

# HCV and HIV Infection among Heroin Abusers in a Methadone Maintenance Treatment Program

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## Abstract

Over the years, it was getting attention to hepatitis C virus (HCV) and human immunodeficiency virus (HIV) infection among injected drug users (IDUs) in Taiwan. This study investigated the frequency of risky behaviors for HCV carriers and IDUs who were HIV carriers in methadone maintenance treatment program. The subjects, intravenously injected heroin abusers, were collected from a special methadone maintenance treatment clinic. The survey included characteristics of participants, sexual activity and attitude towards condom usage. The total number of subjects was 151. Data were analyzed using the statistical package SPSS 15.0. The analytical methods included descriptive analysis, Fisher's exact test, and the logistic regression model. The study showed that 82% of intravenously injected heroin abusers were hepatitis C virus (HCV)-positive, and 44.4% were hepatitis B virus (HBV)-positive; 89.5% of HIV-positive heroin abusers were type C hepatitis positive. Only 21.2% of these intravenously injected heroin abusers always used a condom, and 39.7% never used a condom during sexual activity. Logistic regression analysis showed smoking, sharing syringes needles, HBV status and condom use status were four main risk factors on HIV infection. Sharing or using contaminated syringes needles was the main cause of HIV, HBV, and HCV infection in the drug addiction group. Since our government has the policy of providing a methadone maintenance treatment program, the spread of HIV is under control, but knowledge about HIV and safe sex education still needs improvement.

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## Keywords

Intravenously Injected Heroin Abusers, Human Immunodeficiency Virus, Hepatitis C, Sexual Behavior

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## 1. Introduction

Opioid abuse is a complex problem, and not only impacts the affected person's physical and psychological health, but also threatens public security and the level of productivity in society. HIV infection has spread expansively in Taiwan.

The first HIV case in Taiwan was reported in 1984. As of the end of 2013, the total number of HIV cases had been accumulated to 26,475. The number of HIV infections among the injecting drug users (IDUs) began to surge since 2003 and then consistently decreased since Taiwan CDC harm reduction programs [1]. As the drug addiction problem grows, so does the rate of HIV infection. HIV infection may be transmitted by sharing needles or sharing the containers used for mixing that contain the drug. Some studies have shown that patients addicted to opium have more health problems, and that IDUs will suffer from a decrease in life quality and an increased rate of death [2]-[4].

At the end of 2009, 34% of Taiwanese IDUs also had HIV [5]. Lee found that 80% - 90% of IDUs had contracted HCV [6]. Survey data have shown that HCV infection is as high as 76.6%, and that more than 90% of HIV-infected IDUs in China had HIV-HCV co-infection [7] [8]. Most heroin addicts use the intravenous injection method, and commonly share needles or use the same container for the heroin chemical mix. Hence, infectious diseases, such as HIV, HBV and HCV are spread uncontrollably, and HCV is one of the most common infectious diseases in the world [9] [10]. The primary goal of the methadone maintenance treatment program (MMTP) is stemming the spread of HIV, rather than treating heroin dependence; the use or possession of heroin is still illegal in Taiwan. Offenders can choose either to take methadone for at least one year as an outpatient in a hospital or be incarcerated in a residential detoxification or rehabilitation center administered by the Taiwan Ministry of Justice.

Solomon's study pointed out that high-risk behaviors were common and included needle-sharing, unsafe disposal and inappropriate cleaning of needles, and limited condom use. IDUs in India need to be educated on harm reduction and safe-injection practices, and pharmacies could serve as potential venues for HIV prevention interventions in this group [11]. IDUs appear to have been the major group severely affected by HIV in Taiwan; the HIV infection rate has increased year by year in Taiwan, with intravenous injection being the main source of infection. In 2006, the Taiwan Ministry of Justice and Department of Health joined together to conduct a MMTP trial. Heroin addicts who were willing could participate in the trial, and as a reward, the prosecutor would take less stringent action against them.

