



Measuring Baseline Hepatitis C and HIV Screening Efficacy, Tattoo Prevalence, and Interest in Tattoo-Removal Services Among Patients in an MGH Community Health Center

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Scholarly Report submitted in partial fulfillment of the MD Degree at Harvard Medical School

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Student Name: Nicholas Jensen, BS

Scholarly Report Title: Measuring Baseline Hepatitis C and HIV Screening Efficacy, Tattoo Prevalence, and Interest in Tattoo-Removal Services Among Patients in an MGH Community Health Center

Mentor Names and Affiliations: Arianne Shadi Kourosch, MD, MPH, Dept of Dermatology, Massachusetts General Hospital

Collaborators, with Affiliations: Marya J. Cohen, MD, MPH, Dept of General Medicine, Massachusetts General Hospital

Abstract

TITLE: Measuring Baseline Hepatitis C and HIV Screening Efficacy, Tattoo Prevalence, and Interest in Tattoo-Removal Services Among Patients in an MGH Community Health Center

Nicholas Jensen, Arianne Shadi Kourosh, Marya J. Cohen

Purpose: The Crimson Care Collaborative (CCC) clinic at Massachusetts General Hospital's Chelsea HealthCare Center (CHC) provides primary care for post-incarcerated and other high-risk populations for whom screening for hepatitis C (HCV) and human immunodeficiency virus (HIV) is indicated. Successful treatment of these diseases depends upon timely diagnosis and the clinic's efficacy in screening. Tattoos are a visible risk factor for both diseases and can be a source of stigma for individuals in the community and workplace by standing as a barrier to social integration. This study seeks (1) to assess the baseline efficacy of HCV and HIV screening practices at the CCC, (2) to determine the prevalence of HCV and HIV among CHC patients, and (3) to determine the prevalence of tattoos and interest in tattoo removal services among CHC patients.

Methods: A written questionnaire was used to identify patients indicated for HCV and HIV screening and to determine the prevalence of tattoos and interest in tattoo-removal services. Chart review provided participants' screening test dates and results in order to calculate screening efficacy and the prevalence of HCV and HIV.

Results: 126 patients met criteria for inclusion in the study. Of the 35 patients indicated for HCV screening, 31 underwent screening (HCV screening efficacy of 88.6%). Of the 122 patients indicated for HIV screening, 116 underwent screening (HIV screening efficacy of 95.1%). The prevalence of HCV was 4.8% among all patients screened and 9.7% among patients indicated for screening who were screened, highest among post-incarcerated and tattooed patients. The prevalence of HIV was 0% among all patients screened. 24% of participants had at least one tattoo, and 53% of tattooed participants were interested in utilizing tattoo-removal services.

Conclusions: The CCC student-faculty clinic demonstrated rates for HCV and HIV screening higher than those published by other primary care practices, but patients at risk for infection were still identified who remained unscreened. This practice gap was larger for HCV screening than HIV screening based on screening efficacy values. Risk-based HCV screening, in particular, is an area for improvement compared to birth-cohort HCV screening. The prevalence of HCV is approximately 3 times higher among CHC patients than the general U.S. population, with a history of incarceration and tattoos being the most common non-age risk factors for infection. However, a larger study is needed to more accurately study

HIV prevalence at the CHC. Tattoo prevalence at the CHC is consistent with the national average, but study participants demonstrated an increased interest in utilizing tattoo removal services.

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Glossary of Abbreviations

AIDS	acquired immunodeficiency syndrome
ART	antiretroviral therapy
CCC	Crimson Care Collaborative
CDC	Centers for Disease Control and Prevention
CHC	Chelsea HealthCare Center
EMR	electronic medical record
HCV	hepatitis C virus
HIV	human immunodeficiency virus
IRB	institutional review board
MGH	Massachusetts General Hospital
PCP	primary care physician
SVR	sustained virologic response
USPSTF	United States Preventive Services Task Force

Section 1: Introduction

Specific Aims

In 2015 alone, over 640,000 prisoners were released from state and federal correctional facilities into the U.S. civilian population.¹ A history of incarceration is an independently associated risk factor for hepatitis C virus (HCV) infection,² and in 1997 it was estimated that between 29-43% of all Americans living with HCV had been held in a prison or jail within that year.³ HCV infection is also positively linked to prior acquisition of tattoos, especially those acquired in a correctional facility setting.^{4,5} Furthermore, the Centers for Disease Control and Prevention (CDC) reports that incarcerated individuals also face an increased risk of contracting human immunodeficiency virus (HIV).⁶

Massachusetts General Hospital (MGH) Chelsea Adult Medicine runs a student-faculty collaborative clinic in Chelsea, MA (“Crimson Care Collaborative at MGH Chelsea”) that offers care tailored to the needs of post-incarcerated patients. In addition to primary care, the Chelsea HealthCare Center (CHC) provides mental health services, HIV/AIDS care, and a hepatitis C clinic that together can address many of the health concerns that disparately affect this at-risk population, and a pro bono tattoo-removal clinic to assist patients with social reintegration has also been recently established. Considering the frequently asymptomatic onset of HCV infection^{7,8} and the underdiagnosis of both acute HCV and HIV infection,^{9,10} effective screening practices for these diseases in the community setting are essential for early disease detection and treatment in patients with risk factors including prior incarceration and tattoos. However, to date, the CHC has not evaluated the efficacy of its HCV and HIV screening protocols, which we define here as the percentage of patients with risk factors who agree to screening. In a setting where a greater number of at-risk patients may be presenting for care and to utilize free tattoo-removal services, we have implemented a questionnaire regarding HCV and HIV risk factors to identify these high-risk patients for whom screening is recommended. This questionnaire, which incorporates consent to screening and additional tattoo-related questions, in conjunction with the tracking of patients’ lab results in the electronic medical record (EMR), was used to achieve the following three specific aims:

