AIDS Behav (2015) 19:2025–2035
DOI 10.1007/s10461-015-1103-1

ORIGINAL PAPER

Factors Influencing Uptake of Rapid HIV and Hepatitis C Screening Among Drug Misusing Adult Emergency Department Patients: Implications for Future HIV/HCV Screening Interventions

Roland C. Merchant[1,2] · Allison K. DeLong[3] · Tao Liu[4] · Janette R. Baird[1]

Published online: 3 June 2015

Abstract In this randomized, controlled trial among 957 English- or Spanish-speaking drug misusing adult emergency department (ED) patients, we determined if a tailored brief intervention (BI) increased uptake of rapid HIV/HCV screening, and identified factors associated with greater screening uptake. Rapid HIV/HCV screening uptake was greater in the control than the BI arm (45 vs. 38 %; $p < 0.04$). Screening uptake depended on elapsed study time and which research staff member offered testing. In the control arm, uptake was lowest for those spending <30 or ≥90 min in the study. In the BI arm, screening uptake generally increased over time. Tailored BI content specifically addressing participant HIV/HCV knowledge, HIV/HCV risk behaviors, or need for HIV/HCV screening was not associated with greater screening uptake. These study findings suggested factors that should be considered when designing future ED-based screening initiatives, such as elapsed study time, who offers testing, and the content of interventions.

Keywords HIV · Hepatitis C · Emergency medicine · Mass screening · Intervention studies · Drug abuse

Introduction

Due to the overlap of risk behaviors for HIV and hepatitis C virus (HCV) acquisition [1, 2], the relative high co-occurrence of these infections in some populations [3–10], and the potential for more complex medical needs and worse sequelae for those co-infected [11–18], it is appropriate that emergency departments (EDs) in the United States (US) screen patients for both infections. Screening is especially warranted for patients at higher risk for HIV/HCV, including those who misuse drugs. However, some ED patients decline screening, despite their risk. A common reason ED patients decline HIV screening is a belief of not being at risk for HIV [19–31], although ED patient self-perceived and self-reported HIV risk are not necessarily congruent [32]. Overcoming this patient-level barrier remains elusive, despite efforts to improve screening uptake, including using an opt-out HIV approach [19, 33–40] financial incentives [41], ED staff or clinician-initiated testing [20, 33, 42], oral fluid sampling for testing [43], prevention counseling [44], and video or computer-based interventions [45–47]. Motivational interviewing encased in a brief intervention (BI) might be a valuable technique to encourage ED patients to face their risk for these infections and undergo rapid HIV/HCV screening. BIs have been successful in increasing HIV screening uptake among sexually transmitted clinic patients [48], improving

Electronic supplementary material The online version of this article (doi:10.1007/s10461-015-1103-1) contains supplementary material, which is available to authorized users.

✉ Roland C. Merchant
rmerchant@lifespan.org

[1] Department of Emergency Medicine, Rhode Island Hospital, Alpert Medical School of Brown University, 593 Eddy Street, Claverick Building, Providence, RI 02903, USA

[2] Department of Epidemiology, School of Public Health, Brown University, Providence, RI, USA

[3] Center for Statistical Sciences, School of Public Health, Brown University, Providence, RI, USA

[4] Department of Biostatistics, Center for Statistical Sciences, School of Public Health, Brown University, Providence, RI, USA

substance misuse treatment patients' HIV/HCV risk factor knowledge [49], reducing young gay/bisexual men's drug use and anal sex without condoms [50], and increasing ED patients' confidence in their ability to decrease their alcohol use and increase condom use with regular sexual partners [51].

We previously conducted a small randomized, controlled trial examining a BI to increase combined rapid HIV/HCV screening among 395 ED patients who reported any prescription or illicit drug use (injection or non-injection) within the past 3 months [52]. Although uptake of screening was high, uptake was nearly identical for those randomly assigned to receive a BI versus no BI (64.5 vs. 65.2 %; $\Delta = -0.7$ %; 95 % CI −10.1 to 8.7). Possible reasons for the lack of impact of the BI to increase screening uptake include the narrow focus of the intervention (primarily focused on HIV/HCV screening uptake instead of drug misuse and their interrelationship), the brevity of the intervention (which might not have allowed for sufficient time to develop a therapeutic bond), and the inclusion of patients with low levels of drug use/misuse who might not be as motivated to be tested as those with higher levels of drug misuse and might be at greater risk for HIV and HCV.

We recently completed a larger, randomized, controlled trial of a BI primarily aimed to decrease drug misuse among ED patients with a greater severity of drug misuse. In this study, we also investigated if a tailored BI that comprehensively addressed drug misuse, HIV/HCV risk-taking behaviors and need for HIV/HCV screening conferred greater uptake of rapid HIV/HCV screening than no BI. Further, we examined patient and study-level factors that might influence screening uptake and could inform future screening initiatives, such as demographic characteristics of study participants, self-reported HIV/HCV risk-taking behaviors, severity of drug misuse and consequent need for a more intensive intervention, content of the BI, the personal influence of the study staff, and elapsed study time (time elapsed while participating in the study). This investigation focuses on the HIV/HCV screening results from this larger, more comprehensive trial of a BI aimed at decreasing drug misuse and increasing HIV/HCV screening uptake among ED patients who require at least a brief or more comprehensive intervention for their drug misuse.

Methods

Study Design and Setting

Brief Intervention for Drug Misuse in the Emergency Department (BIDMED) was a randomized, controlled trial conducted over a 30-month period from July 2010 through December 2012 at two urban EDs affiliated with a medical school in the same hospital system and city in New England. One ED is a Level 1 trauma center with an annual patient volume of >100,000 adult visits/year, and the other is a community hospital ED with an annual patient volume of >55,000 adult visits/year. Among all samples submitted to this hospital system's laboratory from July 2012 through June 2013 for HIV and hepatitis C testing, the seroprevalence was 5.3 % for HCV antibody and 1.3 % for HIV antibody (unpublished data). Among its general adult population, the state has one of the highest reported prevalences of drug dependency in the United States (9–13 %) [54]. The hospital institutional review board approved the study.

Study Population

BIDMED was conducted from 8:00 am to midnight 7 days a week when bilingual (English- and Spanish-speaking) research assistants (RAs) could conduct the study. Before each shift, the RA generated lists of the patient rooms in each ED in random order with replacement using an internet-based random selection program (www.random.org). The RAs first evaluated the ED electronic medical record (EMR) of patients whose rooms were selected randomly. If the ED EMR review indicated that the patient was potentially eligible for the study, the RAs would ask about their demographic characteristics, confirm their study eligibility through a brief interview and administer the subsequent study instruments.

