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Evaluation of a Hepatitis C Education Intervention with Clients Enrolled in Methadone Maintenance and Needle/Syringe Programs in Malaysia

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Abstract

Background—Approximately 40%–90% of people who inject drugs (PWID) in Malaysia have hepatitis C (HCV). PWID continue to be disproportionately affected by HCV due to their lack of knowledge, perceived risk and interest in HCV treatment. Education interventions may be an effective strategy for increasing HCV knowledge in PWID, and harm reduction services are uniquely positioned to implement and deploy such interventions.

Methods—We recruited 176 clients from methadone maintenance treatment (MMT: N=110) and needle/syringe programs (NSP: N=66) between November 2015 and August 2016. After baseline knowledge assessments, clients participated in a standardized, 45-minute HCV education program and completed post-intervention knowledge assessments to measure change in knowledge and treatment interest.

Results—Participants were mostly male (96.3%), Malay (94.9%), and in their early 40s (mean=42.6 years). Following the intervention, overall knowledge scores and treatment interest in MMT clients increased by 68% and 16%, respectively ($p<0.001$). In contrast, NSP clients showed no significant improvement in overall knowledge or treatment interest, and perceived greater treatment barriers. Multivariate linear regression to assess correlates of HCV knowledge post-intervention revealed that optimal dosage of MMT and having had an HIV test in the past year significantly increased HCV knowledge. Having received a hepatitis B vaccine, however, was not associated with increased HCV knowledge after participating in an education session.

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Conclusion—Generally, HCV knowledge and screening is low among clients engaged in MMT and NSP services in Malaysia. Integrating a brief, but comprehensive HCV education session within harm reduction services may be a low-cost and effective strategy in improving overall HCV knowledge and risk behaviors in resource-limited settings. In order to be an effective public health approach, however, education interventions must be paired with strategies that improve social, economic and political outcomes for PWID. Doing so may reduce HCV disparities by increasing screening and treatment interest.

Keywords

Hepatitis C; harm reduction; patient education; PWID

INTRODUCTION

Southeast Asian countries account for over 60% of the global burden of hepatitis C virus (HCV) infection (Messina, et al., 2015). In Malaysia, approximately 2.5% of adults are infected with HCV, however, the prevalence ranges from 40–90% among people who inject drugs (PWID) (McDonald, Mohamed, Dahlui, Naning, & Kamarulzaman, 2014; Vicknasingam, Narayanan, & Navaratnam, 2009), and Malaysia's volatile drug use epidemic is associated with increased HIV and HCV incidence (Singh, Chawarski, Schottenfeld, & Vicknasingam, 2013). Consequently, harm reduction strategies like methadone maintenance therapy (MMT) and needle/syringe programs (NSP) were introduced and expanded nationally in 2005 (Mohamed & Marican, 2014; Reid, Kamarulzaman, & Sran, 2007; Singh, et al., 2013). Although harm reduction programs were initially introduced to lower the incidence of HIV, HCV is also of great concern, and was not initially prioritized due to the lack of effective treatment. When compared to HIV, the risk of HCV transmission is 150–800 times greater when injecting with a contaminated needle (Crofts, Aitken, & Kaldor, 1999). Moreover, viral hepatitis has grown to be a greater contributor to disability-adjusted life years (DALYs) than HIV, largely due to liver cirrhosis and cancer (Degenhardt, et al., 2016).

MMT and NSP services are well positioned to prevent transmission of blood-borne viruses among PWID. MMT markedly reduces injection frequency and HCV transmission, and does not complicate HCV treatment (Litwin, Soloway, & Gourevitch, 2005). Furthermore, linkage to care and integration of services have been shown to be beneficial in this population, leading to high levels of adherence and use of onsite services for HCV prevention and treatment (Litwin, et al., 2005). Previous studies have also shown that uptake of opioid agonist therapies (OAT) and high coverage of NSP can substantially reduce HCV transmission risk, and is a cost effective strategy at lowering HCV incidence in PWID (Hagan, Pouget, & Des Jarlais, 2011; Robaey, et al., 2013; Turner, et al., 2011). Therefore, harm reduction programs may play an important role in providing HCV screening, education, and treatment referrals.

Previous studies from the US and Australia, where HCV is also primarily transmitted through drug injection, show that overall HCV knowledge, perceived risk, and treatment interest is limited in this population and that many misconceptions about HCV transmission,

symptoms and treatment options exist (Chitwood, McBride, French, & Comerford, 1999; Dhopes, Taylor, & Burke, 2000; Edlin, 2002; Heimer, et al., 2002; Munoz-Plaza, et al., 2008; Stein, Maksad, & Clarke, 2001; Strauss, et al., 2007). HCV education can reduce risk behaviors and disparities in infection rates, and influence a patient's decision to explore and initiate antiviral treatment (Doab, Treloar, & Dore, 2005; Nyamathi, et al., 2010; Strauss, et al., 2007; Surjadi, Torruellas, Ayala, Yee, & Khalili, 2011; Walley, White, Kushel, Song, & Tulsy, 2005). Consequently, there is a need to improve HCV knowledge within this population, and to date; there have been no studies examining HCV knowledge or treatment interest among PWID in Malaysia.

