Hepatitis C risk factors in a Cambodian American population in Lowell, Massachusetts

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HEPATITIS C RISK FACTORS IN A CAMBODIAN AMERICAN POPULATION IN LOWELL, MASSACHUSETTS

by

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Submitted in partial fulfillment of the requirements for the degree of Master of Science

2015
Dedicated to my husband, Peter Pinch, and my children, Emma and Richard
I would like to acknowledge the generous time and dedication of my committee members in helping to bring this thesis to fruition, and the tireless help and support of my husband.
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CATHERINE YU

ABSTRACT

Background: Hepatitis C (HCV) is the most common chronic blood-borne infection in the US and has life-threatening complications. HCV rates in Cambodian Americans are as high as national rates, but the transmission risks for Cambodians in the US are unclear. Rates of drug use, the most common national transmission risk, are not as high in this population. With the second largest population of Cambodians nationally, Lowell, Massachusetts provides a unique opportunity to study the risk factors associated with HCV transmission.

Objective: The objective of this study is to examine the risk factors associated with HCV in Cambodian Americans. The hypothesis is that HCV infected Cambodian Americans will have different rates of the United States Preventive Services Task Force (USPSTF) recognized risk factors compared to HCV infected non-Cambodian Americans.

Methods: This is a cross sectional study of HCV infected Cambodian and non-Cambodian Americans. Medical record data were abstracted for adults with reactive HCV antibody or RNA virus testing at Lowell Community Health Center (LCHC) between 2009 and 2012. Information regarding USPSTF-designated HCV risk factors was collected, and a comparison was made of HCV risk factors
between infected Cambodian and non-Cambodian Americans.

**Results:** Cambodian Americans with HCV (n=128) were older (mean age 53 vs. 43 years old) and less likely to be male (41%) than the non-Cambodian group (67% male, n=541). Cambodians had far lower rates of overall recreational drug use (2.3% vs. 82.1%) and intravenous drug use (1.6% vs. 33.6%). The predominant HCV risk factor in Cambodians was birth between 1945 and 1965, while that for non-Cambodians was drug use.

**Conclusion:** Most HCV infected Cambodian Americans treated at LCHC between 2009 and 2012 lacked any history of drug use. In contrast, the major risk factor for HCV infected non-Cambodian Americans treated at LCHC was drug use, consistent with the major risk factor for HCV transmission nationwide.\(^{3,6,21}\) This suggests that the current major HCV risk factors fail to describe how this virus was transmitted to Cambodian Americans who seek care at LCHC.
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# List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASLD</td>
<td>American Association for the Study of Liver Diseases</td>
</tr>
<tr>
<td>ALT</td>
<td>Alanine aminotransferase level</td>
</tr>
<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
</tr>
<tr>
<td>HCV</td>
<td>Hepatitis C</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
</tr>
<tr>
<td>IDSA</td>
<td>Infectious Diseases Society of America</td>
</tr>
<tr>
<td>IAS-USA</td>
<td>International Antiviral Society-United States of America</td>
</tr>
<tr>
<td>IU/L</td>
<td>International Units per Liter</td>
</tr>
<tr>
<td>MA</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>NHANES</td>
<td>National Health and Nutrition Examination Survey</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>USPSTF</td>
<td>US Preventive Services Task Force</td>
</tr>
</tbody>
</table>
**Introduction**

Hepatitis C (HCV) is a serious systemic viral infection with potentially fatal consequences that include cirrhosis and hepatocellular carcinoma.\(^{27}\) A 2010 surveillance of viral hepatitis in the United States (US) also noted the high mortality associated with this infection. In 2008, of the three most common viral hepatitides (hepatitis A, B, and C), death rates were highest among persons infected with hepatitis C (4.7 deaths per 100,000 population).\(^{11}\) From 1999 to 2007 the numbers of hepatitis C related deaths exceeded deaths due to HIV in the US. HCV related deaths increased to 15,106 for 2007 while HIV related deaths that year dropped to 12,734.\(^{11,25}\) In addition, HCV associated liver disease remains the leading indication for liver transplant in the US.\(^{10,18,44}\) These medical and financial burdens lend significance to the seriousness of HCV infection.

The modes of HCV transmission involve exposure to blood and bodily fluids. The specific nature of the transmission risk, however, can greatly differ amongst different population groups. For example, the risk factors for HCV include specific behaviors and exposures by which blood-borne transmission can occur, and the major risk in the US is intravenous drug use.\(^{3,27,29,34,42}\) Nationwide, 43–60% of HCV infections are due to intravenous drug use.\(^{3,6,21}\) However, in many developing countries outside of the US, the most frequently identified mode of HCV transmission is through poor hygiene in medical practices.\(^{24}\) In these countries, intravenous drug use is not as prominent
a risk for HCV transmission.\textsuperscript{14,21,34}

Even within the US, rates of HCV transmission risks in Asian-Americans, whether of Cambodian origin or not, may differ greatly from those of Americans who are not ethnically Asian. Studies have found that HCV-infected Asian Americans have rates of drug use that are less than 4\%,\textsuperscript{14,21} compared to between 43–60\% among HCV-infected non-Asian Americans.\textsuperscript{14,21} These studies also suggest previous “unsafe therapeutic injections” are the most common source of HCV infection in HCV infected Asian Americans.\textsuperscript{14,21} This description of HCV transmission for Asians in America is very similar to the transmission risks noted for Asians from unhygienic medical practices outside of the US.\textsuperscript{14,21} These unhygienic medical practices would be the “reusage of unsterilized needles and syringes”,\textsuperscript{14} “reusable or contaminated surgical equipment during routine medical or dental care, acupuncture”, and “mass immunization”.\textsuperscript{21} At a minimum, this suggests that risks for HCV transmission are not the same in every population. Studies of HCV risk factors have included many Asian Americans who are mostly not of Cambodian origin, and have not included Cambodian Americans in large numbers.\textsuperscript{11,14,21,22,37} Lowell, Massachusetts has the second largest population of Cambodian Americans in the US,\textsuperscript{12,19} which provides an opportunity for an examination of the risks for hepatitis C transmission among Cambodian Americans that is larger than has been published previously.\textsuperscript{11,14,21,22,37}

The objective of this study is to assess the risk factors associated with
hepatitis C infection in a population of Cambodian Americans compared with non-Cambodian Americans receiving care in a large urban health center. Cambodian Americans have been found to have comparable rates of hepatitis C infection\textsuperscript{11,22,37} to the general American population,\textsuperscript{5,41} but the prevalence of injection drug use, the major risk factor for hepatitis C infection in the US,\textsuperscript{29,34,41} is significantly lower among Cambodian Americans.\textsuperscript{14,21,34} Thus, my hypothesis is that Cambodian American adults who have hepatitis C will have different rates of nationally recognized and guideline-sanctioned risk factors for HCV transmission than non-Cambodian Americans infected with HCV. This is important to examine, as it is crucial to recognize and understand how different populations have different rates of transmission risks in order for disease identification to be more complete. Furthermore, this can assist in setting policy to tailor screening recommendations for different ethnic subpopulations of US residents.