Patients were study eligible if they qualified for a brief or more intensive intervention for drug misuse according to World Health Organization (WHO) recommendations per their responses to the Alcohol, Smoking and Substance Involvement Screening Test, Version 3 (ASSIST) [53], modified for the purposes of this study (as described in detail previously) [52]. Per WHO recommendations, an ASSIST score of four or more points for any of 12 drug categories suggests a need for BI, and a score of ≥27 points suggests a need for a more intensive intervention. Because the WHO also recommends that anyone who has ever injected drugs should receive at least a BI, any patient who reported ever injecting drugs was study eligible. Additional inclusion/exclusion criteria were age 18–64 years-old (which is the age group which CDC currently targets for *en masse* HIV screening in healthcare settings); English- or Spanish-speaking; not critically ill or injured; not a prison inmate, under arrest, or undergoing home confinement; not presenting for an acute psychiatric illness; not intoxicated; and not having a physical disability or mental impairment that prevented providing consent or participating in the study.

In pursuit of the goal of a representative sample of patients and to avoid influences other than the study on measured outcomes, ED staff members were not permitted

to encourage, refer, or discourage patients to be in the study. Patients were informed during the consent process that they were being asked to enter a randomized, controlled trial regarding reducing their drug use and misuse and its relationship to HIV and HCV, but were not informed that they would be offered rapid HIV/HCV screening. They also were informed that the study investigators obtained a certificate of confidentiality from the National Institutes of Health about participant drug use and misuse. Participants received a gift card to a local store for being in the study.

Study Protocol

Following study consent and 1:1 random assignment into one of two study arms (BI or no BI [control arm]), participants completed a battery of questionnaires using an audio computer-assisted interviewer (ACASI), including an HIV/HCV risk-taking behaviors questionnaire adapted from our previous studies [52, 54, 55]. This questionnaire asked about injection-drug use and HIV/HCV sexual risk-taking behaviors by gender and according to type of sexual partner (main, casual, or exchange). The reading level of all questionnaires in English was at a Flesch-Kincaid grade level of 6.6 (Microsoft Word) and the reading level of the questionnaires in Spanish was at a Huerta Reading Ease score of 100, indicating an easy level of difficulty [56]. The RAs were blinded to participant responses. English language versions of all study questionnaires are available in Data Supplement 1.

The time required to answer the questionnaires and therefore to complete the study (hereafter referred to as "elapsed study time") differed due to use of skip patterns based on participant responses. For example, participants who reported having used multiple types of drugs, having multiple sexual partner types, and previously attending multiple types of substance abuse treatment programs answered more questions than other participants. Participants also differed in their elapsed study time because of being assigned to the BI versus the control arm, and because the duration of the BI was affected by tailored discussions related to participant HIV/HCV risk behaviors and drug misuse, and likely also due to participant engagement and interest in the BI. The BI was conducted after study questionnaire completion and there was no similarly-timed "placebo" intervention for the control arm.

After completing the questionnaires, participants randomly assigned to the control arm were offered free rapid HIV and/or HCV screening (opt-in), commensurate with their HIV/HCV infection status (HIV only, HCV only, HIV and HCV testing, or no testing offered). Those assigned to the intervention arm were offered screening at the end of or during the BI, depending on the flow of the discussion. The RAs performed rapid HIV testing using the OraQuick Advance rapid HIV-1/2 antibody test and rapid HCV testing using OraQuick HCV rapid antibody test (OraSure Technologies, Bethlehem, PA). Sample collection was either via fingerstick or through use of the Diff-Safe (Alpha Scientific Corporation, Malvern, PA) device if a phlebotomized sample had already been obtained.

Description of the BI

The primary goal of the BI was to motivate participants to address their drug misuse. The secondary goal was to encourage participants to be tested for HIV and/or HCV (appropriate to their HIV/HCV status). An outline of the BI content is in Data Supplement 2. The median duration of the BIs was 23 min (IQR 15–31). The BI sessions were based on two theoretically-driven approaches to behavior change: motivational interviewing [57] and the health belief model [58]. The BIs were delivered by interventionists who used motivational interviewing techniques (e.g. decisional balance, discussing goals and values) [59] to facilitate a discussion about behavior changes. Prior to the study onset, the interventionists underwent motivational interviewing training by a Motivational Interviewing Network of Trainers (MINT)-certified trainer, were trained in delivery of the BI and the study protocol, had over 50 h of mock BI practice prior to engaging participants in the study, were certified by the state as HIV and HCV prevention counselors, had training in rapid HIV and HCV testing techniques, practiced the study protocol and procedures with direct observation with the study staff, and underwent didactic instruction by the investigators on relevant substance misuse and HIV and HCV topics. Intervention sessions were audiotaped and reviewed by the study's clinical and research psychologists. Interventionists met regularly with the study psychologists to discuss their performance, review issues or concerns raised during or about the interventions, and ensure fidelity to and correct deviations from the study protocol. Following the study, a RA not involved in the study extracted data from tapes of the BI sessions on the HIV/HCV content discussed during each session using a standardized form. A random sample of 10 % of the data extracted was independently verified by a separate RA also not involved in the study ($\kappa = 0.95$ for the principal HIV/HCV BI content).

Data Analysis

Based on the results from two previous studies on rapid HIV screening in which 39.3 % agreed to be screened for HIV when no risk assessment was performed [30], and in which 55 % agreed to be screened after an ACASI-based HIV risk assessment with or without computer-delivered

feedback about risk [47], we hypothesized that among this drug misusing population there could be at least a 15 % absolute increase in uptake of HIV/HCV screening among participants who underwent a BI compared to those who did not. We believed that if asking about HIV risk led to greater screening, then adding a BI might further increase screening. For this hypothesis, we estimated requiring a sample size of 235 per arm with 90 % power, or 164 per arm for 80 % power, using Pearson's X^2 test with a two-sided Type I error rate of 0.05. We recruited beyond this sample size to address other objectives in the study. Unless otherwise specified, for all analyses a two-sided $\alpha = 0.05$ level of significance was used.