METHODS

Participant recruitment

Participants met eligibility criteria if they were 18 years or older, provided consent, self-reported current or former drug injection (not including alcohol), and were currently receiving client services at a harm reduction program. Information sessions were provided at each recruitment site where all clients were encouraged to attend. Interested individuals underwent eligibility screening and informed consent procedures with a trained research assistant, and were invited to participate in a standardized HCV education program. Participation was voluntary and no payment was provided. All activities were conducted in Bahasa Malaysia language, and medical ethics committees at Yale University and University of Malaya Medical Center approved this study.

Study Sample

Overall, 176 participants were recruited from a Cure & Care Service Center (CCSC) that provides MMT (n=110) in Klang Valley, and from three NSP sites (n=66) in Klang Valley, Kedah/Perlis and Pahang between November 2015 and August 2016.

Care & Cure Service Centers are operated by Malaysia's Anti-Drug Agency (AADK) and provide limited psychosocial and medical care, as well as vocational training to patients recovering from substance use disorders. CCSC's are voluntary, and provide MMT. The Malaysian AIDS Council (MAC) coordinates the efforts of nongovernmental and community-based organizations in Malaysia, including NSP. MAC has partnered with the Malaysian Ministry of Health to ensure that NSPs throughout Malaysia operate similarly, and offer needle/syringe exchange, HIV/HCV testing, condom distribution and assistance in completing welfare forms for social services.

HCV education session

The HCV education program consisted of a standardized, didactic presentation adapted from the United States Department of Veterans Affairs Hepatitis C Resource Center (The VA Hepatitis C Resource Center Program and National Hepatitis C Program Office Veterans Health Administration, 2006). Study investigators and healthcare providers familiar with HCV and the needs of PWIDs assisted with the adaptation process. All session materials were translated into Bahasa Malaysia language, and screening and treatment resources were amended to reflect options available in Malaysia. Four outreach workers familiar with the

needs of PWID were trained as health educators, and facilitated each session. Training sessions for the outreach workers, and the education program were standardized to ensure that each site would receive the same information, and that the information would be conveyed in the same manner. Moreover, a single person oversaw the training and observed each session to ensure the fidelity of the intervention. Education sessions covered topics related to HCV screening and diagnosis, symptoms, transmission, disease progression, treatment regimen, side effects, success rates and duration, potential drug interactions and barriers to receiving treatment. Dialogue between participants and health educators were encouraged.

Each education sessions had 5–15 participants, lasted no more than 90 minutes and was presented in Bahasa Malaysia language. Program sessions consisted of a sociodemographic questionnaire, and knowledge assessment prior to the education program. Immediately following the program, participants would complete the same knowledge assessment post-intervention. All questionnaires were self-administered to reduce bias, however, a small minority of questionnaires had to be interviewer-administered to help with literacy issues. We also completed medical chart review of all MMT clients to obtain HIV and HCV infection data. We did not review medical charts of NSP clients, as NSPs do not retain medical records.

Measure of HCV Knowledge

Change in HCV knowledge was measured using a pre-/post-knowledge assessment developed by study investigators (Table 3). The knowledge assessment was developed after extensive literature review of similar studies, and based on the content covered in the education program (Surjadi, Torruellas, Ayala, Yee, & Khalili, 2011; Walley, White, Kushel, Song, & Tulskey, 2005). The overall knowledge assessment consisted of 28 items, 25 that were true/false/not sure, and 3 that were multiple-choice questions in which several answers could be chosen. The true/false items included questions such as “People with HIV cannot receive treatment for hepatitis C,” and “People on methadone cannot receive treatment for hepatitis C.” Multiple-choice questions included questions about HCV transmission, symptoms, and treatment side effects, and included items such as “A person can get or spread hepatitis C by (select all that apply).” The adapted HCV education program and knowledge assessments were pilot tested among 15 MMT clients and revised for clarity.

Statistical Analysis

An ANOVA was used to examine differences between NSP sites. Sociodemographic factors, risk behaviors, HIV and HCV risk factors were then summarized using mean $\pm$ SD or proportion. Income was dichotomized to reflect poverty line income levels (Hatta & Ali, 2013). MMT doses were categorized to reflect no MMT, suboptimal (<80 mg) and optimal ($\geq$ 80 mg) dosage. Studies have consistently shown that higher doses of methadone, defined as $\geq$ 80–100 mg result in prolonged treatment retention and lower rates of illicit opioid use when compared to those on lower doses of methadone (Faggiano, Vigna- Taglianti, Versino, & Lemma, 2003; Maxwell & Shinderman, 2002; Peles, Schreiber, & Adelson, 2006; Strain, Bigelow, Liebson, & Stitzer, 1999; Wickersham, 2013). Therefore, we defined dosage $\geq$ 80mg as optimal, while dosages <80 mg were defined as suboptimal. A chi-square test for