Aim 1: To determine baseline efficacy of HCV and HIV screening in the Crimson Care Collaborative student-faculty clinic at the MGH Chelsea HealthCare Center which serves a large population of patients who are at risk of HCV and HIV infection secondary to incarceration and tattooing.

Aim 2: To determine the prevalence of HCV and HIV infection among patients cared for at the MGH Chelsea HealthCare Center, comparing the prevalence between four subgroups: 1) post-incarcerated patients, 2) tattooed patients, 3) post-incarcerated patients with tattoos, and 4) patients who meet screening criteria without the aforementioned risk factors.

Aim 3: To determine the prevalence of tattoos among patients receiving care at the MGH Chelsea HealthCare Center and to determine the percentage of patients with tattoos who desire to utilize tattoo-removal services available at the CHC.

By quantitatively measuring how effective the CHC is at encouraging these at-risk patients to consent to screening, we set out to inform and improve future clinical practices with respect to HCV and HIV screening and treatment delivery. This study's additional focus on identifying patients hoping to utilize free tattoo-removal services also shines light on the barriers to social reintegration that tattoos can generate as social determinants of health.

Significance

Numerous studies highlight incarceration as a social determinant of health, demonstrated by the fact that a prisoner's risk of HCV infection is directly related to his or her duration of incarceration.^{11,12} As a result, the Federal Bureau of Prisons currently recommends HCV screening for any inmate with risk factors for infection and HIV screening for all previously untested inmates to reduce the burden of disease and the risk of transmission during incarceration.¹³ However, risk-based testing in correctional facilities may fail to capture more than half of patients infected with HCV, resulting in delayed diagnosis and treatment for these individuals.¹⁴ This failure is especially alarming given that the HCV seropositivity rate for patients in correctional facilities may fall between 12-34%, compared to 1.6% among the general U.S. population.¹⁴ Therefore, since more than 95% of prisoners are eventually released back into society,¹¹ the diagnosis and treatment of these infectious diseases is often unknowingly postponed until the post-incarceration period.

Fortunately, hepatitis C is now, in many cases, a curable disease with direct-acting antiviral therapies achieving a sustained virologic response (SVR) in 90-100% of patients.¹⁵ Similarly, current antiretroviral therapy (ART) has transformed HIV from an AIDS-related death sentence into a chronic disease with often undetectable viral loads for many years. However, both of these positive outcomes depend upon early diagnosis of infection. Untreated hepatitis C develops into a chronic infection in the majority of acute cases, increasing these individuals' risk of cirrhosis and hepatocellular carcinoma after 30 years.¹⁶ For those unknowingly infected with HIV, the timeline to irreparable damage is much shorter as it usually only requires about 10 years for the virus to progress into AIDS, rendering those afflicted unable to fight off even simple infections.¹⁷

Given the large number of prisoners returning to American society each year and their increased risk of having acquired HCV or HIV prior to or during their incarceration, it is crucial to offer systematic screening to post-incarcerated patients, both to catch and treat these devastating diseases earlier and,

through counseling, to reduce their risk of unwittingly transmitting HCV and HIV to others. However, effective screening requires a few essential components, including provider knowledge about screening recommendations and risk factors for infection, the ability to elicit an accurate history of risk factors from patients, and ultimately patient consent to screening. Concerningly, a 2009 study revealed that 41.7% of the primary care physicians (PCPs) surveyed were unfamiliar with published guidelines for HCV screening.¹⁸ Additionally, as few as 59% of PCPs reported that they ask all of their patients about risk factors for HCV infection,¹⁹ and a 2003 chart review demonstrated that risk factors for HCV infection were discussed during less than 10% of initial patient visits.²⁰ Furthermore, due to the stigma associated with many of the risk factors for infection, including injection drug use, there is ongoing debate regarding the ability of risk-based screening to identify patients at highest risk for infection as these patients may be hesitant to endorse these behaviors, especially in a correctional facility setting.^{14,21} Unfortunately, even patient consent to screening is highly variable, and there is concern that those patients who turn down screening may have a higher risk of HIV infection.²² Considering the at-risk population served by the CHC, it is therefore crucial to evaluate how effectively the clinic is screening its patients for HCV and HIV as a first step to improving its services in these areas.

Innovation

Although the total numbers of new HCV and HIV cases in Massachusetts have decreased over the past 10 years, the demographic and risk history data associated with reported HCV cases are typically absent,^{23,24} making it challenging to assess which patient populations are and are not engaging in disease screening. However, recent data from Barnstable County jail suggest that over 60% of inmates who tested positive for HCV during incarceration did not seek follow-up services after release.²⁵ This indicates that post-incarcerated patients—who already face an increased risk of HCV and HIV—are likely falling between the cracks in the medical system after release. This project primarily aims to evaluate the efficacy of HCV and HIV screening among post-incarcerated patients and patients with tattoos. As the CHC has not conducted such an analysis to date, this project set out to establish baseline values for screening efficacy for at-risk patients seen at the clinic which can be used to tailor these services in the future.