With the encouragement of the local government and local prosecutor's office, the

number of participants in the MMTP increased from 252 in 2006 to 11,366 in 2009, and with the advent of the MMTP, the number of cases of HIV infection decreased from 3389 in 2005 to 1938 in 2007 [12]. However, there were reports by participants stating that the difficulty of withdrawing from methadone was significantly greater than withdrawing from heroin. If the addicts cannot successfully withdraw from heroin in the MMTP and also become dependent on methadone, this may lead to a dual addiction, and a situation in which the participants may continue to commit crimes and become involved in the illegal selling of methadone. Prosecutors are not doctors; it is more difficult for them to judge if the patients have successfully withdrawn from the addiction. Therefore, it was more important that the drug abusers in MMTP understood that their sexual behavior, continued heroin use, and sharing of needles, diluents and containers were associated with HIV infection [13]-[15].

Thus, the aims of this study were: 1) to evaluate the IDUs with an HIV risk behavior status; and 2) to investigate the association of sexual behavior, continued heroin use, and sharing of needles, diluents and containers with HIV infection in IDUs in MMTP.

## **2. Methods and Materials**

### **2.1. Participants and Ethical Approval**

This study was based at the MMTP clinic of a hospital in Tainan City. The participants were selected if they were heroin addicts who agreed to participate in this study and signed a consent form (those who were unconscious, or had a severe hearing problem, cognition problem or difficulty understanding the questioners were excluded). The study was reviewed and approved by the Department of Nursing, Chung Hwa University of Medicine and Technology Institutional Review Board (IRB), and was performed during from June 2008 to December 2010. The participants were asked to go through a series of basic physical examinations at the beginning of the study, including chest X-ray, EKG, blood routine, HIV test, urinalysis, and so on. Of the 206 patients at the MMTP clinic, 151 (73.3%) were willing to participate in the study and able to complete the required study material, as mentioned before.

### **2.2. Assessment Instruments**

We used a simple questionnaire for data collection, and the survey consisted of two types of questions.

### **2.3. Demographic**

The participant's basic information was collected during the first visit to the MMTP clinic. The questions included gender, marital status, age, educational level, drug history, sexual history, condom use habits in the past year, history of STD, and whether the participants had ever engaged in prostitution for money or drugs.

### **2.4. Risk of Unprotected Sexual Behavior-Related HIV**

This survey was done one month after the MMTP clinical study. The main goal of the

survey was to understand whether the participants had engaged in sexual behavior and needle-sharing behavior after entering the MMTP clinic. There were 10 questions in all, divided into two parts: 5 questions on drug usage behavior (such as how many times did you use intravenously injected drugs this month? How many times did you share a needle with others? How often do you clean your needle equipment before use?), and 5 questions on sexual behavior (such as how many people did you have sexual intercourse with? How often do you use a condom when you have sexual intercourse with your regular sex partner? How many times did you engage in anal sex? How often did you use a condom when you engaged in sexual intercourse with a temporary partner? How often did you use a condom when you engaged in sexual transactions?) Each question was scored from 0 to 5, according to the rate of occurrence.

### 2.5. Method of Study

At the beginning of the study, staff members explained the content of the survey, the definitions of terms and the method of answering questions, and there were research assistants standing by to answer any questions at all times. This was done to ensure a consistency of data from all participants. After the survey was finished, the data were run through SPSS software for statistical analysis. First, the data were compared with the basic information for descriptive analysis, and then analysis of unprotected sexual behavior within the first month, relative to HCV and HIV-positive IDUs, was carried out. The main focus of the analysis was the variable, “test of HIV infection”, as HIV infection will lead to a more serious outcome in intravenous injection-transmitted diseases. In our study, 132 participants were HIV-negative and 19 were HIV-positive, which was a significant difference in ratio; hence, when running the data through cross analysis with multiple variables, many of the fine grid results became zero. When we changed the method of analysis to the chi square test, the expected result would be larger than 5 for an calculated analysis; therefore, we combined the variables that belonged to the same group together, and then ran them through analysis to find the correlation between HIV-positive results and their variables. However, even with the combination of variables, some fine grid variables were still smaller than 5, so we combined some of the variables together to form one combined category; for example, condom usage was changed to “used in all sexual conduct” or “did not use in all sexual conduct.”