categorical variables or t-test for continuous variables was used to assess significant differences by education site (MMT or NSP). Knowledge scores were created by dichotomizing each true/false/unsure response, so that the correct response would receive one point. All correct items selected in the multiple-choice questions were also assigned one point. Composite knowledge scores were created by adding the number of correct responses, and subscales were created to measure knowledge related to symptoms, transmission and treatment. Overall knowledge scores had a maximum score of 44, and symptom, transmission and treatment subscales had a maximum score of 19, 11 and 14, respectively. A paired t-test was then used to assess change in overall knowledge, and knowledge subscales after the intervention, and a McNemar's test was used to identify knowledge improvement for each question. Correlates of post-intervention HCV knowledge were examined using a bivariate linear regression. All covariates significant at $p < 0.20$ were entered into a multivariate linear regression model, in which covariates significant at $p < 0.05$ were retained after backwards elimination. Finally, treatment interest and differences in perceived treatment barriers between MMT and NSP clients were examined using a McNemar's test and chi-square test. All statistical analysis was completed using SPSS v24 (SPSS Inc., 2016).

RESULTS

Few differences were observed between NSP sites. Specifically, participants in Klang Valley were significantly older ($p = 0.011$) and participants from Pahang had a higher frequency of drug injection ($p = 0.011$) and were more likely to have ever been tested for HIV ($p = 0.002$). Of those prescribed MMT, participants from Kedah/Perlis received higher doses ($p = 0.027$). Although minor variations exist between the sites, there were no significant differences between NSP sites in terms of baseline ($p = 0.330$) or post-intervention HCV knowledge ($p = 0.196$). For this reason, results are summarized across all NSP sites.

Sociodemographic characteristics, risk behaviors, HIV and HCV risk factors are summarized in Table 1. The mean age across both sites was 42.6 ± 9.4 years, with NSP clients being slightly younger than MMT clients. The majority of participants were male (96.3%), Malay (94.9%), and had completed primary school (84.8%). More than half (59.6%) of the MMT clients had a full-time job, compared to the NSP clients (28.8%), who were also more likely to earn below the poverty level.

When examining HCV risk factors, 86.0% of participants reported injection drug use, with NSP clients reporting a greater frequency of injection drug use in the past month. Condom use was low across both sites, with NSP clients reporting a greater number of sexual partners and lower frequency of condom use than MMT clients. We were unable to obtain medical records for NSP clients, but among MMT clients, 26.4% and 67.3% were HIV and HCV positive, respectively, with 14.2% being HIV/HCV co-infected. NSP clients reported a higher frequency of recent HIV testing, and were more likely to have received hepatitis A or B vaccine ($p < 0.001$). NSP clients were also more likely to have received previous HCV treatment, or know someone infected with HCV ($p < 0.001$).

Table 2 and Figure 1 show changes in HCV knowledge scores. Baseline HCV knowledge did not differ between the sites ($p=0.425$). Following the intervention, however, overall HCV knowledge improved by 68% among MMT clients ($p<0.001$), and knowledge related to symptoms, transmission and treatment improved by 72.3%, 63.3% and 84.4%, respectively ($p<0.001$). NSP clients on the other hand, showed no significant improvement in overall HCV knowledge, or symptom, transmission, and treatment subscales ($p>0.05$).

Examining knowledge improvement by each subscale question (Table 3) revealed that baseline knowledge was consistently low across MMT and NSP clients. More specifically, most MMT clients were unaware that HCV often has no symptoms (18.2%), vaccines are available to prevent hepatitis A and B (36.4%; 39.1%), sterilizing used needles often does not kill HCV (26.4%), people with HIV can receive HCV treatment (32.7%), re-infection is possible (31.8%), that HCV treatment is not always effective (5.5%) and that treatment is not life-long (16.4%). Most NSP clients seemed to be unaware that HCV is a virus (19.7%) that affects the liver (18.2%). They also seemed unaware vaccines were available to prevent HAV (16.7%) and HBV (18.2%), but were knowledgeable that HCV was not preventable by vaccine (81.8%). Given that NSP clients are active drug users, it is alarming that knowledge related to transmission did not improve, and only 18.2% were aware that sterilizing needles using bleach, boiling water or alcohol may not kill HCV post-intervention. NSP clients were also largely unaware that they would be able to receive HCV treatment if they were HIV-positive (10.6%), or on methadone (21.2%). Notable improvements were observed across most questions for MMT clients, following the knowledge intervention. Among NSP clients, however, knowledge gaps persisted even after the intervention.

Table 4 shows the results of a linear regression model examining correlates of greater HCV knowledge after attending the HCV education program. After controlling for variables identified as significant in the bivariate analysis, the final multivariate model revealed that participants who reported receiving optimal dosages of MMT, and having been tested for HIV within the past year were more knowledgeable about HCV after the educational intervention ($p<0.05$). Conversely, those who had been vaccinated against hepatitis B were less knowledgeable of HCV post-intervention ($p=0.013$).

