letter to me via e-mail. Thank you very much for your time and consideration.

Sincerely,



Kandace Bogaert

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE

McGill-Queen's University Press, Authorized by:

Julia Loukes, (Rights Manager)

Date: *15 June, 2015*

Signature:



Figure 2. Letter of Permission from Jane van Koeverden, expressing consent to publish book chapter in this thesis.

Jane van Koeverden
13283 Magnavilla Line
Thamesville, Ont.
N0P 2K0

June 2nd, 2015

Dear Jane van Koeverden,

I am completing a Ph.D. thesis at McMaster University, tentatively titled "The 1918 Influenza Pandemic among Ontario's Soldiers". I would like to ask your permission as my co-author, to reprint the following book chapter in full in my thesis:

Chapter 13: Tracing "The Trail of Infected Armies": Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19
pg. 274

Authors: Kandace Bogaert, Jane van Koeverden, and D. Ann Herring

In:

Lives in Transition: Longitudinal Analysis from Historical Sources

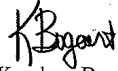
Edited by Peter Baskerville and Kris Inwood

Published in 2015

I also request that you grant irrevocable, nonexclusive license to McMaster University and to the National Library of Canada to reproduce this material as part of the thesis. Proper acknowledgement of your copyright of the reprinted material will be given in the thesis.

If these arrangements meet with your approval, please sign below and return this letter to me via e-mail. Thank you very much for your time and consideration.

Sincerely,



Kandace Bogaert

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE

Authorized by: *Jane van Koeverden*

Date: *June 3, 2015*


Signature: 

Figure 3. Letter of Permission from D. Ann Herring, expressing consent to publish book chapter in this thesis.

D. Ann Herring
Dept. of Anthropology
McMaster University
1280 Main Street W.
Hamilton, Ont.
L8S 4L8

June 2nd, 2015

Dear Ann Herring,

I am completing a Ph.D. thesis at McMaster University, tentatively titled "The 1918 Influenza Pandemic among Ontario's Soldiers". I would like to ask your permission as my co-author, to reprint the following book chapter in full in my thesis:

Chapter 13: Tracing "The Trail of Infected Armies": Mobilizing for War, the Spread of the 1918 Influenza Pandemic, and the Case of the Polish Army Camp at Niagara-on-the-Lake, 1917-19
pg. 274

Authors: Kandace Bogaert, Jane van Koeverden, and D. Ann Herring

In:

Lives in Transition: Longitudinal Analysis from Historical Sources

Edited by Peter Baskerville and Kris Inwood

Published in 2015

I also request that you grant irrevocable, nonexclusive license to McMaster University and to the National Library of Canada to reproduce this material as part of the thesis. Proper acknowledgement of your copyright of the reprinted material will be given in the thesis.

If these arrangements meet with your approval, please sign below and return this letter to me via e-mail. Thank you very much for your time and consideration.

Sincerely,



Kandace Bogaert

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE

Authorized by: D. Ann Herring, June 3, 2015

Signature:



Appendix B

Figure 4. Photograph of soldier tombstones at the Hamilton Cemetery, Hamilton, Ontario. Photograph by K. Bogaert, 2015.



Figure 5. Photograph of rows of tombstones registered with the CWGC at the Hamilton Cemetery, Hamilton, Ontario.
Photograph by K. Bogaert, 2015.



Figure 6. Cross of Sacrifice at the Hamilton Cemetery, commemorating those who died for King and Country in WWI. Photograph by K. Bogaert, 2015.