**Background**

**Hepatitis C Virus**

According to data from the third National Health and Nutrition Examination Survey (NHANES III), the prevalence of HCV infection is estimated to be 1.8% of the US population.\textsuperscript{5,41} At this prevalence rate, HCV remains the most common chronic blood-borne infection nationally.\textsuperscript{5,6} Acute HCV can resolve spontaneously, but in 50–85% of cases, infection persists indefinitely.\textsuperscript{7,9,26,31,40}
The US Preventive Services Task Force (USPSTF) defines chronic HCV infection as “the presence of HCV RNA in the blood for at least 6 months after acute infection”. Chronic infection has serious medical implications as noted above and is the leading indication for liver transplantation in the US and in Europe. While there are few estimates of hepatitis C prevalence specifically in Cambodian Americans; prevalence rates vary from 1.3% to 6% in a variety of studies examining hepatitis C in Asian Americans of multiple ethnicities, mostly non-Cambodian. Thus, Asian Americans carry similar rates of HCV infection compared to the rest of the U.S., and the lifelong consequences of HCV infection are serious and chronic, making hepatitis C a significant concern among Cambodian Americans.

Risk Factors

There are currently three major sets of US guidelines that identify risk factors for HCV transmission. These guidelines have been issued by: 1) the American Association for the Study of Liver Diseases (AASLD), Infectious Diseases Society of America (IDSA), and the International Antiviral Society-USA (IAS-USA) jointly, 2) the Centers for Disease Control and Prevention (CDC), and 3) the US Preventive Services Task Force (USPSTF). While the three sets of guidelines have many similarities, there are some notable differences. Each authority’s set of risk factors for HCV is outlined in Table 1 and described below.
**Table 1.** HCV Risk Factors by Professional Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>AASLD/IDSA/IAS-USA(^1,17)</th>
<th>CDC(^6,34,43)</th>
<th>USPSTF(^28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous drug use</td>
<td>Intravenous drug use</td>
<td>Intravenous drug use</td>
<td>Intravenous drug use</td>
</tr>
<tr>
<td>Transfusion or transplant</td>
<td>Transfusion or transplant</td>
<td>Transfusion or transplant</td>
<td>Blood transfusion before 1992</td>
</tr>
<tr>
<td>Donor later test +HCV</td>
<td>Donor later test +HCV</td>
<td>Donor later test +HCV</td>
<td>Blood transfusion before 1992</td>
</tr>
<tr>
<td>Long term hemodialysis</td>
<td>Long-term hemodialysis</td>
<td>Long-term hemodialysis</td>
<td>Long-term hemodialysis</td>
</tr>
<tr>
<td>Birth to HCV+ mother</td>
<td>Birth to HCV+ mother</td>
<td>Birth to HCV+ mother</td>
<td>Birth to HCV+ mother</td>
</tr>
<tr>
<td>Health care, emergency medical, public safety worker after needle stick, sharp, or mucosal exposure to HCV</td>
<td>Health care, emergency medical, public safety worker after needle stick, sharp, or mucosal exposure to HCV</td>
<td>Health care, emergency medical, public safety worker after needle stick, sharp, or mucosal exposure to HCV</td>
<td>Percutaneous exposure (Health care workers, Surgery before universal precautions)</td>
</tr>
<tr>
<td>Incarceration</td>
<td>Incarceration</td>
<td>Incarceration</td>
<td></td>
</tr>
<tr>
<td>Intranasal drug use</td>
<td>Intranasal drug use</td>
<td>Intranasal drug use</td>
<td></td>
</tr>
<tr>
<td>Tattoo in unregulated setting</td>
<td>Tattoo in unregulated setting</td>
<td>Tattoo in unregulated setting</td>
<td></td>
</tr>
<tr>
<td>Persistently abnormal ALT</td>
<td>Persistently abnormal ALT</td>
<td>Persistently abnormal ALT</td>
<td></td>
</tr>
<tr>
<td>HIV</td>
<td>HIV</td>
<td>HIV</td>
<td></td>
</tr>
</tbody>
</table>
AASLD/IDSA Joint Statement

The AASLD and the IDSA collaborate with the International Antiviral Society-USA (IAS-USA) to maintain web-based HCV diagnosis and treatment guidelines which are regularly updated.\textsuperscript{1,17} The major HCV risk factor identified in this statement is intravenous drug use. Also listed are: intranasal illicit drug use; incarceration; long term hemodialysis; tattoos received in unregulated settings; birth to HCV infected mothers; transfusion or transplant of donated material before July 1992 or from donors later found to be HCV positive; transfusion with clotting factor concentrate before 1987; HIV; elevated aminotransaminase levels, specifically alanine aminotransferase (ALT); and being a health care worker who has sustained a needle stick or mucosal exposure to HCV.\textsuperscript{17} In January, 2015, the AASLD/IDSA/IAS-USA joint statement also added a year of birth between 1945 and 1965 as a risk for HCV infection.\textsuperscript{1,17}

CDC Guidelines

In 2012, the CDC issued guidelines listing the following risk factors for HCV transmission. These factors are intravenous drug use, clotting factor transfusion before 1987, long-term hemodialysis, abnormal aminotransferase levels, HIV, transfusions or transplants from a donor who was later found to have HCV, or recipients of these donations before July 1992, health care work with possible percutaneous exposure to HCV, birth to HCV positive mothers, and a year of birth between 1945 and 1965.\textsuperscript{34,43}
USPSTF Guidelines

In 2013, the USPSTF issued a set of recommendations for HCV testing to update guidelines from 2004. This set of guidelines listed the risk factors for HCV to be: intravenous drug use, any blood transfusion before 1992, any use of long-term hemodialysis, having been born to an HCV infected mother, incarceration, intranasal drug use, tattoos in unregulated settings, and percutaneous exposures through health care work or surgery before the institution of universal precautions. In 2012, the USPSTF added year of birth between 1945 and 1965 to the list of risk factors.\textsuperscript{28} This is a significant change from the previous 2004 USPSTF guidelines, as these guidelines did not strongly recommend cohort screening for HCV.\textsuperscript{28,38}