Table 5 identifies perceived barriers towards HCV treatment. Attending an HCV education program significantly increased treatment interest by 16.2% among MMT clients ($p<0.001$), but not among NSP clients ($p=0.625$). Additionally, NSP clients reported several more barriers towards receiving HCV treatment, including believing that HCV will resolve on its own (77.3%), healthcare accessibility issues (77.3%), and high medication burden (77.3%). Common barriers MMT clients reported included not knowing where to go (37.3%), long HCV treatment duration (17.3%), and cost of treatment (16.4%).

DISCUSSION

Several studies, mostly in high-income settings, have explored HCV knowledge among PWID, and have found that knowledge is universally low, and treatment interest is limited (Cohen-Moreno, et al., 2010; Marshall, et al., 2015; Surjadi, et al., 2011; Treloar, Hull, Dore, & Grebely, 2012). Similarly, this study in a middle-income setting, demonstrates that a

significant gap in knowledge persists among PWID in Malaysia. Few studies have explored the association between HCV knowledge interventions and treatment interest, however information, education, and communication interventions have proven successful in increasing health literacy and promoting behavior change for drug use and HIV-related risk behaviors, leading us to believe they are effective in reducing HCV-related risk behaviors as well (Aggleton, 2005; Nutbeam, 2000). Previous studies from the US have noted that brief interventions ranging from 15 minutes to 2 hours have resulted in notable improvements in HCV knowledge among PWID populations (Norton, et al., 2014; Surjadi, et al., 2011). Furthermore, increased HCV knowledge is associated with greater willingness to receive treatment especially when patients are stabilized on MMT (Doab, et al., 2005; Marshall, et al., 2015; Treloar, et al., 2012; Zeremski, et al., 2016).

In this study, HCV knowledge was generally low across MMT and NSP clients prior to the intervention. We found that a brief, but comprehensive HCV education program is an effective strategy of improving HCV knowledge in PWID on MMT, although moderate knowledge related to HCV symptoms, re-infection, and treatment side effects and success rates post-intervention show room for improvement. In contrast, NSP clients showed no improvement in HCV knowledge related to symptoms, transmission or treatment. Although education attainment did not vary by MMT or NSP status, NSP clients generally had lower levels of employment and were more likely to fall below the poverty line, and as a result were most likely of lower socioeconomic status compared to MMT clients. Several studies indicate that the social determinants of health, particularly low socioeconomic status, homelessness and incarceration of PWID, contribute to poor knowledge about disease and disease risk in this population (Galea & Vlahov, 2002). Furthermore, individuals of lower socioeconomic status may have undeveloped reading and writing skills and less exposure to traditional health education, and as a result, less developed skills to act upon the information received (Nutbeam, 2000). In contrast, MMT patients are generally more stable, more likely to be employed, and less likely to be using drugs or be engaged in criminal activity when compared to PWIDs that are not engaged in treatment. (Jackson, et al., 2014; Sun, et al., 2015). Several studies also indicate that in order for a health education intervention to be successful, they must be combined with structural level approaches that aim to change the political, economic, social and community context of drug use, and that social determinants of health must be taken into account (Aggleton, 2005; Galea & Vlahov, 2002; Nutbeam, 2000). For this reason, NSP clients may not benefit from an HCV education program until their economic, environmental and social needs are met. Moreover, a single HCV education session may not have been enough to increase knowledge in active drug users.

HCV treatment uptake remains low in PWID globally (N. Martin, et al., 2015; Mehta, et al., 2008). Perceived barriers and beliefs reported in our study are consistent with previous studies examining the barriers to HCV treatment among PWID, which include limited knowledge of HCV, lack of perceived need for treatment due to the asymptomatic nature of the disease, fear of treatment related side-effects, stigma associated with HCV and injection drug use, unmanaged drug addiction, mistrust of doctors, and difficulty accessing healthcare (Chen, et al., 2013; Cohen-Moreno, et al., 2010; Grebely, et al., 2008; Mehta, et al., 2008; Strauss, et al., 2007; Swan, et al., 2010). Current HCV treatment in Malaysia is largely limited to pegylated interferon and ribavirin. As HCV treatment evolves, however, there is a

need to continually educate those living with HCV and those at risk for acquiring HCV about prevention and treatment efforts. Future HCV prevention and treatment interventions should emphasize direct-acting antivirals (DAA) once they become accessible in Malaysia, and examine whether DAAs eliminate current barriers to treatment.

Although we were unable to measure behavior change in terms of increased screening or treatment, previous studies demonstrate that increased HCV knowledge is associated with greater willingness to undergo treatment (Robaeys, et al., 2013; Zeremski, et al., 2014). We found treatment acceptability to be high among MMT clients, especially after attending an HCV education program. Treatment interest among NSP participants, however, was low and did not significantly increase after attending an HCV education session. This is consistent with previous findings from the US and Canada, where patients stabilized on opioid-substitution treatment were more willing to undergo HCV treatment compared to active injection drug users (Grebely, et al., 2008; Treloar, et al., 2012). When examining perceived barriers towards HCV treatment, nearly all NSP clients reported several barriers to receiving HCV treatment. The number of perceived barriers, in addition to a lack of knowledge improvement might explain low treatment acceptability in NSP clients. Even modest increases in the rate of HCV treatment among active PWID has been proven to substantially reduce HCV transmission and prevalence among PWID, despite the possibility of re-infection (N. K. Martin, et al., 2011). For this reason, future health programs should incorporate social determinants of health, and examine treatment barriers when designing a health intervention for PWID.