Additionally, since weak incentives have presented as a barrier to screening post-incarcerated patients in the past,²⁶ this project launched concurrently with the opening of a free tattoo-removal program at the CHC. All patients seeking tattoo removal were offered the questionnaire, HCV and HIV screening, and enrollment in this study. We anticipated that the free tattoo-removal clinic would attract patients at a higher risk for infection for a variety of reasons, including the desire to reduce stigma associated with visible tattoos and to remove observable markings that indicate gang affiliation. Thus, we estimated that

this clinic would increase the number of at-risk patients screened for HCV and HIV and, therefore, the study's sample size.

Section 2: Student Role

During the initial phase of the project, I introduced the questionnaire to patients presenting at the clinic and offered, but did not administer, the optional blood draw to screen for these two infectious diseases. I also stood by to answer any questions participants had; I additionally reviewed the questionnaires for completion before the patients were discharged. For all patients with tattoos, regardless of whether or not they opted for screening, I discussed the free tattoo-removal program that is offered at the clinic. During the project's inaugural year, I served as the Administrative Director and Volunteer Coordinator for the pro bono tattoo-removal clinic (Project Phoenix), a role in which I coordinated questionnaire administration, performed a chart review for study participants, trained and led undergraduate and medical student volunteers, and assisted in scheduling and contacting patients for tattoo-removal appointments. I transitioned these duties to another medical student during my third year who continued the patient recruitment and data collection processes. I am additionally responsible for calculating the efficacy of HCV and HIV screening, the prevalence of HCV and HIV, the prevalence of tattoos, and the percentage of patients with tattoos who desire to utilize tattoo-removal services.

Section 3: Methods

Study Population

To be included in this study, individuals had to be at least 18 years old and must have been new or existing patients at the Chelsea HealthCare Center. Gender was not considered when recruiting or enrolling participants in the study.

Recruitment Timing

Recruitment of participants began after IRB approval in the spring of 2014. This analysis includes all participants enrolled during the first 25 months of the study. Recruitment occurred at the CHC on Tuesday evenings, during which time various specialty clinics which cater to these patients occur.

Recruitment Protocol

All patients who presented at the MGH Chelsea HealthCare Center for clinics serving certain higher risk demographics, including the CCC student-faculty clinic, mental health services, and the tattoo-removal clinic were offered a short questionnaire regarding HCV and HIV risk factors and tattoos. Before giving patients the questionnaire, the research team explained that the questionnaire is part of a study looking at how effectively the clinic is screening and treating its patients for hepatitis C and HIV. Patients were asked if they would be willing to allow their questionnaire responses and the results of their prior or current screening tests—if they chose to have them—to be used in the study anonymously. The research team also requested consent to access the patients' medical records to identify the results of screening tests for hepatitis C and/or HIV. It was emphasized that completing the questionnaire and being included in the study were completely optional and that the screening would still be offered whether patients chose to participate in the study or not. Among patients who chose to complete the optional questionnaire, only patients who met the eligibility criteria defined above were included in the study. The study authors, along with trained student clinicians, administered this questionnaire in patient rooms prior to or after the main clinical visit. Attending and resident physicians were present and available for assistance if necessary.

Patients were informed that, in their answers, they may choose to indicate interest in the free tattoo-removal clinic at the Chelsea HealthCare Center, and that patients who wished to enroll in the tattoo-removal clinic may be notified if they met its inclusion criteria. The questionnaire was completely optional and available in English and Spanish versions, and it was not included in the patient's medical record.

Data Aggregation and Participant Anonymity

Each participant in the study was assigned a unique code, and the index of patient names and their codes was stored in a password-protected Microsoft Access database accessible only to the researchers. In a separate database, the transcribed questionnaire responses and screening results, gathered via chart review of each study participant, were linked to the code that corresponds to the correct patient. All data for analysis were stored in the code-only database, ensuring that all research data remain anonymous to everyone except the research team. While the questionnaire results were only recorded in the code-only database accessible to the investigators, HCV and HIV screening results were treated as standard clinical care information and were, therefore, included in the participants' medical records for clinical use since screening would be indicated as part of the study participants' routine medical care, regardless of the study, given their risk factors.