Summary of risks

The three sets of guidelines described above list many of the same risk factors, but there are also a few differences. The risk factors that are shared by these guidelines are intravenous drug use, birth between 1945–1965, long-term hemodialysis, health care work, birth to an HCV infected mother, and transfusion or transplant before 1992. The factors that are not shared by all three guidelines are HIV infection, aminotransferase abnormalities, intranasal drug use, unregulated tattoos, and incarceration. In the methods section, the risk factors assessed in this study will be identified and discussed.
**Conceptual Model**

A conceptual model describes the relationship between population characteristics and a health condition such as infection with HCV. The model below specifies the characteristics that could be HCV risk factors and the relationship of these factors with HCV infection for Cambodian and non-Cambodian Americans.

**Solar and Irwin Conceptual Framework.**

The Solar and Irwin Conceptual Framework on the Social Determinants of Health in Figure 1 models the factors that affect how a medical condition is distributed within a population.  

^36

Application of the Solar & Irwin model for the Risk of HCV Transmission
In this model, Structural Determinants are population characteristics from a Social, Economic, or Political context that strongly predict the Social Positions of individuals in that population. The Social Positions are defined by the education level, the form of occupation, the income level, the gender, and the ethnicity or race. This Social Position acts through Intermediary Determinants to affect the distribution of a health condition. Intermediary Determinants include material circumstances, social cohesion, behaviors, biological factors, and psychosocial factors. These determinants interact with the available health care system\textsuperscript{36} and lead to a health condition of concern. The differences in how populations are exposed to hepatitis C can then be evaluated by comparing the Structural and Intermediary Determinants between the groups.

**Adaptation of Framework for HCV Transmission**

The application of the Solar and Irwin Conceptual Framework to HCV risk factors involves refinement of the Determinants to apply directly to this health condition. Socioeconomic and Political Structural Determinants encompass health policy, governmental regulations, and cultural norms as they relate to HCV exposure. Health policies and governmental regulations, when enacted, can reduce known HCV risks on a large scale. Examples of these policies include the regulation of tattoo parlors and the screening of blood and organ donations. Cultural norms describe a belief system that frames an understanding of disease
and acceptance of health policy mandates. For example, an American cultural norm would be the acceptance of routine pediatric appointments for well-child visits or the belief that disease transmission can be understood through science. These cultural norms and governmental policy interact to strongly influence how Social Position is shaped.

Social Positions describe an individual’s standing in their community. This position is determined by levels of education, occupation, income, gender, and ethnicity. These characteristics can be adjusted for better relevance to HCV infection. Education includes an understanding of disease and how HCV can be transmitted. Certain occupations also serve as an HCV risk, such as health care work or public safety work that involves percutaneous HCV exposures. Gender, Ethnicity, and the level of financial stability define an individual's identity and susceptibility to HCV exposures. Age affects an individual’s social position, and the 1945–1965 birth cohort is a grouping of individuals who share an age range. The risk to this cohort derives from previously unregulated health care and transfusion practices (Governance and Health Policy as found in the Socioeconomic and Political Context) and the poor understanding of HCV transmission risk that was present before the early 1990’s (Education as found in the Social Position). These components of an individual’s social position combine with the Socioeconomic and Political Context to form the Structural Determinants that lead to Intermediary Determinants of HCV transmission.
Intermediary Determinants include factors that more directly lead to HCV infection. These include material circumstances, the cohesiveness of the surrounding community, the rates of HCV risk behaviors, and some medical conditions that may necessitate treatments associated with HCV exposure. Drug use would also be a component of this population’s Intermediary Determinant Profile. These factors interact with a health care system that can also be a risk for HCV transmission. Health care transmission is possible from reused syringes and needles\textsuperscript{14,21} or from transfusions of infected blood, as used to occur before all donated blood was screened starting in 1992\textsuperscript{6,17,28,34,43}. Collectively, these Structural and Intermediary Determinants describe where HCV risks can lead to HCV infection, the health condition of concern for this study.

Differences in Determinants between Cambodian and non-Cambodian Americans

There are differences in Structural and Intermediary Determinants for HCV infected Cambodian Americans and non-Cambodian Americans. Starting with Structural Determinants of a Socioeconomic and Political Context, Cambodian Americans’ HCV risks are influenced by Cambodian governance and polices and American governance and health policies. A 2011 review of infection control standards in Cambodian hospitals and clinics noted inadequate training and poor adherence to World Health Organization (WHO) based protocols, and cleaning.
protocols that did not meet sterilization standards. These practices confer HCV transmission risk to the Cambodian Americans who were subjected to them.

For both groups, HCV risk is affected by American governance and health policies. Before 1990, significant risk of HCV could be found in the transfusion of blood or clotting factor concentrates, in percutaneous exposure to reused needles for those receiving medical care, and in health care workers who were also at risk of percutaneous or mucosal exposure to HCV. Subsequent infection control policies have since protected individuals in the US from these HCV risk factors.

The Social Position sets the stage for differences in HCV transmission because Determinants like gender or occupation affect social standing differently for Cambodian and non-Cambodian American individuals. Compared to their male peers, Cambodian women have lower rates of literacy and lower levels of education. Strong cultural norms dictate that they adhere to domestic roles and remain subordinate to men. A Cambodian woman could be at a higher risk of HCV transmission because of the vulnerable position dictated by this Structural Determinant of gender. Other differences exist between the population groups in their Social Positions. The level of education and occupation can also be higher overall for non-Cambodian Americans due to a greater level of comfort with the language and cultural norms of their home country.

Regarding the 1945–1965 birth cohort, although non-Cambodian and Cambodian Americans may share this cohort risk, they come from different
Socioeconomic and Political Contexts. These lead to different types of exposure risks and rates of exposure risks that are represented by this Social Position.

The Intermediary Determinant that is most influential in HCV transmission is injection drug use. Injection drug use has great relevance for HCV infection in the US.\textsuperscript{1,6,17,28,34,43}

Health Care Systems interact with Intermediary Determinants, and there are differences between health systems available to Cambodian and non-Cambodian Americans. Cambodians would have HCV risk concerns from traditional healing practices as well as Cambodian and American national health practices. Non-Cambodians would not be seeking care from Cambodian traditional healing practices, and they would only experience HCV risk influences from American health care.