When examining HCV risk factors, participants reported needle sharing despite access to NSP programs and low condom use, indicating a high risk for not only HCV, but also for HIV and sexually transmitted infections. Moreover, only 36.5% and 58.1% of NSP clients reported ever being tested for HIV or HCV, respectively. Given that PWID are largely a hidden population, harm reduction services provide an opportunity to implement HIV and HCV screening procedures, and promote safer sex habits. Recent developments in rapid diagnostic testing for HIV and HCV make it easy for harm reduction programs to efficiently screen for HIV and HCV (Lee, et al., 2010; Reynolds, et al., 2002; Shivkumar, Peeling, Jafari, Joseph, & Pai, 2012). Furthermore, point of care diagnostic testing has demonstrated cost-effectiveness for use among high-risk populations, making it easier to implement HIV and HCV testing as part of regular and routine screening for MMT and NSP clients (Paltiel, et al., 2005; Shrestha, et al., 2008). We also found that approximately 30% of MMT patients, and several NSP clients were on suboptimal (<80mg/day) dose of MMT, which is not effective in managing opioid dependence. In this study, higher dosages of MMT and HIV testing within the past year were correlated with increased HCV knowledge post-intervention. OAT programs should increase their efforts to provide optimal doses of MMT, potentially as a stabilizing factor for patients. Higher doses are associated with prolonged treatment retention, risk reduction for blood-borne viruses like HCV and HIV, and ongoing screening and treatment (Faggiano, et al., 2003; Maxwell & Shinderman, 2002; Peles, et al., 2006; Strain, et al., 1999; Wickersham, 2013). Patients who are more stabilized are then better able to focus on their health and potentially retain greater knowledge obtained from education interventions. On the other hand, having received an HAV or HBV vaccination was correlated with lower post-intervention HCV knowledge. Several studies have reported

misconceptions of hepatitis vaccination (Cohen-Moreno, et al., 2010; Heimer, et al., 2002; Marshall, et al., 2015; Soto-Salgado, et al., 2011). Receiving a HAV or HBV vaccine may have given participants a false sense of protection against HCV compared to those that are unvaccinated. This may have led vaccinated participants to be less engaged in the intervention, leading to lower knowledge post-intervention.

Globally, less than 5% of chronic hepatitis infections are diagnosed, and <1% are receiving treatment (WHO, 2016). The 2030 Sustainable Development Goal (3) aims to combat hepatitis by diagnosing 90% of chronic hepatitis, and increasing treatment to at least 80% of those infected (WHO, 2016). In order to achieve this, the WHO recommends implementing a comprehensive package consisting of targeted information and education for PWID, in addition to the provision of sterile injection equipment, treatment for opioid dependence (including MMT), testing and counseling for HIV and antiretroviral treatment, condom distribution, and diagnosis and treatment for tuberculosis and viral hepatitis (World Health Organization, 2016). This study supports integrating HCV education within harm reduction programs as an effective strategy to increase HCV knowledge related to symptoms, transmission and treatment in a high-risk population. Hepatitis prevention interventions can also be applied to the prevention of HIV, STIs, and other blood-borne infections, however, repeated exposure is important to maintain the benefit from prevention strategies (WHO, 2012). Finally, harm reduction programs provide the infrastructure to circumvent screening and treatment obstacles, as well as the provision of some social services, providing a strategic public health opportunity for lowering HCV incidence among PWID (Hagan, et al., 2011; Robaey, et al., 2013; Turner, et al., 2011; Zeremski, et al., 2014).

Limitations

Study participants were not selected randomly, but rather those that were interested in learning more about HCV were invited to participate, and our findings may be limited by a lack of randomization. Furthermore, MMT clients were recruited from a single site, and this study sample may not be representative of all MMT clients, however, NSP clients were recruited from several sites across Malaysia, increasing the generalizability of our results. All data, apart from HIV and HCV status of MMT clients, was self-reported and may exhibit some social desirability bias. Finally, this study was cross-sectional, and we were not able to measure knowledge sustained over time, or behavior change in terms of increased HCV screening and treatment uptake. More studies are needed to examine the influence of education on behavior change in this population.

CONCLUSIONS

This study adds to the growing body of evidence that HCV knowledge is low among PWID globally. We also observed low rates of HIV and HCV screening, condom use and suboptimal MMT dosage in a population that is at high-risk for acquiring and transmitting HIV and HCV. A brief, but comprehensive HCV education program is a low-cost and effective strategy in improving HCV knowledge, treatment interest, and promoting health behaviors among PWID engaged in MMT. Future education interventions should also focus on ensuring access to social services and improving the social, economic and political

situation for PWID when integrating health-promoting interventions to maximize public health impact.