HIV testing was performed on serum using HIV ELISA 1.2.0 (Abbott Murex Biotech Limited, Kent, England), repeated using Genscreen HIV 1/2 Version 2 ELISA (BioRad, Marnes-la-Coquette, France) and confirmed using Western blot (BioRad, Marnes-la-Coquette, France).

### 2.6. Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) Version 15.0 was used to perform descriptive analysis. Categorical variables were reported as percentage. Differences in proportions were assessed using Fisher’s exact tests. A logistic regression model was used to calculate the odds ratio (**Table 1**); 95% confidence intervals, abbreviated as CI.

**Table 1.** Find HIV-related variables using Fisher's exact test.

| Variable                                | HIV<br>negative<br>(n = 132) | HIV<br>positive<br>(n = 19) | P value | Variable                           | HIV<br>negative<br>(n = 132) | HIV<br>positive<br>(n = 19) | P value |
|---|------------------------------|-----------------------------|---------|------------------------------------|------------------------------|-----------------------------|---------|
| <b>Gender</b>                           |                              |                             | 0.472   | <b>MDMA use</b>                    |                              |                             | 1.0     |
| male                                    | 115(87.1)                    | 18(94.7)                    |         | Yes                                | 1(0.8)                       | 0(0)                        |         |
| female                                  | 17(12.9)                     | 1(5.3)                      |         | No                                 | 131(99.2)                    | 19(100)                     |         |
| <b>Marital status</b>                   |                              |                             | 1.0     | <b>Ketamine use</b>                |                              |                             | 0.334   |
| Ever married                            | 47(35.6)                     | 7(36.8)                     |         | Yes                                | 2(1.5)                       | 1(5.3)                      |         |
| Never married                           | 85(64.4)                     | 12(63.2)                    |         | No                                 | 130(98.5)                    | 18(94.7)                    |         |
| <b>Employment status</b>                |                              |                             | 0.224   | <b>Needle-sharing*</b>             |                              |                             | <0.001* |
| Employed                                | 63(47.7)                     | 6(31.6)                     |         | Yes                                | 14(10.6)                     | 12(63.2)                    |         |
| Unemployed/Other                        | 69(52.3)                     | 13(68.4)                    |         | No                                 | 118(89.4)                    | 7(36.8)                     |         |
| <b>Educational level</b>                |                              |                             | 0.608   | <b>Sex partner</b>                 |                              |                             | 0.377   |
| ≤9 years                                | 87(65.9)                     | 14(73.7)                    |         | Yes                                | 104(78.8)                    | 13(68.4)                    |         |
| >9 years                                | 45(34.1)                     | 5(26.3)                     |         | No                                 | 28(21.2)                     | 6(31.6)                     |         |
| <b>Smoking*</b>                         |                              |                             | 0.009*  | <b>Prostitution</b>                |                              |                             | 0.494   |
| Yes                                     | 121(91.7)                    | 13(68.4)                    |         | Yes                                | 4(3.0)                       | 1(5.3)                      |         |
| No                                      | 11(8.3)                      | 6(31.6)                     |         | No                                 | 128(97.0)                    | 18(94.7)                    |         |
| <b>Amphetamine use</b>                  |                              |                             | 0.807   | <b>Condom usage*</b>               |                              |                             | 0.006*  |
| Yes                                     | 62(47.0)                     | 8(42.1)                     |         | Yes                                | 23(22.3)                     | 8(61.5)                     |         |
| No                                      | 70(53.0)                     | 11(57.9)                    |         | No                                 | 80(77.7)                     | 5(38.5)                     |         |
| <b>Drinking</b>                         |                              |                             | 0.202   | <b>Venereal disease*</b>           |                              |                             | 0.006*  |
| Yes                                     | 51(38.6)                     | 4(21.1)                     |         | Yes                                | 10(7.6)                      | 6(31.6)                     |         |
| No                                      | 81(61.4)                     | 15(78.9)                    |         | No                                 | 122(92.4)                    | 13(68.4)                    |         |
| <b>HBV status*</b>                      |                              |                             | 0.046*  | <b>HCV status</b>                  |                              |                             | 0.529   |
| yes                                     | 63(47.7)                     | 4(21.1)                     |         | Yes                                | 107(81.1)                    | 17(89.5)                    |         |
| No                                      | 69(52.3)                     | 15(78.9)                    |         | No                                 | 25(18.9)                     | 2(10.5)                     |         |
| <b>Age at first<br/>amphetamine use</b> |                              |                             | 0.472   | <b>Age at first<br/>heroin use</b> |                              |                             | 1.0     |
| ≤20 y/o                                 | 25(40.3)                     | 2(25.0)                     |         | ≤20 y/o                            | 19(14.4)                     | 2(10.5)                     |         |
| >20 y/o                                 | 37(59.7)                     | 6(75.0)                     |         | >20 y/o                            | 113(85.6)                    | 17(89.5)                    |         |