The Solar and Irwin Conceptual Framework applied to HCV risks shows where these factors can occur in the social, economic, and political influences in population communities. The Social and Political influences on Cambodian and non-Cambodian Americans are refined to describe risks for HCV. How these influences differ in the strength of their effects can thus demonstrate differences in the rates of HCV risks in these population groups.
Methods

Study Design

This is a cross sectional study of HCV infected adults tested for HCV between 2009 and 2012. The group of interest, Cambodian HCV infected adults, is compared to a group of non-Cambodian HCV infected adults.

Study Setting

The city of Lowell, Massachusetts provides a rare opportunity to study in better detail the risk factors associated with HCV infection among Cambodian Americans. The city has the second largest population of Cambodian Americans in the US,\textsuperscript{12,19} facilitating the study of risk factors in one focused area.

Approximately 10,000 adult residents of the Lowell, Massachusetts community come to Lowell Community Health Center (LCHC) annually seeking primary care. The community health center itself is divided into a number of clinics. The major patient-oriented care clinics are Adult Medicine, Family Medicine, Pediatrics, Obstetrics-Gynecology and Family Planning, Behavioral Health, and the Metta Health Center, a clinic that focuses on Southeast Asian issues. About 4000 of the patients seen annually at LCHC self-identify as Cambodian.
The system-wide medical records of LCHC are stored electronically using the eClinical Works software. This format allows efficient review of patient visits, outside medical records, and laboratory and radiologic orders and reports.

Study Sample

Figure 2 below shows how the study sample was collected.
Figure 2. Flowchart

N=4541
Ever tested for hepatitis C
Seen between 1/1/09-12/31/12

N=2960
Non-Cambodian
Ever tested for hepatitis C
Seen between 1/1/09-12/31/12

N=1581
CAMBODIAN
Ever tested for hepatitis C
Seen between 1/1/09-12/31/12

N=541
Non-Cambodian
Ever tested between
1/1/09-12/31/12
VERIFIED hepatitis C

N=128
CAMBODIAN
Ever tested between
1/1/09-12/31/12
VERIFIED hepatitis C
The initial sample for this study was drawn from 4,541 adults over the age of 18 years old who were tested for HCV at LCHC between January 1, 2009 and December 31, 2012. Hepatitis C testing included HCV antibody or RNA virus labs. This group of individuals included persons of all ethnicities, Cambodian and non-Cambodian.

Of this preliminary group of 4,541 adults who were tested, demographic data was reviewed, and Cambodian ethnicity was confirmed in 1,581 individuals. The medical data of these 1,581 individuals was further reviewed and positive hepatitis C antibody or RNA test results were verified for 128 of these individuals, so they were included in the study as Cambodian American Hepatitis C infected adults.

The rest of the 2,960 individuals tested for HCV were non-Cambodian Americans whose medical data was further reviewed to verify their hepatitis C diagnosis. HCV infection was verified by positive laboratory testing in 541 individuals, and they were included in the study as non-Cambodian American Hepatitis C infected adults.

Variables of Interest

Risk Factors

The primary outcome of this study was differences between Cambodian and non-Cambodian Americans in the risk factors for HCV transmission. The risk factors used in this analyses included: 1) history of intravenous drug use, 2)
history of transfusions of blood products, 3) history of hemodialysis, 4) previous work in any healthcare field, 5) prior or current sexual partner with hepatitis C, 6) history of maternal infection with hepatitis C, and 7) year of birth between 1945 and 1965. The above outcome variables reflect the USPSTF recognized risk factors. These risk factors were documented in the Medical History, Problem List, and Social History sections of the electronic medical record. The USPSTF recognized HCV risk factors of intranasal drug use, incarceration, and tattoos in unregulated settings were not included as outcome variables because their documentation in the medical records was poor.

**Patient Characteristics**

Patient characteristics abstracted from the medical record were: patient's age at the time of hepatitis C testing, gender, need for translator service, overall drug use, chronic HCV infection, and, for Cambodians, their year of arrival to the US if available in the medical record.

Chronic infections are defined as having persistent viremia for at least 6 months. This was included in the study to allow a more complete evaluation of any differences in ALT abnormalities. Individuals with verified HCV RNA in their blood were more likely to have hepatocyte injury detectable by ALT elevation compared to individuals who possibly cleared their acute HCV spontaneously in the past.
The year of arrival to the US indicated how many years a Cambodian American individual was under the care of Cambodian health policies and medical care versus American health policies and medical care. The need for translator service was evaluated because it described the level of language literacy, a detail that helped characterize these individuals’ Social Positions.

**Covariates**

Data regarding a number of other potential covariates were also abstracted. These covariates were the presence of HIV infection, alcohol use, and the presence of underlying liver disease that was documented with elevated aminotransferase levels on laboratory testing.

HIV is a listed HCV risk factor by AASLD/IDSA/IAS-USA and CDC guidelines “because of shared transmission modes”.\(^1\,2\,8\,3\) HIV is closely associated with higher rates of injection drug use, transfusions, sexual exposure, and maternal exposure.\(^{23}\) HIV is not, however, considered a risk factor by the USPSTF. For this reason, HIV infection was not considered an outcome variable as this study focused on USPSTF designated HCV risk factors. HIV infection was documented as present if a positive HIV antibody test was found in that individual’s medical data and evaluated as a covariate that could confound findings about some outcome variables.

Alcohol use is not a risk factor for HCV transmission, but excessive alcohol use is associated with increased rates of recreational drug use.\(^{30}\)
Increased rates of alcohol use could affect rates of the outcome variable of injection drug use, so excess alcohol use was considered a potential covariate in this study. Alcohol use was defined as cases where the patient described a history of excessive alcohol use, or more than 14 drinks per week were documented, the weekly drink number that defines at-risk drinking.\textsuperscript{16,39}

Aminotransferase levels were measured with ALT (alanine aminotransferase) testing, the standard marker of liver injury for HCV infection and the marker specified in the AASLD guidelines.\textsuperscript{7,15} Hepatocyte injury measured by ALT elevation is a consequence of chronic HCV infection.\textsuperscript{9} As all individuals in the study have HCV, findings regarding ALT abnormalities would be an effect of that infection instead of a measure of HCV risk. Thus, these measures were not evaluated as outcome variables because of concern that the ALT abnormality would be heavily influenced by the infection being studied. Instead, the ALT measurement is considered a covariate representing secondary causes of liver injury that could be associated with other outcome variables of interest.