Indications for Screening

All patients entering the CHC clinics on Tuesday nights that serve high-risk populations were offered the questionnaire regarding HCV and HIV risk factors. Among patients who completed the questionnaire and consented to inclusion in the study, this questionnaire identified patients for whom HCV and HIV screening was indicated secondary to specific risk factors; we refer to these individuals as at-risk patients. Consistent with United States Preventive Services Task Force (USPSTF) recommendations, indications for HCV screening included date of birth between 1945 and 1965 and specific risks for infection which included a history of injection drug use, prior incarceration, blood transfusion prior to 1992, and tattoos acquired in an unlicensed environment.²⁷ Again consistent with USPSTF recommendations, indications for HIV screening included age between 15 and 65 and specific risks for infection which included a history of injection drug use, prior incarceration, tattoos acquired in an unlicensed environment, and unprotected sexual contact with someone known or suspected to have HIV.²⁸ (Table 1)

Data Analysis and Statistical Methods

For participants indicated for screening, chart review revealed if or when HCV and HIV screening was conducted and the date of each participant's initial visit to the CCC health clinic. Participants were then divided into four categories based on when they were screened relative to their initial CCC visit: screening conducted prior to initial visit, within one month of initial visit, more than one month after initial visit, or never conducted. Screening efficacy was then calculated according to the formula below (Aim 1):

$$\text{HCV/HIV screening efficacy} = \frac{\# \text{ of at - risk patients screened}}{\# \text{ of at - risk patients}}$$

Chart review also provided participants' HCV and HIV screening results which were used to calculate the prevalence of HCV and HIV infection among the study groups (Aim 2). Only participants who underwent screening were included in prevalence calculations.

Participants' questionnaire responses were used to calculate the prevalence of tattoos in the study population, according to the formula below (Aim 3):

$$\text{Tattoo prevalence} = \frac{\# \text{ of participants with tattoos}}{\text{total \# of participants}}$$

Patients with tattoos were also queried on the questionnaire regarding their desire to have any of their tattoos removed, with this needs assessment calculation reflected in the following formula (Aim 3):

$$\text{Prevalence of interest in tattoo – removal services} = \frac{\# \text{ of participants with tattoos seeking removal}}{\# \text{ of participants with tattoos}}$$

Since the CHC has never conducted such an analysis in the past, these calculations established baseline values for screening efficacy, HCV and HIV prevalence, tattoo prevalence, and patient desire for tattoo-removal services. No power calculation was needed because no prior data exist to which this study's data could be compared. We estimated that 75 to 100 patients would enroll in this study.

IRB and Ethical Considerations

To protect the anonymity of the study participants, all research data, including screening results and questionnaire responses, were recorded in a coded database separate from the password-protected index—accessible only to the research investigators—that links the unique codes to their participant identities. Additionally, all patients who were invited to be included in the study were informed that they could still receive HCV and HIV screening and free tattoo removal even if they wished to opt out of participation in the project. Finally, patients who chose to undergo screening were counseled regarding the minimal risk of injury associated with the standard blood draw.

Section 4: Results

Patient Characteristics

A total of 126 patients were enrolled in the study over its first 25 months. 73 participants (58%) were male, and 53 participants (42%) were female. The mean age of study participants at the date of study consent was 38.2 years. (Table 2)

Aim 1: Hepatitis C Screening Efficacy

35 participants (27.8% of study population) were indicated for HCV screening. The most common single indication for screening was birth date between 1945-1965 (15 patients, 43%), followed by unlicensed tattoo acquisition (7 patients, 20%). 3 patients were indicated for screening due to prior incarceration alone (9%), and injection drug use alone did not account for any indicated screenings. The remaining 10 patients (29%) were indicated for HCV screening due to a combination of the risk factors above (Table 3).

31 of the 35 patients indicated for HCV screening were screened, yielding an HCV screening efficacy of 88.6%. When broken down by timing of screening relative to the initial CCC visit date, 23% of these patients were screened prior to their initial visit, 46% were screened within one month of their initial visit (3 days on average after visit date), 20% were screened more than one month after their initial visit (230 days on average after visit date), and 11% remained unscreened (Table 5).

Aim 1: HIV Screening Efficacy

122 participants (96.8% of study population) were indicated for HIV screening, all of whom warranted screening based on age between 15 and 65. For 100 of these patients (82%), age was the only screening indication. Unlicensed tattoo acquisition was the most common sole additional risk factor (8 patients, 7%), followed by prior incarceration (4 patients, 3%). The remaining 10 patients (8%) were indicated for HIV screening due to additional combinations of risk factors, including injection drug use and unprotected sexual contact with a person known or suspected to have HIV (Table 4).

116 of the 122 patients indicated for HIV screening were screened, yielding an HIV screening efficacy of 95.1%. When broken down by timing of screening relative to the initial CCC visit date, 23% of these patients were screened prior to their initial visit, 57% were screened within one month of their initial visit (3 days on average after visit date), 15% were screened more than one month after their initial visit (559 days on average after visit date), and 5% remained unscreened (Table 5).

Aim 2: Hepatitis C Prevalence

Of the 31 patients indicated for HCV screening who underwent screening, 3 tested positive for HCV, yielding a prevalence of 9.7% among patients indicated for screening. When these patients are divided into subgroups based on prior incarceration and tattoo acquisition as risk factors, the prevalence of HCV was 0% for the post-incarceration group (n=3), the tattooed group (n=10), and the group with neither risk factor (n=12). The group with both prior incarceration and tattoos as risk factors (n=6) demonstrated an HCV prevalence of 50% (Table 6).

Among the entire study population, including those for whom screening was not indicated based on known risk factors, 83 patients were screened for HCV. The prevalence of HCV among all patients tested at the clinic was 4.8% (4 patients). Of note, only 1 patient tested positive for HCV who did not warrant screening based on risk factors queried on the study questionnaire.

Aim 2: HIV Prevalence

Of the 116 patients indicated for HIV screening who underwent screening, 0 tested positive for HIV, yielding a prevalence of 0% among patients indicated for screening. Consequently, the prevalence of HIV was 0% for the four subgroups based on prior incarceration and tattoo acquisition as risk factors (Table 6).