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Figure 1. Changes in HCV Knowledge
methadone maintenance treatment (MMT); needle/syringe program (NSP); hepatitis C virus (HCV)

Table 1

Descriptive Characteristics

Characteristic N (%) or mean $\pm$ SD	Overall	Methadone clinic (MMT)	Needle/syringe program (NSP)	p-value
Sample size	176 (100.0)	110 (55.3)	66 (33.2)	
<i>Sociodemographic Factors</i>				
Mean age, years (SD)	42.6 $\pm$ 9.4	44.8 $\pm$ 9.1	39.3 $\pm$ 9.0	<0.001
Gender				0.941
Male	158 (96.3)	103 (96.3)	55 (96.5)	
Female	6 (3.7)	4 (3.7)	2 (3.5)	
Ethnicity				0.331
Malay	167 (94.9)	103 (93.6)	64 (97.0)	
Other	9 (5.1)	7 (6.4)	2 (3.0)	
Religion				0.331
Islam	167 (94.9)	103 (93.6)	64 (97.0)	
Other	9 (5.1)	7 (6.4)	2 (3.0)	
Marital Status				0.498
Single/Divorce/Widow	108 (63.5)	64 (61.5)	44 (66.7)	
Married/Partner	62 (36.5)	40 (36.4)	22 (33.3)	
Employment Status				<0.001
Part-time/Temporary	47 (27.6)	24 (23.1)	23 (34.8)	
Full-time	81 (47.6)	62 (59.6)	19 (28.8)	
Unemployed	42 (24.7)	18 (17.3)	24 (36.4)	
Education attainment				0.959
Less than primary school	26 (15.2)	16 (15.1)	10 (15.4)	
More than primary school	145 (84.8)	90 (84.9)	55 (84.6)	
Monthly Income				<0.001
Below poverty level	67 (43.5)	32 (32.7)	35 (62.5)	
Above poverty level	87 (56.5)	66 (42.9)	21 (37.5)	
<i>Risk Behaviors</i>				

Characteristic N (%) or mean $\pm$ SD	Overall	Methadone clinic (MMT)	Needle/syringe program (NSP)	p-value
History of drug injection	135 (86.0)	78 (78.0)	57 (100.0)	<0.001
Mean number of times injected (past 30 days)	12.3 $\pm$ 33.0	2.0 $\pm$ 11.2	28.4 $\pm$ 46.7	<0.001
Mean number of times injection equipment was shared (past 30 days)	0.5 $\pm$ 3.5	0.0 $\pm$ 0.0	1.3 $\pm$ 5.5	<0.001
Age of first drug injection	22.0 $\pm$ 8.6	22.3 $\pm$ 8.3	21.5 $\pm$ 9.0	0.613
Years of drug injection	21.3 $\pm$ 10.9	23.0 $\pm$ 10.3	18.8 $\pm$ 11.3	0.031
MMT dose (mg/day)	72.4 $\pm$ 70.1	112.5 $\pm$ 61.6	12.1 $\pm$ 23.3	<0.001
Not on MMT	48 (27.3)	0 (0)	48 (72.7)	<0.001
Suboptimal dose MMT (<80mg)	48 (27.3)	32 (29.1)	16 (24.2)	
Optimal dose MMT ($\geq$ 80mg)	80 (45.5)	78 (70.9)	2 (3.0)	
Number of sex partners (past 30 days)	0.6 $\pm$ 3.0	0.4 $\pm$ 2.2	0.9 $\pm$ 4.0	0.066
Frequency of condom use				0.007
Never	85 (69.7)	43 (58.9)	42 (85.7)	
Sometimes	25 (20.5)	20 (27.4)	5 (10.2)	
Always	12 (9.8)	10 (13.7)	2 (4.1)	
<i>HIV-related risk factors</i>				
Knowing someone HIV-positive	64 (39.5)	41 (41.0)	23 (37.1)	0.849
Having ever had a previous HIV test	133 (75.6)	85 (86.7)	48 (76.2)	0.085
Having a HIV test within the past year	49 (27.8)	16 (38.1)	33 (52.4)	<0.001
<i>HCV-related risk factors</i>				
Received Hepatitis A vaccine	40 (26.5)	7 (7.1)	33 (63.5)	<0.001
Received Hepatitis B vaccine	38 (25.2)	5 (5.0)	33 (64.7)	<0.001
Knowing someone HCV positive	49 (32.7)	19 (19.2)	30 (58.8)	<0.001
Having ever had a previous HCV test	115 (69.7)	72 (69.9)	43 (69.4)	0.941
Having a HCV test within the past year	38 (23.0)	22 (66.7)	16 (25.8)	0.511
Previous HCV treatment	59 (38.3)	20 (19.8)	39 (73.6)	<0.001

[†]Numbers may not sum to N=176 due to some missing data.

standard deviation (SD); methadone maintenance treatment (MMT); needle/syringe program (NSP); hepatitis C virus (HCV)