In this study, the level of hepatocyte injury was evaluated in two ways. The maximum recorded ALT test result for each study individual was collected, and these levels were averaged to be compared between the two study groups. The rates of maximum recorded ALT levels greater than 40IU/L were also compared between the study groups. The ALT level of 40IU/L has been recognized as an upper limit for normal liver function by national groups.\textsuperscript{2,17,30}
Data Analysis

The data were organized in a Microsoft Excel spreadsheet, and basic statistics were performed with R statistical software.32 The frequencies of patient characteristics and risk factors were determined with Microsoft Excel and in SAS statistical software.33 Due to the small numbers in some of the risk factor categories, Fisher’s Exact Test and Welch’s T-test was used with R software to determine the significance of risk factor differences between the hepatitis C infected Cambodian Americans and non-Cambodian Americans.32

Results

Description of the study sample

Table 2 shows the study sample, comparing the Cambodian and non-Cambodian populations.
Table 2. Patient Characteristics and Covariates (N=669 patients in care with HCV)

<table>
<thead>
<tr>
<th></th>
<th>Cambodian (n=128)</th>
<th>Non-Cambodian (n=541)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>52.57</td>
<td>42.75</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Standard dev</td>
<td>12.33</td>
<td>11.07</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>19</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Max</td>
<td>90</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>53 (41.4%)</td>
<td>360 (66.5%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female</td>
<td>74 (57.8%)</td>
<td>181 (33.5%)</td>
<td></td>
</tr>
<tr>
<td>Transgender</td>
<td>1 (0.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Translator need</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>117 (91.4%)</td>
<td>75 (13.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No</td>
<td>11 (8.6%)</td>
<td>466 (86.1%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Drug Use</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3 (2.3%)</td>
<td>444 (82.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No</td>
<td>125 (97.7%)</td>
<td>97 (17.9%)</td>
<td></td>
</tr>
<tr>
<td><strong>HIV infection</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>4 (3.13%)</td>
<td>60 (11.09%)</td>
<td>0.47</td>
</tr>
<tr>
<td>Negative</td>
<td>23 (17.97%)</td>
<td>212 (39.19%)</td>
<td></td>
</tr>
<tr>
<td>Untested</td>
<td>101 (78.91%)</td>
<td>269 (49.72%)</td>
<td></td>
</tr>
<tr>
<td><strong>Maximum ALT (IU/L)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>91.28</td>
<td>131.50</td>
<td>0.001</td>
</tr>
<tr>
<td>Stand dev</td>
<td>95.14</td>
<td>200.5</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>14</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>852</td>
<td>2052</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><strong>ALT greater than 40 IU/L</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>93 (72.66%)</td>
<td>419 (77.45%)</td>
<td>0.07</td>
</tr>
<tr>
<td>No</td>
<td>35 (27.34%)</td>
<td>103 (19.04%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>19</td>
<td>19 (3.51%)</td>
<td></td>
</tr>
<tr>
<td><strong>Excessive Alcohol Use</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15 (11.7%)</td>
<td>217 (40.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>No</td>
<td>110 (85.9%)</td>
<td>291 (53.8%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>3 (2.3%)</td>
<td>33 (6.1%)</td>
<td></td>
</tr>
</tbody>
</table>

1 Single maximum ALT recorded, see page 16, Covariates
2 Any history of excessive alcohol use, see page 16, Covariates
In terms of patient characteristics, there were statistically significant differences between Cambodian and non-Cambodian Americans in these samples. The average overall age of Cambodian adults in this study was significantly higher than the average age of non-Cambodian adults (52.6 vs. 42.8 years, \( p<0.001 \)). (See Table 2 above) The non-Cambodian HCV infected adults’ ages were distributed with a peak in the mid 30 year olds and another peak at the early 50 year olds. (See Figure 3 in appendix)

There were also statistically significant differences in the gender distributions in the sample groups. Cambodian adults in this study were 58% women, 41% men, and 0.8% transgender women while the non-Cambodian group was composed of more men than women: 66.5% men and 33.5% women. This difference in gender distributions between the two groups achieved statistical significance \( p<0.001 \).

There were significantly more Cambodian American adults that describe a need for a translator compared to the non-Cambodians in this study, 91.4% vs. 13.9%, \( p<0.001 \). The year of immigration to the US was reported in 91 cases. The year with the most arrivals was 2005, with most of these Cambodian Americans coming to the US between 2000 and 2005 (see Figure 4 in appendix).

**Risk Factors**

Table 3 shows the individual risk factors used in this study, comparing the Cambodian and non-Cambodian samples.
<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Cambodian (n=128)</th>
<th>non Cambodian (n=541)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No or Unknown</td>
<td>Yes</td>
</tr>
<tr>
<td>Born between 1945–1965</td>
<td>85</td>
<td>(66.4%)</td>
<td>241</td>
</tr>
<tr>
<td>IV drug Use</td>
<td>2</td>
<td>(1.6%)</td>
<td>182</td>
</tr>
<tr>
<td>Transfusion</td>
<td>5</td>
<td>(3.9%)</td>
<td>9</td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>0</td>
<td>(0%)</td>
<td>1</td>
</tr>
<tr>
<td>History of work In Health Care</td>
<td>8</td>
<td>(6.25%)</td>
<td>3</td>
</tr>
<tr>
<td>Sexual exposure</td>
<td>6</td>
<td>(4.7%)</td>
<td>8</td>
</tr>
<tr>
<td>Family history Maternal</td>
<td>4</td>
<td>(3.1%)</td>
<td>4</td>
</tr>
<tr>
<td>One or more Risk factors</td>
<td>97</td>
<td>(75.8%)</td>
<td>371</td>
</tr>
<tr>
<td>Two or more Risk factors</td>
<td>15</td>
<td>(11.7%)</td>
<td>117</td>
</tr>
</tbody>
</table>

*The response “U” for “Unknown” was used if there was no indication the individual had been asked about the risk factor or if no history of the presence or absence of this risk factor was available.*
There were statistically significant differences in the rates of injection drug use in Cambodian and non-Cambodian individuals (1.6% vs. 33.6%, p<0.001, see Table 3). There were also significantly more HCV-infected Cambodian adults born between 1945 and 1965 than non-Cambodians (66.4% vs. 44.5%, p<0.001).