Among the entire study population, including those for whom screening was not indicated based on known risk factors, 120 patients were screened for HIV. The prevalence of HIV among all patients tested at the clinic was also 0%.

Aim 3: Tattoo Prevalence and Interest in Tattoo-Removal Services

Among the entire study population, 30 patients (24%) endorsed having at least one tattoo. The tattoo prevalence among females was 28%, and the tattoo prevalence among males was 21%. Tattoos were more common among the post-incarcerated patient population, of whom 67% had tattoos. Tattooed patients had, on average, 4.5 tattoos per patient. Of patients with tattoos, 53% (16 patients) were interested in utilizing tattoo-removal services, comprising 40% of the females with tattoos and 67% of the males with tattoos (Figure 1). Four patients interested in tattoo removal felt judged or were afraid that they may be judged because of their tattoos, two of whom additionally cited difficulty getting a job because of their tattoos as a reason for interest in removal. Other reasons for interest in tattoo removal included regret over getting the tattoo (n=8), the desire to remove a person's name (n=3), and dissatisfaction with the tattoo's appearance or location (n=5).

Notably, 14 patients with tattoos (47%) acquired at least one tattoo in an environment known or suspected to be unlicensed.

Section 5: Discussion, Limitations, Conclusions, and Suggestions for Future Work

Aim 1: HCV Screening Efficacy

Overall, 27.8% of the participants in this study were indicated for HCV screening, 89% of whom underwent screening. Age was the most prevalent indicator for screening, with 57% of indicated patients falling into the 1945-1965 birth cohort. While identification of these patients for screening requires that a provider is solely aware of a patient's age, identification of the remaining 43% of indicated participants born outside of this range stands as a more challenging endeavor, requiring a more intrusive discussion regarding each patient's specific risk factors. This increased difficulty in identifying patients at risk for HCV infection outside of the birth cohort is reflected by the fact that 95% of birth-cohort patients underwent HCV screening compared to 80% of non-birth-cohort patients who warranted screening due to a history of incarceration, injection drug use, or unlicensed tattoo acquisition, factors which providers must discuss with their patients in order to identify the need for screening. Although this study did not include a comprehensive review of participants' provider notes and therefore cannot conclusively determine why a minority of indicated patients were not screened, two possibilities stand out as most likely: either providers did not discuss these risk factors and did not consider HCV screening in these patients, or these patients declined testing. Data from a 2015 large health system study evaluating HCV screening patterns lends support for the former, as patients with no documented history of drug use demonstrated the lowest screening rates for HCV, surprisingly lower even than rates for patients with a history of never using drugs.²⁹ While it is estimated that 75% of patients infected with hepatitis C fall within the birth cohort and thus may be easily identified for screening,³⁰ there has been a recent concerning increase in HCV infection among young adults attributed to a rise in injection drug use in this demographic.³¹ As a result, it is more important than ever for providers to be aware of the risk factors for HCV infection—beyond just birth cohort screening—and to initiate discussions with patients to identify those at greatest risk for infection and, thus, greatest need for screening.

Reassuringly, this study demonstrates that 89% of participants indicated for HCV screening were appropriately screened. Due to the heterogeneous design of studies evaluating screening for hepatitis C, it is difficult to directly compare this value to the screening efficacy of other clinics, as many studies focus on screening rates for a specific at-risk population (e.g., birth cohort) or for entire clinic populations, and these studies exclude patients who were previously screened. While this study intended to evaluate the screening efficacy for all CCC patients, including those screened prior to becoming CCC patients, we do recognize the importance of identifying previously unscreened patients, who comprised 77% of those indicated for screening. Of this previously untested cohort, 59% were screened within one month of the initial visit, and 26% were screened, on average, over half a year later, resulting in 85% of previously

unscreened patients undergoing screening. This screening rate compares favorably to that of a similar hospital-based urban primary care clinic that reported a baseline birth-cohort screening rate of 55%, which rose to 75% after the introduction of a multipronged HCV screening initiative.³² Another study that utilized a similar risk-identification questionnaire reported a screening rate of 55.4% for patients who had at least one risk factor for HCV infection.³³ Notably this latter study appears to have had a patient population similar to that of the CCC, as 27.8% of its study participants were indicated for screening based on the questionnaire—the same percentage indicated for screening in this study. It should also be noted that both of these comparable studies included much larger sample sizes—4,419 and 902 participants, respectively—improving their ability to extrapolate to the larger clinic population compared to this study.

Of course, while the CCC's HCV screening rates appear to outperform those of similar clinics, it remains important to recognize that 15% of previously unscreened at-risk patients at the CCC, comprising 11% of all patients indicated for screening, did not have evidence of screening in the EMR. While performing better than other clinics is good, such relative performance is not and should not be the standard of care. Considering that 75% of the unscreened at-risk patients were indicated for screening due to risk factors other than age, these patients appear at greater risk of being overlooked for screening than patients in the birth cohort who may be more easily identified as at-risk for infection. Future studies may further investigate what factors contribute most to these at-risk patients not undergoing screening in order to inform innovations to close this practice gap.