Study eligibility assessments and enrollment were summarized using the recommended Consolidated Standards of Reporting Trials (CONSORT) approach for randomized, controlled trials [60]. Participant demographic characteristics and HIV and hepatitis testing history were summarized (median and interquartile range [IQR], or proportions) and then compared by study arm using Wilcoxon rank sum tests for continuous variables and Fisher's exact tests for categorical variables. The proportions of participants meeting WHO recommendations for a brief or intensive intervention based on ASSIST scores and responses to the HIV/HCV risk-taking behavior questionnaire were summarized by study arm.

Primary Outcome of Uptake of Rapid HIV/HCV Screening

The primary outcome was uptake of rapid HIV and/or HCV screening among all participants. For this primary outcome, uptake was considered to be acceptance of any test offered (i.e., the HIV test only, the HCV test only, or both tests). Additional outcomes were uptake of: (1) HIV screening among those eligible for both tests, (2) HCV screening among those eligible for both tests, (3) HIV screening only among participants already known to be HCV seropositive, and (4) HCV screening only among those already known to be HIV seropositive. These outcomes were compared by study arm using unadjusted odds ratios (ORs) and corresponding exact 95 % confidence intervals (CIs).

Secondary Outcome of Factors Influencing Uptake of Rapid HIV/HCV Screening

Our a priori plan for the secondary outcome analyses was to identify patient and study-level factors that might have influenced rapid HIV/HCV screening uptake through regression modeling. However, we observed that elapsed study time not only differed as expected by study arm (because of the length of the BI), but that screening uptake was related to elapsed study time. The impact of time on screening uptake appeared also to differ by study arm. As a result, elapsed study time, as a post-randomization variable that differed by study arm, confounded the estimate of the treatment effect of the BI on screening uptake. We also suspected that elapsed study time in the tailored BI as part of the study might be related to participant drug misuse history and HIV/HCV behavior risk, which are factors that also could impact interest in HIV/HCV screening. Because of this apparent treatment effect modification, we conducted the analyses investigating patient and study-level factors influencing uptake of rapid HIV/HCV screening separately by study arm.

To further explore the influence of time elapsed while participating in the study by study arm, we created a variable representing elapsed study time for each participant. The study protocol captured the time participants consented to participate in the study and the time the HIV/HCV testing was offered; elapsed study time was estimated as the difference (in minutes) of these two time points. Some participants in the intervention arm were offered screening during their BI (due to the tailored nature of the BI and flow of the conversation about HIV/HCV), hence their elapsed study time was approximated as the time from consent to the midpoint of the BI session. Median elapsed study time (time between study consent and test offer) in the control group was 34 min (IQR 25–47); median elapsed study time in the intervention arm was 60 min (IQR 42–82), after adjusting the times for the 30 participants who were offered testing during the BI.

We first examined whether patient and study-level factors were predictive of elapsed study time using linear regression. Analyses were performed separately for each study arm and variables that had a $p < 0.10$ in univariable regression analyses were included in multivariable models. Next, we investigated patient and study-level factors associated with uptake of rapid HIV/HCV screening in each arm in univariable and multivariable logistic regression analyses. Multivariable logistic regression models were created using factors with a $p < 0.10$ from univariable analyses; ORs and corresponding 95 % CIs were estimated. Separate models were created with (1) patient and study-level factors, (2) patient and study-level factors with the elapsed study time variable, and (3) patient and study-level factors, the elapsed study time variable, and factors associated with elapsed study time. This third type of model was constructed to examine whether or not the effect of elapsed study time remained associated with screening uptake after adjusting for the factors that were found to predict elapsed study time from the aforementioned multivariable linear regression analyses (i.e., the mediating effect of elapsed study time). Hosmer–Lemeshow goodness-of-fit testing was used to check multivariable model fitness.

Results

Participant Enrollment and Descriptions

The CONSORT diagram of study enrollment, random assignments, and HIV/HCV screening eligibility based on self-reported HIV/HCV status is depicted in Fig. 1. Of the 957 participants analyzed, there were no differences in the distribution of demographic characteristics and HIV and hepatitis testing histories by study arm (Supplemental Table 1). The distribution of participants qualifying for no BI, a BI or more intensive intervention by drug category (per WHO recommendations) and drug use and sexual risk-taking behaviors is provided in Supplemental Tables 2–5.

Uptake of Rapid HIV/HCV Screening

Uptake of any rapid HIV/HCV test (HIV alone, HCV alone, HIV/HCV combined) was greater in the control arm (Table 1). HIV screening uptake also was greater and HCV screening uptake trended towards greater uptake in the control arm. When stratified by HIV/HCV status, there also was a trend towards greater uptake of applicable HIV and/or HCV screening in the control arm. Of the 381 screened for HIV, none had a reactive HIV antibody test. Of the 346 screened for HCV, five participants had a reactive HCV antibody test (1.4 %; two in the intervention arm and three in the control arm). Of these, one participant later revealed that he/she already knew he/she previously had a reactive HCV antibody test, which left four (1.2 %) who were previously unaware of their HCV antibody test results.

Influence of Patient and Study-level Factors and Elapsed Study Time on Rapid HIV/HCV Screening Uptake

Uptake categorized by elapsed study time (Table 2) as stratified by study arm confirmed differential test uptake by study arm and elapsed study time. As shown in Table 2, uptake also appeared to differ by HIV/HCV testing history. In the control arm, a plot of the log-odds of test uptake versus elapsed study time using a generalized additive model showed a non-linear, parabolic relationship, with the highest testing uptake for elapsed study times between 45 and 50 min and with lower uptake at shorter and longer elapsed study times. Likelihood ratio tests confirmed the significance of this relationship ($p < 0.01$). The relationship between the log-odds of test uptake and elapsed study time was approximately linear in the intervention arm, showing an increase in test uptake at longer elapsed study times ($p < 0.01$).

In the control arm, being female, currently homeless, receiving disability payments, presenting to the ED for an illness instead of an injury, having children <17 years or no children compared to grown children, no known HCV test or unknown whether had a test, having received help to cut down or stop drug use, and study RA were predictive of greater uptake of HIV/HCV screening in the multivariable models (Supplemental Tables 6, 7). After adjusting for factors in the multivariable model, the relationship of elapsed study time and screening uptake remained strongly significant; uptake was parabolic in shape, peaking around 45–60 min, and was lowest for those who spent between 60 and 90 or ≥90 min in the study (Fig. 2).