Prior health care work, sexual exposure, and maternal history of infection were reported in small numbers of individuals, but there were statistically significant findings for these risk exposures. For employment in health care, significantly more Cambodians reported this history (6.25% vs. 0.6%, p<0.001). Significantly more Cambodian adults also reported a sexual exposure to HCV (4.7% vs. 1.5%, p=0.034) and a maternal history of HCV infection (3.1% vs. 0.7%, p=0.048). Rates of transfusion were greater in Cambodian Americans, but this finding did not achieve statistical significance (3.9% vs. 1.7%, p=0.159). Rates of hemodialysis were negligible and equivalent between the study groups (0% vs. 0.2%, p=1.0).

Significantly more non-Cambodian Americans had two or more HCV risk factors, but there was no statistically significant difference between Cambodians and non-Cambodians with one or more risks (68.6% vs. 75.8%, p=0.13). The factors considered for this calculation were the outcome variables described: intravenous drug use, birth between 1945 and 1965, history of transfusion, history of hemodialysis, healthcare employment, sexual exposure, and maternal history of HCV. None of the Cambodians with two or more risk factors had a
history of injection drug use, and 93.3% had the birth cohort as one of the multiple risk factors.

As noted above, rates of individuals that had one or more risk factors were not significantly different between the study groups. Among individuals with one or more risk factors, significantly more Cambodian Americans were born between 1945 and 1965 (87.6% vs. 62.9%, p<0.001) and significantly more non-Cambodian Americans reported intravenous drug use in their past (49.1% vs. 2.1%, p<0.001).

**Covariates**

Cambodian adults with HCV had lower rates of HIV infection, but this difference did not achieve statistical significance (3.13% vs. 11.09%, p=0.469). Many adults in the Cambodian group were never tested for HIV, and only 27 individuals have any test result for this condition.

The average ALT was significantly greater in non-Cambodian than in Cambodian individuals (132 IU/L vs. 91 IU/L, p=0.001). More non-Cambodian individuals had ALT levels greater than 40 IU/L, a finding that approached but did not achieve statistical significance (72.66% vs. 77.45%, p=0.07). Significantly more non-Cambodians had chronic HCV infection than Cambodians (73.75% vs. 53.13%, p<0.001).

Rates of alcohol use were significantly higher for non-Cambodian adults than for Cambodian adults, 40.1% compared to 11.7%. This difference was
statistically significant. There was a high rate of documentation for this characteristic as information regarding this behavior was present for 94% to almost 98% of the individuals (data not shown).

**Discussion**

**Major Risk Factors**

Injection drug use was not a major HCV risk factor for infected Cambodians seen at LCHC between 2009 and 2012. Studies of HCV infected Asian Americans have not included many Cambodian Americans, so no conclusions could be made about the low rates of injection drug use found in Cambodians.\(^{11,14,21,22,37}\) Unlike those studies, Cambodian Americans were well represented here, and fewer than 2% of the HCV infected Cambodian Americans seeking care at LCHC had any history of injection drug use. This finding was significant and profound.

One explanation for the lack of injection drug use was seen in a graph of Cambodian individuals’ ages side by side with non-Cambodians (Figure 4). In Massachusetts, the increase in injection drug use-associated with hepatitis C infection has been associated with 15–24 year olds, suggesting that 20–30 year old non-Cambodians also contributed strongly to injection drug use rates in Lowell.\(^{29}\) Unlike the non-Cambodian Americans, HCV infected Cambodian Americans in this study included very few 20–30 year olds. The Cambodian group did not include any of these younger individuals for whom HCV
transmission would have occurred through injection drug use.

Instead of injection drug use, the predominant risk factor for Cambodians in this study was birth between 1945 and 1965. This study was first planned at the end of 2012, the same year that CDC Morbidity and Mortality Weekly Report (MMWR) publications recognized increased HCV in this birth cohort. The ages of individuals in this study were collected as important patient characteristics, but it was not anticipated that one group’s older age profile would become a designated risk factor during the course of the study. Many Cambodian individuals had only this birth cohort as a risk factor of significance (86.7%). This also means that no identifiable risk behavior explained why almost 87% of the Cambodian individuals acquired hepatitis C. The US risk factor guidelines did not seem appropriate to describe transmission risk in this population of Cambodian Americans.

For Cambodians in this birth cohort, percutaneous exposures to HCV may have occurred through Cambodian medical care or traditional health practices. Although there are no exact numbers to demonstrate how many Cambodians in this study received medical care in Cambodia, it can be surmised that this exposure was more likely in those who came to the US recently, after 2000 (see Figure 4). For these individuals, most of their lives were lived in Cambodia, not in the US, suggesting HCV exposure likely occurred before their arrival in the US. Most specific risk factors, namely transfusions, dialysis, health care work, sexual exposure, or maternal infection, were reported in small numbers. It was difficult
to attribute HCV infection to these exposures. The descriptions of risk factors in
the US were thus not adequate for the risks to which the Cambodian Americans
in this study were exposed.

Multiple Risk Factors

There was no significant difference in the rates of individuals with one or
more HCV risk factors, but significantly more non-Cambodians had two or more
HCV risk factors. For these categories of one or more and two or more risks,
Cambodians and non-Cambodians showed significantly different rates of
injection drug use and birth cohort risk. Cambodians with one or more risk
factors had significantly higher rates of birth cohort risk, a finding consistent with
the older average age in the Cambodian group. Non-Cambodians had
significantly higher rates of injection drug use.

Unlike the direct percutaneous HCV risk of injection drug use, the birth
cohort risk does not offer an explanation for the blood or bodily fluid exposure
that led to HCV for this study’s Cambodian Americans. Possible contributors to
HCV for Cambodians in this birth cohort may have included traditional healing
practices or routine care in Cambodian health care facilities. For example, use of
unsterilized reused needles for acupuncture or other medical care could transmit
HCV in any setting where regulation of these practices is poor. Other studies of
Asian Americans have speculated but did not prove that traditional healing
practices may contribute to HCV transmission. The studies did not include
Cambodians in large numbers. Recent reviews of infection control practices in
Cambodian health care facilities show that transmission from inadequately sterilized medical equipment remains a risk. Neither traditional healing practices or medical care abroad are nationally recognized risk factors for HCV transmission, but they may contribute to the increase HCV risk from birth between 1945 and 1965 for these Cambodian Americans. This differs greatly from the US where HCV risk from unhygienic medical practices has diminished greatly due to effective infection control practices. A larger study of invasive medical procedures received by immigrants prior to their arrival in the US could potentially clarify any association with HCV infection but was outside the scope of this study.