Aim 1: HIV Screening Efficacy

Overall, 96.8% of study participants were indicated for HIV screening, 95% of whom underwent screening. Compared to HCV screening, HIV screening is recommended for a much larger proportion of patients owing to its broader at-risk age range between 15-65 years. As a result, all of the patients indicated for screening in this study warranted screening based on age alone, although 18% of these patients endorsed additional risk factors that placed them at even higher risk for infection including injection drug use, tattoos, prior incarceration, and unprotected sexual contact with someone known or suspected to have HIV. Given that age alone would capture all of the patients indicated for HIV screening in this study population, discussion with patients about these additional risk factors serves a separate but equally important role in screening practice—to evaluate ongoing risky behaviors that may inform how often these patients should be screened, rather than if they should be screened. While the question regarding ideal screening intervals for patients persistently at risk for HIV infection is certainly important, this issue currently remains unresolved²⁸ and is beyond the scope of this study.

Among the patients indicated for HIV screening, 23% underwent screening prior to their initial CCC visit. Of the previously unscreened patients, 74% were screened within one month of their initial visit and 19% were screened, on average, 1.5 years after their initial visit, resulting in 93% of previously unscreened patients undergoing HIV screening. This high level of adherence to guideline-recommended screening at the CCC is notable, as a 2014 survey of PCPs revealed that 50% and 29% of respondents were unaware that routine screening is indicated for teenage and adult patients, respectively, who do not have specific risk factors for infection.³⁴ Furthermore, the 2015 HIV Primary Care National Survey discovered that only 38% of PCPs who do not specialize in HIV care offer routine HIV screening, tending instead to base screening on risk factors for infection despite current guidelines recommending routine—rather than solely risk-based—screening.³⁵ This knowledge and practice gap combined with additional barriers including stigma associated with screening, provider and patient discomfort surrounding the topic of HIV, and insufficient access to or knowledge about HIV treatment resources has resulted in surprisingly low screening rates in primary care practices, in some cases as low as 1.8% to 9.2% even following interventions to increase screening.^{36,37} For the CCC, provider knowledge regarding screening guidelines appears to be high considering the screening efficacy of 95%; additionally, access to HIV treatment resources is easily available at the CHC through its on-site HIV clinic. Thus, these common barriers seem unlikely to account for the minority of patients who did not undergo screening despite being indicated. More likely contributing issues include failure to remember screening, lack of time during clinical visits to discuss screening, patient preference to avoid screening, or a history of prior screening not documented in the EMR. As mentioned before, this study did not include a review of participants' provider notes, making these potential reasons for non-screening speculative rather than conclusive, and future work may focus on identifying the reasons why these patients indicated for screening did not receive it in order to ensure that each patient has access to the standard of care for HIV screening moving forward.

Aim 2: HCV Prevalence

The prevalence of HCV infection was 4.8% among all study participants screened for HCV. This rate is approximately three times greater than that of the general U.S. population,¹⁴ reflecting the greater exposure to risk factors among patients who receive care at the CHC. The prevalence increased to 9.7% among only patients indicated for screening according to USPSTF recommendations, suggesting that current guidelines do increase the specificity of screening compared to routine screening. Among those indicated for screening, all patients diagnosed with HCV were included in the post-incarcerated and tattooed subgroup which had an HCV prevalence of 50%. These findings are consistent with previous literature which has identified both a history of incarceration and tattoo acquisition, especially in a correctional facility setting, as independent risk factors for HCV infection.^{2,4,5} While no patients with a

history of either incarceration or tattoos—but not both—were found to have HCV, this finding is most likely due to the small sample size of the study and does not support the conclusion that incarceration and tattoo acquisition only pose a risk for infection when combined. Among study participants with a history of incarceration, the prevalence of HCV was 33%, also supporting estimates of HCV prevalence rates ranging from 12-34% in correctional facilities.¹⁴

Notably, not all patients diagnosed with HCV belonged to the 1945-1965 birth cohort. (The exact percentage of HCV positive patients belonging to the birth cohort is not included to protect participant anonymity due to the limited number of study participants diagnosed with HCV.) This fact emphasizes the importance of assessing risk factors for infection in each patient to guide screening, especially in patients not indicated for screening based on age alone. This point is further bolstered by a 2013 study that concluded that birth-cohort screening alone would only identify 68% of patients infected with HCV.³⁸ Interestingly, this same study reported that risk-based screening alone would identify merely 27% of cases of HCV; among our entire study population, in contrast, risk-based screening would have identified 75% of cases. Certainly, risk-based screening practices are subject to much more variability than age-based protocols and are dependent upon a strong trust-based patient-provider relationship as well as patients accurately recalling prior risk exposures.³⁰ Overall, our results illustrate that an HCV screening approach that utilizes both birth-cohort and risk-based strategies is superior to either screening protocol in isolation. Nevertheless, even this comprehensive approach may fail to identify cases of HCV if providers are unable to establish a relationship with their patients in which these sensitive conversations can occur or if patients cannot accurately remember their past risky behaviors.