\*P &lt; 0.05.

The criterion for statistical significance was set at  $p < 0.05$ , two-tailed.

### 3. Results

#### 3.1. Characteristics of IDU in MMTP

One hundred fifth-one participants were available for analysis. The mean age was  $38.22 \pm 7.78$  years (range 21 to 64 years). Most of the participants who came to the MMTP clinic were male (88%), most had an educational level below junior high school, and among them, 54% were unemployed and near one quarter were without a sex partner. Most of the participants (82.8%) had not shared a needle one year prior to the MMTP clinic, but 19 participants were HIV-positive IDUs, and 63.2% of them had shared a needle with someone else one year prior to the MMTP clinic; of the 132 participants who were not HIV-positive IDUs, 10.6% had shared needles before.

Almost half of the participants (46.4%) had used amphetamine in the year prior to the MMTP clinic, and only a few had used ecstasy or/and cocaine. The result showed that most of the participants (54.3%) had first tried amphetamine at the age of 21 to 30

years, and that 44.3% of cocaine or/and ecstasy users had tried the drugs at 21 to 30 years of age. Most of the participants (88.7%) had a smoking habit and 92% had a HIV screening test before. Most of the IDUs tested positive (82.1%) for anti-HCV; 44.4% of the IDUs were HBV-positive IDUs. With regard to condom use in the year prior to the MMTP clinic, 21.2% of participants reported they had used a condom when they had sexual intercourse, and 39.7% reported not using a condom during intercourse (Table 2).

### 3.2. The Risky Behaviors of HCV Carriers

Table 3 shows the risk involved with unprotected sexual activity for those IDUs who were HCV-positive IDUs one month after entering the MMTP clinic. Over half of the HCV positive participants still used intravenously injected heroin after one month in the MMTP clinic (51.6%); 11 (8.9%) used other people’s needles, and 7 (5.6%) gave their used needles to others to use. Sixteen participants had sexual intercourse with more than one sex partner, 18 participants did not use a condom during sexual

Table 2. Characteristics of IDU in methadone maintenance treatment program (MMTP).