In the treatment arm, type of insurance, homelessness, presenting to the ED for an illness instead of injury, and study RA were predictive of greater uptake of screening (Supplemental Table 8). Screening uptake generally increased with longer elapsed study times. In addition, in the intervention arm, specifically addressing participant knowledge about HIV/HCV, HIV/HCV risk factors, and their personal need for HIV/HCV screening in the BI was not associated with screening uptake (Table 3).

Discussion

Contrary to our expectations, uptake of rapid HIV/HCV screening among ED patients needing a brief or more intensive intervention for drug misuse was lower than we anticipated (41 % overall). It also was lower than our recent study examining the efficacy of a BI to increase combined rapid HIV/HCV screening among adult ED patients with lower levels of drug use/misuse (any past three-month drug use or misuse) (65 % uptake) [52], lower than our prior study that examined the efficacy of asking about HIV risk-taking behaviors through a computer-based questionnaire with or without providing tailored feedback about risk-taking behaviors (55 % uptake) [47], yet slightly higher than our previous study of rapid HIV screening among a general ED population offered without an intervention or risk assessment (39 % uptake) [30]. A closer examination of temporal, patient and study-level factors provides some insight to possible reasons for the lower than expected screening uptake and lessons for future ED-based HIV/HCV screening efforts.

The results of this current study among adult ED patients requiring a brief or more intensive intervention for drug misuse and our recent study involving patients with lower levels of drug use/misuse indicate that the BIs for both studies did not motivate patients to get tested for HIV and/or HCV. Explanations for the failure of these BIs include the very real possibility that BIs are not effective in increasing HIV/HCV screening uptake among drug using/misusing adult ED patients; the content, form, focus and delivery of these BIs were not conducive to increasing

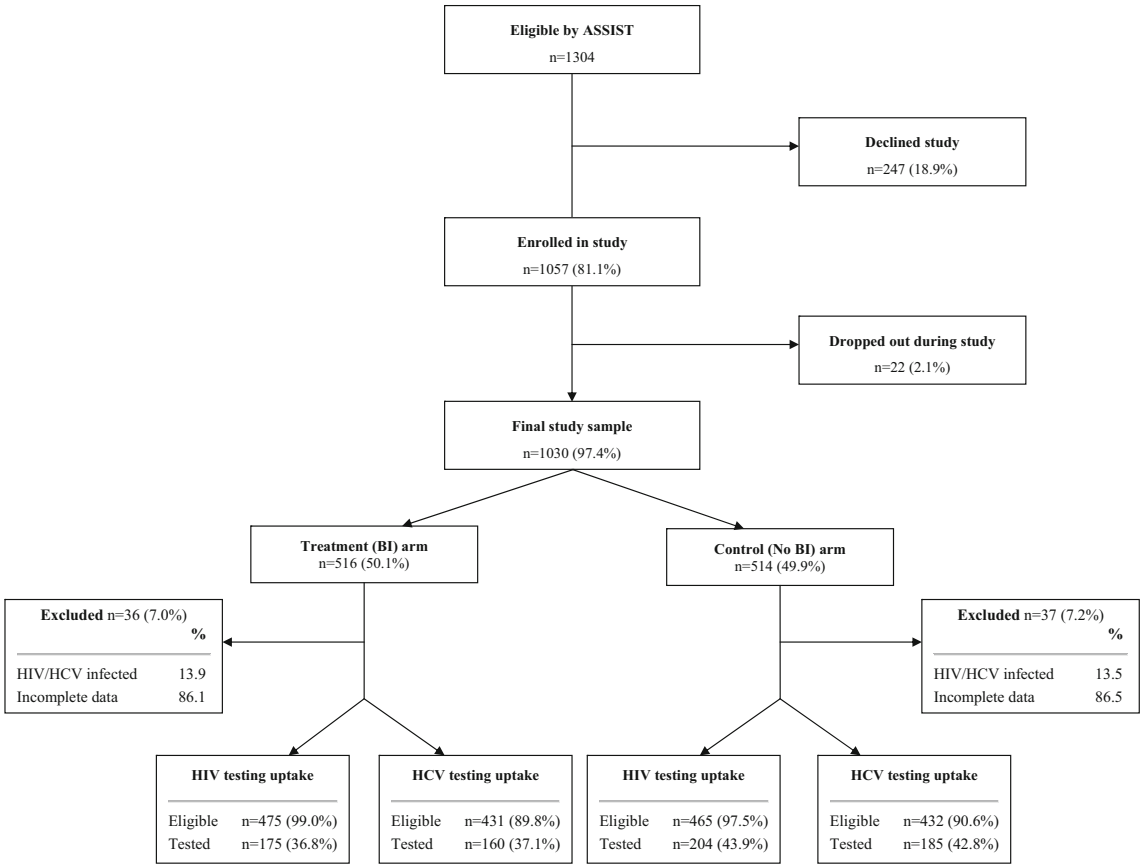

Fig. 1 Eligibility assessment and enrollment flow diagram

Table 1 Participant HIV/HCV testing uptake

Test eligibility	Control arm		Treatment arm		Treatment arm vs. control arm	
	Number eligible *n*	Test uptake %	Number eligible *n*	Test uptake %	*p* value	OR (95 % CI)
HIV, HCV or both[a]	477	45	480	38	0.04	0.76 (0.59, 1.00)
HIV[b]	465	44	475	37	0.03	0.75 (0.57, 0.98)
HCV[c]	432	43	431	37	0.09	0.79 (0.60, 1.05)
HIV only[d]	45	44	49	31	0.20	0.56 (0.22, 1.39)
HCV only[e]	12	33	5	20	1.00	0.52 (0.01, 8.21)
Both HIV and HCV[f]	420	45	426	39	0.09	0.79 (0.59, 1.05)
HIV test uptake						
Both HIV and HCV[f]	420	44	426	38	0.07	0.77 (0.58, 1.03)
HCV test uptake						
Both HIV and HCV[f]	420	43	426	37	0.09	0.79 (0.59, 1.05)

CI confidence interval, *HCV* hepatitis C virus, *HIV* human immunodeficiency virus, *OR* odds ratio

[a] Participants who are HIV and HCV negative, HIV positive and HCV negative, and HCV positive and HIV negative. Excludes those HIV and HCV positive

[b] Participants who are HIV negative

[c] Partcipants who are HCV negative

[d] Participants who are eligible for HIV testing only. Includes only those who are HCV positive and HIV negative

[e] Partcipants who are HCV testing only. Includes only those who are HIV positive and HCV negative

[f] Participants who are HIV and HCV negative

Table 2 Participant HIV/HCV testing uptake by time elapsed in study, HIV/HCV testing history and study arm