Other Considerations

Non-Cambodian Americans had significantly higher rates of excess alcohol use and a higher average maximum ALT. Regarding rates of elevated ALT levels, there was no significant difference between Cambodians and non-Cambodians (72.66% vs. 77.45%, p=0.07). This indicated that non-Cambodian Americans had higher ALT elevations than Cambodian Americans. Significantly more non-Cambodian Americans also described high levels of alcohol use and had chronic infection. Non-Cambodian Americans may have had greater laboratory evidence of hepatocyte injury more frequently because of higher rates of underlying alcohol use and chronic HCV. Non-Cambodians may have had damage from a combination of liver conditions more frequently than Cambodian
Americans.

There was no significant difference between the study groups in rates of HIV infection. HIV infection, then, was unlikely to have been a confounder for the differences found in rates of injection drug use and birth cohort.

Limitations of the study

There were potential limitations of this study, starting with the difference in gender and age profiles between the Cambodian and non-Cambodian groups of patients. The probability of an individual experiencing a specific HCV risk factor could be very different for a man than for a woman or for an older rather than a younger individual. The Cambodian group was significantly older and with significantly more women. This great difference could potentially influence the rates of risk factors that were found, a possible limitation to the study. A decision was made not to select for an age and gender matched group of non-Cambodians to compare with the HCV infected Cambodian Americans. Attempts to match these groups for age by trying to randomly select out older individuals from the Cambodian group would have erased this study’s finding that the 1945–1965 birth cohort was a major risk factor for this population. It was instead recognized that these study populations, as gathered, provided the entirety of confirmed HCV infected Cambodian and non-Cambodian Americans seen at LCHC from 2009 to 2012. By not attempting to better match the study groups, a more accurate comparison was made of all HCV infected Cambodian individuals with all non-Cambodian hepatitis C infected adults during this 4 year period of
Injection drug use was possibly under-reported in this study, but this did not serve as a significant limitation. Instead, any possible under-reporting strengthened this study’s findings. Statewide, Massachusetts reported an injection drug use rate of 72%\textsuperscript{42} In comparison, the 34% rate of injection drug use (p<0.001) found in these non-Cambodians was unexpectedly low for the area. Under-reported injection drug use among non-Cambodians would then suggest an even greater difference between Cambodians and non-Cambodians than what was found in this study. Additionally, the injection drug use rate for Cambodians in this study is consistent with the 3–11% rate in other studies of HCV risk factors in Asian Americans\textsuperscript{14,21} Any potential under-reporting seemed to affect the non-Cambodian group more than the Cambodian group; thus, the large and significant difference in injection drug use rates between the two groups indicated that this finding was at least as great as what was reported in this study, if not more.

Another potential study limitation was incomplete data reporting, a frequent concern about recall bias in any medical data review\textsuperscript{8} Many of the risk factors for HCV transmission included socially stigmatized behaviors that people may not have been comfortable discussing or medical exposures that individuals may not have been able to recall accurately. In this study, use of the same electronic medical data for both groups and care of all patients by the same medical staff minimized the potential of one group being affected more than the
other. This likely reduced the chance of bias.

Incomplete data documentation can lead to the exclusion of cases with HCV tests that were done but not documented. The effects of incomplete medical data on case exclusion may have affected the study’s findings with inaccurate reporting. Rigorous inclusion criteria, however, was needed to insure that the HCV diagnoses were accurate. Applying the same selection criteria to both groups again reduced potential bias.

Incomplete data documentation can also affect the reporting of any of the risk factors and covariates studied. Again, care of both study groups by the same medical staff and documentation in the same electronic medical record likely reduced the possibility of this bias affecting one group more than the other.

Consequences of Inadequate Risk Identification

Failure of the recognized HCV transmission risks to adequately describe infection compromised medical care for this population. Although previous guidelines did not recommend screening for HCV infection, this type of testing is now indicated for those born between 1945 and 1965 because of the availability of new, more effective treatment.28 These same guidelines suggested these individuals in the 1945–1965 birth cohort were infected in the past.28 However, if currently recognized HCV risk factors did not adequately describe HCV transmission for the Cambodian Americans in this study or for adults born between 1945 and 1965, this inadequate description of HCV risk suggested that other individuals may have been at risk unknowingly. This compromises the
health of a population and lends significance to the need for better recognition of HCV risk factors.

HCV risks that are poorly understood can have an impact beyond an ongoing risk of infection. Testing in a healthcare setting is triggered by the presence of previously recognized risk factors. Although some of the current national guidelines recommend baseline screening of all those born between 1945 and 1965, it is more likely that a person will be tested for hepatitis C if the health care worker feels the individual is at risk. The absence of known risk factors can be a barrier to screening if the HCV risk is unrecognized.

Areas for Further Study

Potential areas of further study include more detailed inquiry of Cambodian American individuals at LCHC as well as a larger inquiry of Cambodian Americans in the community and in the US regarding medical procedures, percutaneous exposures, family and sexual exposures that might have contributed to their HCV infection. Intravenous drug use is the predominant risk factor in the US,\textsuperscript{3,27,42} but there remains the possibility that certain pockets of the American population, such as this Cambodian American population in Lowell, may have different, previously unrecognized risk factors or forms of the above risk factors that are not immediately familiar to the health professionals providing their care.

Another area of study would be the evaluation of HCV infection rates in younger Cambodian Americans at LCHC. In Massachusetts, injection drug use
in 15–24 year olds contributes strongly to HCV infection. HCV screening for younger Cambodian Americans would better assess infection rates in Cambodians less than 30 years old. This would assess the accuracy of this study’s findings that few Cambodian individuals 20–30 years old have HCV infection.