| Characteristic           | N(151) | %    | Characteristic                                      | N (151) | %    |
|--------------------------|--------|------|---|---------|------|
| <b>Education level</b>   |        |      | <b>Shared any injection equipment, last 1 month</b> |         |      |
| ≤9 years                 | 101    | 66.9 | No  | 125     | 82.8 |
| Over 9 years             | 50     | 33.1 | Yes   | 26      | 17.2 |
| <b>Gender</b>            |        |      | <b>Amphetamine use, last 1 year</b>                 |         |      |
| female                   | 18     | 11.9 | No  | 81      | 53.6 |
| male                     | 133    | 88.1 | Yes   | 70      | 46.4 |
| <b>Sex partner</b>       |        |      | <b>Venereal disease</b>                             |         |      |
| No                       | 34     | 22.5 | No  | 135     | 89.4 |
| No fixed, many           | 5      | 3.3  | Yes   | 16      | 10.6 |
| Fixed, several           | 11     | 7.3  | <b>Smoking</b>                                      |         |      |
| Fixed and only one       | 101    | 66.9 | No  | 17      | 11.3 |
| <b>Condom use status</b> |        |      | Yes   | 134     | 88.7 |
| Every time               | 32     | 21.2 | <b>Alcohol abuse</b>                                |         |      |
| Often                    | 13     | 8.6  | No  | 96      | 63.6 |
| Sometimes                | 31     | 20.5 | Yes   | 55      | 36.4 |
| Rarely                   | 15     | 9.9  | <b>Any sexual intercourse, last 1 month</b>         |         |      |
| Never                    | 60     | 39.7 | Often   | 1       | 0.7  |
| <b>HBV</b>               |        |      | Sometimes   | 1       | 0.7  |
| negative                 | 84     | 55.6 | Rarely  | 3       | 2    |
| positive                 | 67     | 44.4 | Never   | 146     | 96.6 |
| <b>Anti-HCV</b>          |        |      | <b>Age at first heroin use</b>                      |         |      |
| negative                 | 27     | 17.9 | Below 20 y/o  | 21      | 13.9 |
| positive                 | 124    | 82.1 | 21 - 30 y/o   | 82      | 54.3 |
| <b>HIV</b>               |        |      | 31 - 40 y/o   | 37      | 24.5 |
| negative                 | 132    | 87.4 | Over 41 y/o   | 11      | 7.3  |
| positive                 | 19     | 12.6 | <b>Age at first amphetamine use (n = 70)</b>        |         |      |
| <b>marital status</b>    |        |      | Below 20 y/o  | 26      | 37.1 |
| Never married            | 97     | 64.2 | 21 - 30 y/o   | 31      | 44.3 |
| Ever married             | 54     | 35.8 | Over 41 y/o   | 13      | 18.6 |

IDU: Injected drug users; HBV: hepatitis B virus; HIV: human immunodeficiency virus; HCV: hepatitis C virus.

intercourse with their regular partner, 9 participants did not use a condom during intercourse with temporary sex partners, and 12 participants never used a condom during sexual intercourse (Table 3).

### 3.3. The Risky Behaviors of HIV Carriers

In terms of the numbers and frequency of risky behaviors of IDUs who were HIV carriers after one month of visiting the MMTP clinic, over half of the participants with HIV were still using intravenously injected drugs after entering the MMTP (52.6%); of these participants, two had used other peoples' needles (10.6%) and one gave his/her needle to others to use. Among those participants, three had engaged in sexual

**Table 3.** Number and frequency of risky behaviors of HCV carriers after one month in MMTP.

| Drug use items  | N   | %    | Sexual behavior items   | N   | %    |
|---|-----|------|---|-----|------|
| <b>1. How many times have you hit up (i.e. injected any drugs) in the last month?</b>                     |     |      | <b>6. How many people, including clients, have you had sex with in the last month?</b>                    |     |      |
| Hasn't hit up   | 60  | 48.4 | None  | 67  | 68.5 |
| Once a week or less   | 30  | 24.2 | One   | 41  | 27.4 |
| More than once a week (<once a day)   | 12  | 9.7  | Two   | 15  | 3.2  |
| >Once a day   | 22  | 17.7 | Over 10 people  | 1   | 0.8  |
| <b>2. How many times in the last month have you used a needle after someone else had already used it?</b> |     |      | <b>7. How often have you used condoms when having sex with your regular partner(s) in the last month?</b> |     |      |
| Never   | 113 | 91.1 | No regular partner/no penetrative sex   | 71  | 57.3 |
| One time  | 8   | 6.5  | Every time  | 16  | 12.9 |
| Two times   | 3   | 2.4  | Often   | 10  | 8.1  |
| <b>3. How many different people have used a needle before you in the last month?</b>                      |     |      | Sometimes   | 1   | 0.8  |
| Never   | 116 | 93.5 | Rarely  | 8   | 6.5  |
| One person  | 5   | 4.0  | Never   | 18  | 14.5 |
| Two person  | 2   | 1.6  | <b>8. How often have you used condoms when you had sex with casual partners?</b>                          |     |      |
| 3 - 5 people  | 1   | 0.8  | No casual partners. no penetrative sex  | 90  | 72.6 |
| <b>4. How many times in the last month has someone used a needle after you have used it?</b>              |     |      | Every time  | 10  | 8.1  |
| Never   | 117 | 94.4 | Often   | 6   | 4.8  |
| One time  | 4   | 3.2  | Sometimes   | 1   | 0.8  |
| Two times   | 2   | 1.6  | Rarely  | 8   | 6.5  |
| 3 - 5 times   | 1   | 0.8  | Never   | 9   | 7.3  |
| <b>5. How often, in the last month, have you cleaned needles before re-using them?</b>                    |     |      | <b>9. How often have you used condoms when you have been paid for sex in the last month?</b>              |     |      |
| Does not re-use   | 82  | 68.2 | No paid sex/no penetrative sex  | 89  | 71.8 |
| Every time  | 34  | 26.5 | Every time  | 9   | 7.3  |
| Often   | 5   | 3.3  | Often   | 6   | 4.8  |
| Sometimes   | 2   | 1.3  | Sometimes   | 3   | 2.4  |
| Never   | 1   | 0.7  | Every time  | 5   | 4.0  |
|   |     |      | Often   | 12  | 9.7  |
|   |     |      | Sometimes   |     |      |
|   |     |      | Rarely  |     |      |
|   |     |      | Never   | 123 | 99.2 |
|   |     |      | <b>10. How many times did you have anal sex in the last month?</b>  |     |      |
|   |     |      | Never   | 0   | 0    |
|   |     |      | 1 time  | 1   | 0.8  |
|   |     |      | 2 times   | 0   | 0    |
|   |     |      | 3 - 5 times   |     |      |