Aim 2: HIV Prevalence

The prevalence of HIV infection was 0% among the entire study population. Consequently, there was no difference in the prevalence of HIV between the four subgroups based on prior incarceration or acquisition of tattoos. The study population did exhibit an increased prevalence of HCV compared to the general population as discussed above, and the same risk factors likely responsible for this increased rate of HCV infection (i.e., prior incarceration, injection drug use, unlicensed tattoos) could theoretically increase the rate of HIV infection in this population, as well. However, HIV infection is less common in the United States than hepatitis C—affecting approximately 1.2 million people in America in 2013³⁹ compared to HCV's estimated 3.2 million.²⁹ As a result, it is not especially surprising that no cases of HIV were identified during the course of this study despite this population's increased risk, and a much larger sample size would be needed to effectively evaluate which risk factors are most common among CHC patients infected with HIV.

Aim 3: Tattoo Prevalence and Interest in Tattoo-Removal Services

The overall prevalence of tattoos within the study population was 24%, with tattoos being more common among females than males. These results are quite similar to data collected by the 2015 Harris Poll which reported a 29% prevalence among Americans as well as an increased prevalence among females.⁴⁰ Our finding that tattoos were more common among post-incarcerated patients is similarly consistent with previously published studies demonstrating that 66-70% of incarcerated individuals have tattoos.⁴¹ These data points indicate that the patient population at the CHC is largely reflective of the national population in terms of tattoo trends.

However, the CHC patient population does stray from the national norm regarding its interest in tattoo removal. Whereas 23% of those surveyed in the Harris Poll endorsed tattoo regret and 17% of tattooed individuals in a separate national survey were interested in tattoo removal,^{40,42} this study identified that 53% of tattooed patients at the CHC were interested in utilizing tattoo-removal services. Interestingly, although women tend to face more societal judgment and stigma for having tattoos than men,⁴³ a greater proportion of men with tattoos in this study sought to have them removed. The reasons that study participants cited for their interest in tattoo removal were consistent with previously published themes, including displeasure with a tattoo's appearance, desire to remove a former partner's name, shame, perception of judgment, employment purposes, and dissociation from a prior identity, lifestyle, or affiliation.^{41,43} Importantly, these concerns about judgment and professional appearance are valid and may adversely affect one's ability to gain employment⁴⁴ due to stereotypes about tattooed persons of decreased competence, credibility,⁴⁵ attractiveness, and intelligence.⁴⁰ Of even greater concern to this study's participants with histories of incarceration and gang-affiliation, tattoos may pose a threat to these patients' safety as a review of autopsy data from 2002-2005 determined that victims of homicide had a 1.8 times increased likelihood of having a gang tattoo compared to victims of accidental death.⁴⁶

Overall, this study population has a higher percentage of its tattooed patients seeking removal services than national data would suggest, citing reasons that have been shown to negatively impact career opportunities and safety. The tattoo removal process requires anywhere from 6 to upwards of 10 sessions to achieve adequate removal,⁴⁷ with the cost of each session ranging from \$200-\$500,⁴⁸ placing this impactful procedure out of reach for many patients who may need it the most. As a result, the CHC has demonstrated a need for a pro bono tattoo-removal clinic to reduce the impact that tattoos may have on its patients' social mobility, mental well-being, and safety.

Limitations

The primary limiting factor for this study is its relatively small sample size owing to the CCC's nature as a student-faculty clinic that operates one evening each week. This schedule of the enrollment site did limit the number of patients included in the study which may limit generalizability to larger primary care practices. Because Aim 1 focuses on the HCV and HIV screening efficacies at the CCC clinic specifically, this small sample size simply reflects the student-faculty clinic's smaller patient panel and, therefore, accurately captures screening efficacy values for the CCC. For Aims 2 and 3, however, CCC patients were enrolled to evaluate HCV, HIV, and tattoo prevalence rates for the Chelsea HealthCare Center at large, in which the CCC operates. Consequently, it is possible that prevalence rates at the CCC do not perfectly reflect those of the larger CHC patient population, as patients who receive care at the CCC may possess a different risk profile than those at the CHC who do not receive care at the CCC. However, because all CCC patients are required to be patients of the Chelsea HealthCare Center and are generally referred to the CCC from CHC urgent care and primary care providers, we feel that prevalence data from the CCC do provide an accurate estimate of HCV, HIV, and tattoo prevalences at the Chelsea HealthCare Center.

Concerning screening efficacy determination specifically, this study may have increased the rates of HCV and HIV screening per the Hawthorne effect by raising awareness about ideal screening practices among clinicians. Because this study relied on enrollment of participants during clinic sessions, it did not include a historical sample group and is therefore unable to determine the rates of HCV and HIV screening prior to the study's implementation. Thus, overestimation of HCV and HIV screening efficacies is a possibility. Furthermore, screening efficacy calculations relied upon identifying patients indicated for screening based on their questionnaire responses, and recall bias from patients inaccurately reporting or remembering prior exposures to risk factors may result in at-risk patients not being screened. Given that patients tend to underreport these exposures,³⁰ this would likely cause an overestimation of screening efficacy, as well as an underestimation of HCV and HIV prevalence rates as these patients may remain unscreened. Opposing the overestimation risk secondary to the Hawthorne effect and recall bias, one factor in the study design that may artificially decrease the screening efficacy is that provider notes were not reviewed to assess why screening was not performed for some indicated patients. These notes may have discussed results from HCV and HIV testing conducted elsewhere that were not included in the EMR; if present, these patients would be incorrectly included in the "Never Screened" group rather than the "Screened Prior to CCC" group.