Time elapsed in study	ED HCV testing uptake						ED HIV testing uptake					
	Control arm			Treatment arm			Control arm			Treatment arm		
	n eligible	% tested	p-value	*n* eligible	% tested	p-value	*n* eligible	% tested	p-value	*n* eligible	% tested	p-value
<30 min	180	30	<0.01	43	19	0.01	187	30	<0.01	45	22	0.07
≥30 & <45 min	141	55		82	35		149	55		89	36	
≥45 & <60 min	50	62		97	30		60	62		104	32	
≥60 & <90 min	38	42		124	45		43	47		138	43	
≥90 min	23	26		84	45		26	31		99	40	
Time elapsed in study and HIV/HCV testing history status												
Ever tested			<0.01			0.55			<0.01			0.23
<30 min	116	22		25	28		166	29		41	24	
≥30 & <45 min	92	52		44	34		132	53		68	41	
≥45 & <60 min	33	55		64	31		56	64		95	33	
≥60 & <90 min	28	46		80	39		42	45		127	42	
≥90 min	16	19		57	44		24	33		92	40	
Never tested			0.45			0.01			0.12			0.11
<30 min	42	45		16	6		20	45		4	0	
≥30 & <45 min	33	58		28	39		17	71		17	24	
≥45 & <60 min	14	71		25	36		4	25		7	29	
≥60 & <90 min	5	60		34	59		1	100		11	64	
≥90 min	5	40		15	47		2	0		6	50	
Unknown if ever tested			0.02			0.09			NA			NA
<30 min	22	45		2	0		1	0		0	–	
≥30 & <45 min	16	69		10	30		0	–		4	0	
≥45 & <60 min	3	100		8	0		0	–		2	0	
≥60 & <90 min	5	0		10	50		0	–		0	–	
≥90 min	2	50		12	50		0	–		1	0	

n.b. p-values compare homogeneity of testing uptake by study time stratified by arm and testing history using Fisher's exact test (due to some small cell sizes)

ED Emergency department, *HCV* hepatitis C virus, *HIV* human immunodeficiency virus, *min* minutes, *NA* not applicable

screening uptake; or the target audience was not appropriate. This latter possibility is suggested by our previous research findings which showed that ED patients' initial beliefs, opinions and self-perception of risk for these infections before receiving a BI were the strongest predictors of screening uptake [52]. As such, selective use of BIs could be a more efficient approach to screening, perhaps for those who indicate disinterest or negative views about screening, those who report low self-perception or an inaccurate self-perception of risk, or decline screening. We hope to investigate this possibility in future studies.

Elapsed study time for this current study was greater than our prior rapid HIV/HCV screening BI study [52], which partially could account for the lower overall uptake of HIV/HCV screening observed in this current study (41 % in this current study vs. 65 % in the prior study). A prolonged wait for care in the ED and involvement in a lengthy study with multiple questionnaires could be a strong disincentive to agree to screening. However, our study findings indicate that the relationships among screening uptake, elapsed study time and receipt of a BI or no BI are even more complex. After accounting for patient-level factors (e.g., demographic characteristics, HIV/HCV risk-taking behaviors), elapsed study time appears to be an important mediator of screening uptake, and uptake further differs by whether or not a participant receives a BI (i.e., a synergistic effect).

In the absence of a BI (the control arm), we observed that there was a non-linear, parabolic relationship between uptake of HIV/HCV screening and elapsed study time (uptake was lower with short and very long study times). Among the control arm, those who spent <30 min in the study demonstrated a 31 % uptake of rapid HIV/HCV screening. With increasing elapsed study time in the

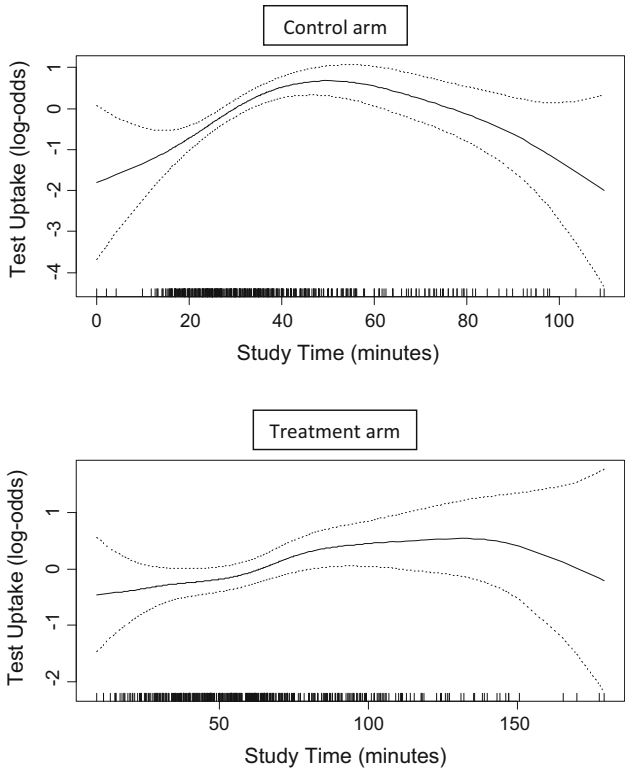

Fig. 2 Generalized additive model plots of the relationship between the log-odds of HIV/HCV screening uptake and time elapsed in the study by study arm

control group (spending 30–90 min in the study), screening uptake also increased (peaking at ≈50–60 % uptake). However, when elapsed study time was greater than 90 min in the control group, screening uptake began to decrease. In contrast, rapid HIV/HCV screening uptake followed a different pattern in the treatment (BI) than the control (no BI) arm. In the treatment arm, participant uptake was more linear in shape and generally increased over time, yet peaked a little later than the control arm at 60-90 min and at a lower percentage (≈45 % uptake).