intercourse with more than one sex partner, four never used a condom during intercourse with their regular partner, one never used a condom during intercourse with a temporary sex partner, and one participant had never used a condom during sexual intercourse (Table 4).

### 3.4. HIV-Related Variables

In the analysis of the HIV-positive IDUs, up to 89.5% (17/19) were HCV-positive, and about 21.1% (4/19) were HBV-positive; 68.4% (13/19) of subjects had a sex partner within the year before entering the MMTP, 61.5% (8/13) used a condom each time they had sex, but up to 38.5% (5/13) of HIV-positive IDUs did not use a condom during sexual intercourse. Fisher's exact test showed that "smoking", "HBV", "needle-sharing", "condom usage" and "venereal disease" were the five variables significantly associated with HIV (Table 1).

Based on these results, we used needle-sharing, condom usage, venereal disease, HBV and smoking as factors to analyze in the stepwise logistic regression model. Stepwise

**Table 4.** Number and frequency of risky behaviors of HIV carriers after one month in MMTP.

| Drug use items  | N  | %    | Sexual behavior items   | N  | %     |
|---|----|------|---|----|-------|
| <b>1. How many times have you hit up (i.e. injected any drugs) in the last month?</b>                     |    |      | <b>6. How many people, including clients, have you had sex with in the last month?</b>                    |    |       |
| Hasn't hit up   | 9  | 47.4 | None  | 9  | 47.4  |
| Once a week or less   | 3  | 15.8 | One   | 7  | 36.8  |
| More than once a week (<once a day)   | 4  | 21.1 | Over two people   | 3  | 15.8  |
| >Once a day   | 3  | 15.8 | <b>7. How often have you used condoms when having sex with your regular partner(s) in the last month?</b> |    |       |
| <b>2. How many times in the last month have you used a needle after someone else had already used it?</b> |    |      | No regular partner/no penetrative sex   | 9  | 47.4  |
| Never   | 17 | 89.5 | Every time  | 4  | 21.1  |
| One time  | 1  | 5.3  | Often   | 2  | 10.5  |
| Two times   | 1  | 5.3  | Never   | 4  | 21.1  |
| <b>3. How many different people have used a needle before you in the last month?</b>                      |    |      | <b>8. How often have you used condoms when you had sex with casual partners?</b>                          |    |       |
| Never   | 18 | 94.7 | No casual partners. no penetrative sex  | 16 | 84.2  |
| One person  | 1  | 5.3  | Every time  | 1  | 5.3   |
| <b>4. How many times in the last month has someone used a needle after you have used it?</b>              |    |      | Often   | 1  | 5.3   |
| Never   | 18 | 94.7 | Never   | 15 | 78.9  |
| One time  | 1  | 5.3  | Every time  | 3  | 15.8  |
| <b>5. How often, in the last month, have you cleaned needles before re-using them?</b>                    |    |      | <b>9. How often have you used condoms when you have been paid for sex in the last month?</b>              |    |       |
| Does not re-use   | 14 | 73.7 | No paid sex/no penetrative sex  | 1  | 5.3   |
| Every time  | 5  | 26.3 | Every time  | 19 | 100.0 |
|   |    |      | Never   |    |       |
|   |    |      | <b>10. How many times did you have anal sex in the last month?</b>  |    |       |
|   |    |      | Never   |    |       |