**Conclusion**

Hepatitis C is a potentially devastating chronic viral infection. However, the predominant HCV risk factor in this group of Cambodian Americans in Lowell, Massachusetts does not seem to be intravenous drug use, the major risk factor nationally and for the non-Cambodian Americans in this study. This is a novel finding for Cambodian Americans. The major risk factor for Cambodian Americans in this study is, instead, the large number of individuals born between 1945 and 1965. Aside from this birth cohort, however, there is no clear, major risk factor present in this Cambodian American population to explain their HCV infection. A lack of recognizable HCV risk factors can affect the perception of any need for HCV testing. This serves as a potential barrier to care for Cambodian Americans and could continue to place Cambodian Americans and older adults at risk of HCV infection if their risks are not well understood.
Appendix

Figure 3. Distribution of ages at the time of HCV testing
Figure 4. Years of Arrival to the United States among Cambodian hepatitis C infected adults
List of Abbreviated Journal Titles

Alcohol Res Health Alcohol Research and Health
Alcohol Research and Health
Am Fam Physician American Family Physician
American Family Physician
Am J Gastroenterol American Journal of Gastroenterology
American Journal of Gastroenterology
Am J Public Health American Journal of Public Health
American Journal of Public Health
Am J Transplant American Journal of Transplantation
American Journal of Transplantation
Ann Intern Med Annals of Internal Medicine
Annals of Internal Medicine
Ann Surg Annals of Surgery
Annals of Surgery
CMAJ Canadian Medical Association Journal
Canadian Medical Association Journal
Hepat Mon Hepatitis Monthly
Hepatitis Monthly
Int J Med Sci International Journal of Medical Science
International Journal of Medical Science
J Hepatol Journal of Hepatology
Journal of Hepatology
J Viral Hepat Journal of Viral Hepatitis
Journal of Viral Hepatitis
MMWR Morbidity and Mortality Weekly Report
Morbidity and Mortality Weekly Report
New England Journal of Medicine
Oral Dis Oral Diseases
Oral Diseases
Semin Liver Dis Seminars in Liver Disease
Seminars in Liver Disease

Bibliography

1. AASLD/IDSA/IAS–USA. HCV testing and linkage to care. Recommendations for testing, managing, and treating hepatitis C.


33. SAS software, Cary, NC


Vita

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Education
2009–2015  MS, Health Services Research
Boston University School of Public Health, Boston, MA

1994–1999  MD
University of Miami School of Medicine, Miami, FL

1990–1994  BA cum laude, Biology with Advanced Standing
Harvard University, Cambridge, MA

Clinical appointments
8/16/10–present  Provider, Adult Medicine, Carino HIV Services
Lowell Community Health Center
Lowell, MA

7/11/05–7/31/10  Instructor of Medicine
Section of Infectious Diseases, Department of Medicine
Boston University School of Medicine
Boston Medical Center
Boston, MA

Postgraduate Education and Training
7/1/02–6/30/05  Infectious Disease Fellowship
UMass Memorial Medical Center
University of Massachusetts Medical School
Worcester, MA

7/1/99–6/30/02  Internship and Residency Programs
Internal Medicine
Baystate Medical Center
Western campus of Tufts University School of Medicine
Springfield, MA

Certifications
2003, 2013  American Board of Internal Medicine (ABIM) Certification
2006  ABIM Certification in Infectious Diseases
Licensure
2001–present Commonwealth of Massachusetts Board of Registration in Medicine Licensure, #216442

Clinical Experience
—Nine years of consultative and ambulatory care of patients with HIV and general Infectious Diseases with supervision of Infectious Disease fellows and Internal Medicine residents.
—Five years of Internal Medicine inpatient care in the role of attending with supervision and teaching of residents and medical students.
—Supervision of medical students and of residents participating in an ambulatory HIV rotation.
—Sub-Investigator in ACTG trials and other sponsored clinical trials through the Center for HIV/AIDS Care and Research at Boston Medical Center
—Specific experience in the treatment of immunocompromised patients including patients with HIV, solid organ transplant, bone marrow transplant and patients undergoing chemotherapy.
—Experience in an established travel clinic with pretravel vaccinations and infectious disease issues in returning travelers.
—Teaching second-year medical students in a physical exam instruction course. Instruction of dental students on issues related to HIV/AIDS in dental medicine.

Research Experience
4/2005–8/2007 University of Massachusetts Medical School, Richard T. Ellison, MD, Div. of Infectious Diseases
Clinical and Laboratory Findings in Individuals with Acute Norovirus Disease

12/2004–6/2005 University of Massachusetts Medical School, Jennifer Daly, MD and Robert Finberg, MD, Dept. of Medicine, Worcester, MA
A Randomized Trial to Determine the Clinical Use of a Urinary Streptococcus pneumoniae Antigen Detection Assay in Community Acquired Pneumonia.

2/2003–11/2004 University of Massachusetts Medical School, Robert Finberg, MD, Dept. of Medicine, Worcester, MA
The role of Toll-Like Receptors in neonate immunity

10/2000–6/2002 Baystate Medical Center, Richard Brown, MD, Dept. of Medicine, Infectious Disease Div., Springfield, MA
Potential impact of identified allergies on treatment during hospitalization

9/1995–8/1998  University of Miami, Marilyn Glassberg, MD, Dept. of Medicine, Pulmonary Division, Miami, FL
Effects of Endothelin on Mitogen-Activated Protein Kinase in bovine smooth muscle cells

6/1991–8/1994  Harvard University Medical School, Judah Folkman, MD, Donald Ingber, MD, PhD,
Dept. of Surgical Research, Boston, MA
Effects of TNP-470, an anti-angiogenic factor, on cytoskeletal components and associated signaling pathways

6/1990–8/1990  University of Miami, Marilyn Glassberg, MD, Dept. of Medicine, Pulmonary Division, Miami, FL
Endothelin’s proliferative effects on bovine endothelial cells and vascular smooth muscle cells.

9/1988–6/1990  University of Miami, Una S. Ryan, PhD,
Dept. of Medicine, Miami, FL
Atrial Natriuretic Peptide and Atriopeptin 1 effects on endothelial cell migration and division.

Honors and Awards
2005  Maxwell Finland Award for Excellence in Infectious Disease Research
Massachusetts Infectious Diseases Society

2005  University of Massachusetts School of Medicine
Medical Microbiology course, Infectious Disease section
Course Assistant

1999  Eastern Student Research Forum
co-director for Abstract and Judging committees
Miami, Florida

1996  Poster at Eastern Student Research Forum: Effects of Endothelin on Mitogen-Activated Protein Kinase in bovine smooth muscle cells
Miami, Florida

1996  Summer Research Program by U. of Miami Research and Graduate Studies
1990  Summer Research Program by U. of Miami Research and Graduate Studies

1989  Poster at International Society of Applied Cardiovascular Biology Young Investigator’s Award Gothenburg, Sweden

1989  Summer Research stipend from American Heart Association

1988–1989  Laboratory Experience Achievement Program

Professional Membership

2007–present  American Academy of HIV Medicine
2003–present  Infectious Diseases Society of America
2002–present  American College of Physicians-American Society of Internal Medicine

Publications


Miscellaneous
Bilingual (Spanish and English)