A possible explanation in general for lower screening uptake with relatively shorter elapsed study times could be that those who finished the study faster were less interested or engaged in the topic, the study and the intervention. A more concerning explanation is that since they reported fewer risk behaviors and less severe substance misuse, those who completed the study faster and had a relatively shorter intervention convinced themselves that they were at lower risk for HIV/HCV, and hence did not believe they needed to be tested. On the other extreme, spending too long a time in the study and in the ED might lead to fatigue and frustration, and hence disinterest in completing yet another task with resultant lower screening uptake. Unfortunately, we do not have a plausible explanation of why screening uptake differed by elapsed study time according to assignment to the treatment (BI) or control (no BI) arm. Perhaps for the BI arm, increasing elapsed study time reflected reporting more risk behaviors and more severe substance misuse, which meant such participants spent a longer time responding to the questionnaires. In addition, these participants might have had longer BI sessions, either because they had more to discuss and/or were more engaged in the sessions. The more they shared about their risk-taking behaviors and substance misuse in the questionnaires and the BI, perhaps the more they were convinced they needed to be tested for HIV and HCV. Of course, interest, engagement, and perception of time spent in the study were not measured. Nevertheless, the practical implications for research and clinical applications are that time and engagement matter; try to engage, but do not delay, or else screening efforts will be affected adversely.

A final practical implication of the study findings is that a "personal touch" matters. Despite a defined protocol and efforts to ensure uniformity of and fidelity to the study protocol, uptake of screening varied dramatically in both

Table 3 Intervention content and participant HIV/HCV testing uptake in treatment arm

Content discussed during intervention	Testing uptake			OR (95 % CI)
	n	Declined test %	Accepted test %	
HIV/HCV fundamentals				
No	225	64	36	Ref
Yes	140	56	44	1.40 (0.91, 2.15)
HIV/HCV risk behaviors				
No	232	62	38	Ref
Yes	133	61	39	1.03 (0.67, 1.60)
Need for HIV/HCV testing				
No	216	64	36	Ref
Yes	149	58	42	1.30 (0.85, 1.99)

Ref Reference, *HIV* human immunodeficiency virus, *HCV* hepatitis C virus

study arms according to the RA or interventionist who engaged participants in the study and offered them testing. Our prior research on HIV screening uptake demonstrated similar results despite fidelity monitoring [30, 52]. Although it is possible that study staff varied their behavior when they were not being monitored, it is probable that some unmeasured aspect (e.g., personality, charm, engagement, interest, persuasive ability, empathy, etc.) enabled certain study staff to get more participants to be tested. Other BI researchers have observed that interventionist personality and ability to form relationships with patients are predictive of patient outcomes [59, 61, 62]. Identifying these attributes likely would assist tremendously in future HIV/HCV screening initiatives.

Limitations

This study has several limitations. Given that marijuana was the predominant drug misused by study participants and its relationship to HIV/HCV is indirect or unknown, participants who only or mostly used this drug could have perceived themselves perhaps appropriately at lower risk for these infections and declined screening as a result. In addition, current Centers for Disease Control and Prevention (CDC) and United States Preventive Service Task Force (USPSTF) recommendations focus on HCV screening focus on persons potentially at higher risk of HCV infection (e.g., injection-drug users and those born between 1945 and 1965 ("baby boomers")) [63–65]. Although unlikely, ED patients might have been aware of these recommendations or the perceived lower prevalence of HCV among people who do not inject drugs or "baby boomers", and this influenced their interest in being screened. However, few participants declined HCV screening in favor of HIV screening alone. Also, we recently reported that if CDC and USPSTF recommendations were followed strictly, several new HCV diagnoses would be missed among non-injection-drug using, non-"baby boomer" ED patients [66]. Furthermore, given the worse clinical course of those co-infected with HIV/HCV [11–18], combined rapid screening, since it is inexpensive, quick, and easy and has high impact, is a rational course of action. The study also cannot measure what impact on the outcomes would have occurred if ED rather than research staff had administered the BI. Because of the nature of the BI, which employed motivational interviewing to increase intrinsic motivation to undergo rapid HIV/HCV screening, an opt-in approach to screening was used. We cannot determine if screening uptake would have been different if an opt-out approach could have been incorporated into the study. An opt-out approach might not have been feasible in this type of research study or desirable since the point of the BI was to motivate the participants to accept testing, whereas an opt-out approach informs the potential test recipient that he/she will be tested unless he/she declines. Future research can examine if employing a BI using motivational interviewing, likely after someone has declined when screening is presented using an opt-out approach, is useful. A potential, but not actual, limitation for the study is that the main outcome was acceptance of screening and not the act of testing itself. However, acceptance of screening and testing participation were virtually identical in this study. Other measures of drug misuse and HIV/HCV risk-taking behaviors might also have led to different study findings. Also, because no follow-up assessments were conducted with these participants, we cannot determine if the intervention had potentially positive effects on future HIV/HCV testing uptake. As always, unmeasured and unknown confounders also could have influenced the study findings, despite the random assignment of participants and adjustments for covariates of interest. Finally, in this study almost all patients completed study participation prior to disposition from the ED. However, it might be difficult for some EDs to implement an intervention of this type, given limits of resources and time patients spend in the ED, especially if time to discharge or admission is short.

Conclusions

The BI utilized in this investigation did not increase uptake of HIV/HCV screening among adult ED patients requiring a brief or more intensive intervention for their drug misuse. Elapsed study time, which likely reflects engagement in the topic, and personal touches by the interventionist beyond the study protocol predict screening uptake. Future HIV/HCV screening initiatives can apply these findings to further improve screening uptake.

References

1. Rietmeijer CA, Wolitski RJ, Fishbein M, Corby NH, Cohn DL. Sex hustling, injection drug use, and non-gay identification by men who have sex with men. Associations with high-risk sexual behaviors and condom use. Sex Transm Dis. 1998;25:353–60.
2. Schilling R, Serrano Y, Faruque S, el-Bassel N, Wei-Huei SF, Edlin B, Irwin K, Ludwig D. Predictor variables of trading sex among male drug users in Harlem. In: International Conference on AIDS; 1992.
3. Kim JH, Psevdos G, Suh J, Sharp VL. Co-infection of hepatitis B and hepatitis C virus in human immunodeficiency virus-infected patients in New York City, United States. World J Gastroenterol. 2008;14:6689–93.
4. Brau N, Bini EJ, Shahidi A, et al. Prevalence of hepatitis C and coinfection with HIV among United States veterans in the New York City metropolitan area. Am J Gastroenterol. 2002;97:2071–8.