Conclusions

In conclusion, the CCC student-faculty clinic demonstrated rates for HCV and HIV screening higher than those published by other primary care practices, but patients at risk for infection were still identified who

remained unscreened. This practice gap was larger for HCV screening than HIV screening based on screening efficacy values. Physicians should focus on discussing risk factors for HCV infection with their patients, as patients with risk factors alone were screened less reliably than those belonging to the 1945-1965 birth cohort; this is especially important in the context of rising injection drug use among young adults. Furthermore, the prevalence of HCV among CHC patients is approximately three times the national average, and a history of incarceration and tattoos were the greatest risk factors for infection among this population. Because no cases of HIV were identified, a larger study would be helpful to more accurately assess the prevalence of HIV at the CHC and to better evaluate which risk factors are most common among CHC patients with HIV. Finally, the percentage of patients with tattoos at the CHC is consistent with the national average, but this patient population demonstrated an increased interest in utilizing tattoo-removal services compared to national data. Considering the negative impacts that tattoos can have on an individual's professional goals, social acceptance, and safety combined with the high cost of tattoo removal, this increased interest demonstrates the need for a pro bono tattoo-removal clinic at the CHC.

Suggestions for Future Work

In the future, it would be helpful to evaluate what impact a study such as this has on screening rates and to determine if any increase in screening due to a study is sustained over time; this would provide a more accurate assessment of screening rates beyond the duration of the study. Additionally, a follow-up study evaluating HCV screening rates between one group that completes a risk-assessment questionnaire and a control group that relies solely on provider-determined screening would help to identify if such a questionnaire improves HCV screening efficacy and diagnosis by standardizing the risk-assessment process. If successful, such a questionnaire could be published and disseminated to improve HCV screening at other primary care clinics. Furthermore, as was mentioned before, a more focused analysis regarding the reasons why patients who were identified as at-risk did not receive appropriate screening for HCV or HIV would be beneficial for the sake of guiding future efforts to improve screening rates. With regards to tattoos, the opening of the pro bono tattoo-removal clinic at the CHC allows for further investigation of tattooed patients' motivations for seeking removal. For patients who complete the tattoo-removal process, it would be informative to evaluate their level of satisfaction with tattoo removal as well as how effectively tattoo removal addressed their initial motivations to utilize this service.

Section 6: Acknowledgements

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Tables and Figures

Table 1: Indications for Screening	
Hepatitis C	HIV
Born between 1945-1965	Age between 15-65 years
History of injection drug use	History of injection drug use
Tattoos acquired in unlicensed environment	Tattoos acquired in unlicensed environment
History of incarceration	Unprotected sexual contact with someone known/suspected to have HIV
Blood transfusion prior to 1992	

Table 2: Patient Characteristics	
Total participants	n = 126
Male	73 (58%)
Female	53 (42%)
Average Age at Study Consent Date	38.2 years

Table 3: Hepatitis C Screening Indications	
Age (born between 1945-1965) alone	15 (42.9%)
Unlicensed tattoo acquisition alone	7 (20.0%)
Prior incarceration alone	3 (8.6%)
Prior incarceration + unlicensed tattoo acquisition	3 (8.6%)
Age + prior incarceration	2 (5.7%)
Prior incarceration + injection drug use + unlicensed tattoo acquisition	2 (5.7%)
Age + unlicensed tattoo acquisition	1 (2.9%)
Age + prior incarceration + injection drug use	1 (2.9%)
Age + prior incarceration + injection drug use + unlicensed tattoo acquisition	1 (2.9%)
Injection drug use alone	0 (0%)
Patients indicated for HCV screening	35 (27.8% of study population)

Table 4: HIV Screening Indications	
Age between 15-65 alone	100 (82.0%)
Age + unlicensed tattoo acquisition	8 (6.6%)
Age + prior incarceration	4 (3.3%)
Age + unlicensed tattoo acquisition + prior incarceration + injection drug use	3 (2.5%)
Age + known/suspected HIV contact	2 (1.6%)
Age + prior incarceration + unlicensed tattoo acquisition	2 (1.6%)
Age + prior incarceration + known/suspected HIV contact	1 (0.8%)
Age + prior incarceration + known/suspected HIV contact + injection drug use	1 (0.8%)

Age + prior incarceration + known/suspected HIV contact + unlicensed tattoo acquisition	1 (0.8%)
Patients indicated for HIV screening	122 (96.8% of study population)

Table 5: HCV and HIV Screening Efficacy

	HCV	HIV
Indicated for screening	35	122
Screened prior to CCC	8 (23%)	28 (23%)
Screened <1 month after initial CCC visit	16 (46%)	70 (57%)
Screened >1 month after initial CCC visit	7 (20%)	18 (15%)
Never Screened	4 (11%)	6 (5%)
Screening Efficacy	88.6%	95.1%

Table 6: HCV and HIV Prevalence Among Patients Indicated for Screening Who Underwent Screening

	HCV	HIV
Post-incarcerated	0% (0/3)	0% (0/4)
Tattooed	0% (0/10)	0% (0/20)
Post-incarcerated and tattooed	50% (3/6)	0% (0/7)
Neither post-incarcerated nor tattooed	0% (0/12)	0% (0/85)
Prevalence	9.7%	0%