Table 2

Changes in HCV knowledge scores

	Pre-intervention (mean $\pm$ SD)	Post-intervention (mean $\pm$ SD)	p-value
MMT (n=110)			
Overall knowledge	16.33 $\pm$ 7.74	27.43 $\pm$ 8.28	<0.001
Symptom	5.74 $\pm$ 3.52	9.89 $\pm$ 3.31	<0.001
Transmission	5.72 $\pm$ 3.04	9.34 $\pm$ 3.29	<0.001
Treatment	4.05 $\pm$ 2.66	7.47 $\pm$ 2.66	<0.001
NSP (n=66)			
Overall knowledge	17.29 $\pm$ 7.70	16.50 $\pm$ 8.68	0.282
Symptom	5.77 $\pm$ 3.16	5.25 $\pm$ 3.40	0.096
Transmission	6.02 $\pm$ 3.32	5.41 $\pm$ 3.58	0.057
Treatment	5.14 $\pm$ 2.46	5.52 $\pm$ 2.56	0.266

standard deviation (SD); methadone maintenance treatment (MMT); needle/syringe program (NSP); hepatitis C virus (HCV)

Table 3

N(%) of Participants Who Identified the Correct Response

	Question	MMT (N=110)		NSP (N=66)	
		Pre-test	Post-test	Pre-test	Post-test
SYMPTOMS	Hepatitis C affects the liver.	87 (79.1)	103 (93.6)*	12 (18.2)	13 (19.7)
	Hepatitis C can lead to cirrhosis.	41 (37.3)	93 (84.5)*	12 (18.2)	15 (22.7)
	Hepatitis C can lead to liver cancer.	74 (67.3)	104 (94.5)*	16 (24.2)	13 (19.7)
	Hepatitis C can lead to liver failure.	69 (62.7)	102 (92.7)*	13 (19.7)	17 (25.8)
	Hepatitis C usually has no symptoms.	20 (18.2)	44 (40.0)*	17 (25.8)	36 (54.5)*
	Hepatitis C can be made worse by drinking alcohol.	69 (62.7)	100 (90.9)*	14 (21.2)	15 (22.7)
	People can live for many years without knowing they have Hepatitis C.	44 (40.0)	78 (70.9)*	18 (27.3)	21 (31.8)
	Symptoms of Hepatitis C include:				
	No symptoms	19 (17.3)	28 (25.5)	50 (75.8)	55 (83.3)
	Nausea	19 (17.3)	59 (53.6)*	46 (69.7)	33 (50.0)*
	Loss of appetite	48 (43.6)	69 (62.7)*	36 (54.5)	29 (43.9)
	Fatigue	53 (48.2)	69 (62.7)*	34 (51.5)	32 (48.5)
	Dark urine	17 (15.5)	68 (61.8)*	49 (74.2)	35 (53.0)*
	Jaundice (yellow skin & eyes)	34 (30.9)	51 (46.4)*	50 (75.8)	40 (60.6)*
	The majority of people infected develop long-term (chronic) Hepatitis C.	37 (33.6)	66 (60.0)*	16 (24.2)	18 (27.3)
TRANSMISSION	There is more than one type of Hepatitis C infection.	31 (28.2)	78 (70.9)*	16 (24.2)	16 (24.2)
	Hepatitis C is caused by a virus.	56 (50.9)	92 (83.6)*	13 (19.7)	13 (19.7)
	Hepatitis C is a common chronic disease in people that inject drugs.	69 (62.7)	95 (86.4)*	15 (22.7)	18 (27.3)
	You can only get Hepatitis C if you have HIV.	90 (81.8)	78 (70.9)*	24 (36.4)	21 (31.8)
	There is a vaccine available to prevent:				
	Hepatitis A	40 (36.4)	93 (84.5)*	11 (16.7)	16 (24.2)
	Hepatitis B	43 (39.1)	93 (84.5)*	12 (18.2)	17 (25.8)