5. Nyirenda M, Beadsworth MB, Stephany P, et al. Prevalence of infection with hepatitis B and C virus and coinfection with HIV in medical inpatients in Malawi. J Infect. 2008;57:72–7.
6. Mohsen AH, Murad S, Easterbrook PJ. Prevalence of hepatitis C in an ethnically diverse HIV-1-infected cohort in south London. HIV Med. 2005;6:206–15.
7. Pereira GA, Stefani MM, Martelli CM, et al. Human immunodeficiency virus type 1 and hepatitis C virus co-infection and viral subtypes at an HIV testing center in Brazil. J Med Virol. 2006;78:719–23.
8. Ponamgi SP, Rahamathulla S, Kumar YN, et al. Prevalence of hepatitis C virus (HCV) coinfection in HIV infected individuals in south India and characterization of HCV genotypes. Indian J Med Microbiol. 2009;27:12–6.
9. Zhang C, Yang R, Xia X, et al. High prevalence of HIV-1 and hepatitis C virus coinfection among injection drug users in the southeastern region of Yunnan, China. J Acquir Immune Defic Syndr. 2002;29:191–6.
10. Backus LI, Boothroyd D, Deyton LR. HIV, hepatitis C and HIV/hepatitis C virus co-infection in vulnerable populations. AIDS. 2005;19(Suppl 3):S13–9.
11. El-Serag HB, Giordano TP, Kramer J, Richardson P, Souchek J. Survival in hepatitis C and HIV co-infection: a cohort study of hospitalized veterans. Clinical Gastroenterol Hepatol. 2005;3:175–83.
12. Anderson KB, Guest JL, Rimland D. Hepatitis C virus coinfection increases mortality in HIV-infected patients in the highly active antiretroviral therapy era: data from the HIV Atlanta VA Cohort Study. Clin Infect Dis. 2004;39:1507–13.
13. De Luca A, Bugarini R, Lepri AC, et al. Coinfection with hepatitis viruses and outcome of initial antiretroviral regimens in previously naive HIV-infected subjects. Arch Intern Med. 2002;162:2125–32.
14. Zhou J, Dore GJ, Zhang F, Lim PL, Chen YM, Database TAHO. Hepatitis B and C virus coinfection in The TREAT Asia HIV Observational Database. J Gastroenterol Hepatol. 2007;22:1510–8.
15. Weis N, Lindhardt BO, Kronborg G, et al. Impact of hepatitis C virus coinfection on response to highly active antiretroviral therapy and outcome in HIV-infected individuals: a nationwide cohort study. Clin Infect Dis. 2006;42:1481–7.
16. Greub G, Ledergerber B, Battegay M, et al. Clinical progression, survival, and immune recovery during antiretroviral therapy in patients with HIV-1 and hepatitis C virus coinfection: the Swiss HIV Cohort Study. Lancet. 2000;356:1800–5.
17. d'Arminio Monforte A, Cozzi-Lepri A, Castagna A, et al. Risk of developing specific AIDS-defining illnesses in patients coinfected with HIV and hepatitis C virus with or without liver cirrhosis. Clin Infect Dis. 2009;49:612–22.
18. Monga HK, Rodriguez-Barradas MC, Breaux K, et al. Hepatitis C virus infection-related morbidity and mortality among patients with human immunodeficiency virus infection. Clin Infect Dis. 2001;33:240–7.
19. Minniear TD, Gilmore B, Arnold SR, Flynn PM, Knapp KM, Gaur AH. Implementation of and barriers to routine HIV screening for adolescents. Pediatrics. 2009;124:1076–84.
20. Pisculli ML, Reichmann WM, Losina E, et al. Factors associated with refusal of rapid HIV testing in an emergency department. AIDS Behav. 2011;15:734–42.
21. Glick NR, Silva A, Zun L, Whitman S. HIV testing in a resource-poor urban emergency department. AIDS Educ Prev. 2004;16:126–36.
22. Schrantz SJ, Babcock CA, Theodosis C, et al. A targeted, conventional assay, emergency department HIV testing program integrated with existing clinical procedures. Ann Emerg Med. 2011;58(S85–8):e1.
23. D'Almeida KW, Kierzek G, de Truchis P, et al. Modest public health impact of nontargeted human immunodeficiency virus screening in 29 emergency departments. Arch Intern Med. 2012;172:12–20.
24. Christopoulos KA, Schackman BR, Lee G, Green RA, Morrison EA. Results from a New York City emergency department rapid HIV testing program. J Acquir Immune Defic Syndr. 2010;53:420–2.
25. Mehta SD, Hall J, Lyss SB, Skolnik PR, Pealer LN, Kharasch S. Adult and pediatric emergency department sexually transmitted disease and HIV screening: programmatic overview and outcomes. Acad Emerg Med. 2007;14:250–8.
26. Lyss SB, Branson BM, Kroc KA, Couture EF, Newman DR, Weinstein RA. Detecting unsuspected HIV infection with a rapid whole-blood HIV test in an urban emergency department. J Acquir Immune Defic Syndr. 2007;44:435–42.
27. Silva A, Glick NR, Lyss SB, et al. Implementing an HIV and sexually transmitted disease screening program in an emergency department. Ann Emerg Med. 2007;49:564–72.
28. Brown J, Kuo I, Bellows J, et al. Patient perceptions and acceptance of routine emergency department HIV testing. Public Health Rep. 2008;123(Suppl 3):21–6.
29. Czarnogorski M, Brown J, Lee V, et al. The prevalence of undiagnosed HIV infection in those who decline HIV screening in an urban emergency department. AIDS Res Treat. 2011;2011:879065.
30. Merchant RC, Seage GR, Mayer KH, Clark MA, DeGruttola VG, Becker BM. Emergency department patient acceptance of opt-in, universal, rapid HIV screening. Public Health Rep. 2008;123(Suppl 3):27–40.
31. Christopoulos KA, Weiser SD, Koester KA, et al. Understanding patient acceptance and refusal of HIV testing in the emergency department. BMC Public Health. 2012;12:3.
32. Pringle K, Merchant RC, Clark MA. Is self-perceived HIV risk congruent with reported HIV risk among traditionally lower HIV risk and prevalence adult emergency department patients? Implications for HIV testing. AIDS Patient Care STDS. 2013;27:573–84.
33. Haukoos JS, Hopkins E, Conroy AA, et al. Routine opt-out rapid HIV screening and detection of HIV infection in emergency department patients. JAMA. 2010;304:284–92.
34. Haukoos JS, Hopkins E, Bender B, et al. Use of kiosks and patient understanding of opt-out and opt-in consent for routine rapid human immunodeficiency virus screening in the emergency department. Acad Emerg Med. 2012;19:287–93.
35. Brown J, Shesser R, Simon G, et al. Routine HIV screening in the emergency department using the new US Centers for Disease Control and Prevention Guidelines: results from a high-prevalence area. J Acquir Immune Defic Syndr. 2007;46:395–401.
36. Freeman AE, Sattin RW, Miller KM, Dias JK, Wilde JA. Acceptance of rapid HIV screening in a southeastern emergency department. Acad Emerg Med. 2009;16:1156–64.
37. Sankoff J, Hopkins E, Sasson C, Al-Tayyib A, Bender B, Haukoos JS. Payer status, race/ethnicity, and acceptance of free routine opt-out rapid HIV screening among emergency department patients. Am J Public Health. 2012;102:877–83.
38. Sattin RW, Wilde JA, Freeman AE, Miller KM, Dias JK. Rapid HIV testing in a southeastern emergency department serving a semiurban-semirural adolescent and adult population. Ann Emerg Med. 2011;58:S60–4.
39. Hoxhaj S, Davila JA, Modi P, et al. Using nonrapid HIV technology for routine, opt-out HIV screening in a high-volume urban emergency department. Ann Emerg Med. 2011;58:S79–84.
40. White DA, Scribner AN, Vahidnia F, et al. HIV screening in an urban emergency department: comparison of screening using an opt-in versus an opt-out approach. Ann Emerg Med. 2011;58:S89–95.