	Question	MMT (N=110)		NSP (N=66)	
		Pre-test	Post-test	Pre-test	Post-test
	Hepatitis C	58 (52.7)	60 (54.5)	54 (81.8)	49 (74.2)
	A person can get or spread Hepatitis C by:				
	Sharing needles	83 (75.5)	95 (86.4)*	25 (37.9)	22 (33.3)
	Blood transfusion	55 (50.0)	67 (60.9)	34 (51.5)	34 (51.5)
	Mother to child transmission	11 (10.0)	22 (20.0)*	55 (83.3)	51 (77.3)
	Unprotected sexual intercourse	39 (35.5)	69 (62.7)*	36 (54.5)	31 (47.0)
	Tattoos/piercings	25 (22.7)	67 (60.9)*	42 (63.6)	35 (53.0)
	Sharing razors	31 (28.2)	64 (58.2)*	41 (62.1)	34 (51.5)
	Hepatitis C is spread through HCV contaminated blood.	60 (54.5)	95 (86.4)*	15 (22.7)	12 (18.2)
	Bleach, boiling water and alcohol cannot kill Hepatitis C.	29 (26.4)	67 (60.9)*	7 (10.6)	12 (18.2)
TREATMENT	Most people with Hepatitis C eventually need a liver transplant.	13 (11.8)	33 (30.0)*	16 (24.2)	22 (33.3)
	People with HIV cannot receive treatment for Hepatitis C.	36 (32.7)	76 (69.1)*	7 (10.6)	14 (21.2)
	People on methadone cannot receive treatment for Hepatitis C.	50 (45.5)	91 (82.7)*	14 (21.2)	16 (24.2)
	Some people with Hepatitis C improve naturally without treatment.	11 (10.0)	18 (16.4)	27 (40.9)	42 (63.6)
	The only way to diagnose Hepatitis C is to get a blood test or liver biopsy.	72 (65.5)	93 (84.5)*	18 (27.3)	15 (22.7)
	Once you are cured of Hepatitis C, you cannot get it again.	35 (31.8)	77 (70.0)*	12 (18.2)	15 (22.7)
	Side effects of Hepatitis C treatment include:				
	Flu-like symptoms	34 (30.9)	47 (42.7)*	45 (68.2)	40 (60.6)
	Hair loss	14 (12.7)	37 (33.6)*	48 (72.7)	43 (65.2)
	Depression	26 (23.6)	66 (60.0)*	40 (60.6)	35 (53.0)
	Thyroid problems	16 (14.5)	31 (28.2)*	52 (78.8)	44 (66.7)
	Hepatitis C treatment (Ribavirin & Interferon) cannot cure everyone of Hepatitis C.	6 (5.5)	27 (24.5)*	10 (15.2)	23 (34.8)*
	Hepatitis C treatment is life-long.	18 (16.4)	47 (42.7)*	15 (22.7)	25 (37.9)*
	Hepatitis C treatment is available in public hospitals and clinics.	64 (58.2)	96 (87.3)*	18 (27.3)	17 (25.8)
	The duration and type of treatment depends on type of Hepatitis C.	58 (52.7)	90 (81.8)*	19 (28.8)	14 (21.2)

methadone maintenance treatment (MMT); needle/syringe program (NSP)
*
p<0.05; significant difference between pre- and post-intervention knowledge

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Table 4

Correlates of post-intervention HCV knowledge

	Unadjusted Model		Adjusted Model*	
Covariate	Beta	p-value	Beta	p-value
<i>Sociodemographic Factors</i>				
Site				
NSP	1.00			
MMT	2.23	0.086		
Ethnicity				
Malay	1.00			
Other	-5.74	0.040		
Religion				
Islam	1.00			
Other	-5.39	0.054		
Marital Status				
Single/Divorce/Widow	1.00			
Married/Partner	2.25	0.092		
Employment Status				
Full-time	1.00			
Part-time/Temporary	-2.27	0.136		
Unemployed	-3.64	0.016		
Education attainment				
Less than primary school	-2.97	0.061		
More than primary school	1.00			
Monthly Income				
Below poverty level	-1.97	0.120		
Above poverty level	1.00			
<i>Risk Behaviors</i>				
History of drug injection	-2.62	0.127		
Number of days injected (past 30 days)	-0.04	0.032		
MMT dose (mg/day)				
Not on MMT	1.00		1.00	
Suboptimal dose MMT (<80mg)	3.22	0.059	1.82	0.263
Optimal dose MMT (≥80mg)	2.90	0.057	3.54	0.033
Frequency of condom use				
Never	1.00			
Sometimes	1.83	0.287		
Always	4.72	0.024		
<i>HIV-related risk factors</i>				

	Unadjusted Model		Adjusted Model*	
Covariate	Beta	p-value	Beta	p-value
Having a HIV test within the past year	3.28	0.016	4.96	<0.001
<i>HCV-related risk factors</i>				
Received Hepatitis A vaccine	−4.09	0.003		
Received Hepatitis B vaccine	−4.33	0.002	−3.80	0.013
Having a HCV test within the past year	2.14	0.140		
Previous HCV treatment	−2.24	0.067		

⁺ Multivariate linear regression model adjusted for covariates significant at the p<0.20 level through backwards elimination

* Adjusted model N=141

methadone maintenance treatment (MMT); needle/syringe program (NSP); hepatitis C virus (HCV)

Table 5

Perceived HCV treatment barriers & beliefs

	MMT N=110 (%)	NSP N=66 (%)	p-value
I don't know where to go	41 (37.3)	39 (59.1)	0.005
Treatment is too expensive	18 (16.4)	46 (69.7)	<0.001
Healthcare facility is not accessible	10 (9.1)	51 (77.3)	<0.001
The side effects are too bad	13 (11.8)	45 (68.2)	<0.001
The course of treatment is too long	19 (17.3)	42 (63.6)	<0.001
I don't want to take any more medications	13 (11.8)	51 (77.3)	<0.001
I don't want anyone to know I have HCV	13 (11.8)	41 (62.1)	<0.001
I believe HCV will go away on its own	6 (5.5)	50 (76.9)	<0.001

methadone maintenance treatment (MMT); needle/syringe program (NSP); hepatitis C virus (HCV)