41. Haukoos JS, Witt MD, Coil CJ, Lewis RJ. The effect of financial incentives on adherence with outpatient human immunodeficiency virus testing referrals from the emergency department. Acad Emerg Med. 2005;12:617–21.
42. Walensky RP, Reichmann WM, Arbelaez C, et al. Counselor-versus provider-based HIV screening in the emergency department: results from the universal screening for HIV infection in the emergency room (USHER) randomized controlled trial. Ann Emerg Med. 2011;58(S126–32):e1–4.
43. White DA, Warren OU, Scribner AN, Frazee BW. Missed opportunities for earlier HIV diagnosis in an emergency department despite an HIV screening program. AIDS Patient Care STDS. 2009;23:245–50.
44. Ubhayakar ND, Lindsell CJ, Raab DL, et al. Risk, reasons for refusal, and impact of counseling on consent among ED patients declining HIV screening. Am J Emerg Med. 2011;29:367–72.
45. Calderon Y, Haughey M, Leider J, Bijur PE, Gennis P, Bauman LJ. Increasing willingness to be tested for human immunodeficiency virus in the emergency department during off-hour tours: a randomized trial. Sex Transm Dis. 2007;34:1025–9.
46. Aronson ID, Bania TC. Race and emotion in computer-based HIV prevention videos for emergency department patients. AIDS Educ Prev. 2011;23:91–104.
47. Merchant RC, Clark MA, Langan TJ, Mayer KH, DeGruttola VG. Can computer-based feedback improve emergency department patient uptake of rapid HIV screening? Ann Emerg Med. 2011;58(S114–9):e1–2.
48. Carey MP, Coury-Doniger P, Senn TE, Vanable PA, Urban MA. Improving HIV rapid testing rates among STD clinic patients: a randomized controlled trial. Health Psychol. 2008;27:833–8.
49. Dunn KE, Saulsgiver KA, Patrick ME, Heil SH, Higgins ST, Sigmon SC. Characterizing and improving HIV and hepatitis knowledge among primary prescription opioid abusers. Drug Alcohol Depend. 2013;133:625–32.
50. Parsons JT, Lelutiu-Weinberger C, Botsko M, Golub SA. A randomized controlled trial utilizing motivational interviewing to reduce HIV risk and drug use in young gay and bisexual men. J Consult Clin Psychol. 2014;82:9–18.
51. Bonar EE, Walton MA, Cunningham RM, et al. Computer-enhanced interventions for drug use and HIV risk in the emergency room: preliminary results on psychological precursors of behavior change. J Subst Abuse Treat. 2014;46:5–14.
52. Merchant RC, Baird JR, Liu T, Taylor LE, Montague BT, Nirenberg TD. Brief intervention to increase emergency department uptake of combined rapid human immunodeficiency virus and hepatitis C screening among a drug misusing population. Acad Emerg Med. 2014;21:752–67.
53. Humeniuk R, Ali R. Validation of the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) and pilot brief intervention [electronic resource]: a technical report of phase II findings of the WHO ASSIST Project. Geneva: World Health Organization; 2006.
54. Merchant RC, Freelove SM, Langan TJt, et al. The relationship of reported HIV risk and history of HIV testing among emergency department patients. Postgrad Med. 2010;122:61–74.
55. Trillo AD, Merchant RC, Baird JR, Ladd GT, Liu T, Nirenberg TD. Interrelationship of alcohol misuse, HIV sexual risk and HIV screening uptake among emergency department patients. BMC Emerg Med. 2013;13:9.
56. Fernandez-Huerta JM. Simple readability measures. Consigna. 1959;214:29–32.
57. Miller WRRS. Motivational interviewing: preparing people for change. 2nd ed. New York: Guilford Press; 2002.
58. Rosenstock IM. Historical origins of the health belief model. Health Educ Monogr. 1974;2:328–35.
59. Miller WR, Rose GS. Toward a theory of motivational interviewing. Am Psychol. 2009;64:527–37.
60. Moher DSK, Altman DG, Lepage L. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. Lancet. 2001;357:1191–4.
61. Gaume J, Gmel G, Faouzi M, Daeppen JB. Counselor skill influences outcomes of brief motivational interventions. J Subst Abuse Treat. 2009;37:151–9.
62. Borsari B, Apodaca TR, Jackson KM, et al. In-session processes of brief motivational interventions in two trials with Mandated College Students. J Consult Clin Psychol. 2014;. doi:10.1037/a0037635.
63. Recommendations for prevention and control of hepatitis C virus (HCV) infection and HCV-related chronic disease. Centers for Disease Control and Prevention. MMWR Recommendations and reports: morbidity and mortality weekly report recommendations and reports/centers for disease control 1998;47:1–39.
64. Smith BD, Morgan RL, Beckett GA, et al. Recommendations for the identification of chronic hepatitis C virus infection among persons born during 1945–1965. MMWR Recommendations and reports: morbidity and mortality weekly report recommendations and reports/centers for disease control 2012;61:1–32.
65. Moyer VA. Force USPST. Screening for hepatitis C virus infection in adults: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med. 2013;159:349–57.
66. Merchant RC, Baird JR, Liu T, Taylor LE. HCV among The Miriam Hospital and Rhode Island Hospital Adult ED Patients. Rhode Island Med J. 2014;97:35–9.