MMTP: Methadone maintenance treatment program.



logistic regression analysis found significant differences in needle-sharing (odds ratio = 12.375,  $p < 0.001$ ), condom usage (odds ratio = 5.565,  $p = 0.005$ ), venereal disease (odds ratio = 5.538,  $p = 0.004$ ) and HBV (odds ratio = 0.292,  $p = 0.037$ ) (**Table 5**).

## 4. Discussion

### 4.1. Methadone Maintenance Treatment Program

Methadone treatment was introduced in Taiwan in 2006 as a harm-reduction program in response to HIV, which is endemic among Taiwanese heroin users. Methadone maintenance therapy primarily provides heroin-dependent patients with long-term methadone and recovery plans, such as hygiene training, routine physical and mental health checkup, urine tests, and group psychological counseling [16]. Methadone treatment can help prevent many blood-transmitted diseases (HIV, syphilis, B hepatitis, C-type hepatitis) caused by sharing needles. MMTP may increase the probability that drug addicts can live a normal life, work and go back to the community, have the opportunity to live a day without looking for drugs, and commit fewer crimes. So methadone treatment minimizes the damage that IDUs may do to people and the community.

### 4.2. The Risky Behaviors of HIV Carriers and HCV Carriers

The IDUs in the Tainan County community MMTP were mainly young men, less educated and more likely to be unemployed. Most patients in MMTP did not share syringes during the previous year (82.8%); this result was similar to that in Hou's study, which found that 13.9% of IDU subjects had shared injection equipment [17]. However, this study also showed that 63.2% (12/19) of these HIV-positive IDUs had shared needles. This was more than that reported by the CDC in 2010, in which the proportion of IDUs infected with HIV-1 increased from 1.7% (13/772) in 2002, to 72.4% (2461/3399) in 2005, and dropped to 32.15% (6448/20,057) in 2010 [5]. Chen's study also pointed out that the most important risk factor for Taiwanese intravenous drug users is needle sharing, followed by the sharing of heroin diluents [18]. Since they commonly share injection equipment (needles), and HCV and HIV are transmitted mainly through blood and serum, IDUs are highly susceptible to HCV, HIV [19]-[22] and HBV, among other blood-borne infections. Estimates of the prevalence of HIV among Indian IDUs encompass a broad range, from 1% to 68% [23], with recent national estimates suggesting a prevalence of 15% among IDUs older than 25 years [24].

Our study results showed that a reduced proportion—52.6% (10/19)—of HIV infected

**Table 5.** Multiple logistic regression analysis of HIV-related variables.

| Variable         | B      | P-Value | OR     | 95% CI      |
|------------------|--------|---------|--------|-------------|
| Needles-sharing  | 2.516  | <0.001* | 12.375 | 4.22, 36.29 |
| Condom usage     | 1.717  | 0.005*  | 5.565  | 1.66, 18.66 |
| Venereal disease | 1.712  | 0.004*  | 5.538  | 1.73, 17.72 |
| HBV              | -1.231 | 0.037*  | 0.292  | 0.09, 0.93  |

\* $p < 0.05$ .

patients with heroin abuse within one month after entering MMTP still used intravenous drugs, and the proportion of those letting others use their used syringes dropped to 10.6% (2/19). These results show that the reduction of cases of sharing syringes with others again is worthy of consideration. IDUs have a risk of HIV infection. In addition to sharing HIV-contaminated needles and diluents with others, previous studies have pointed out that the IDUs continue to engage in risky sexual behaviors, including multiple sex partners, prostitution and unprotected sexual intercourse [25]-[27]. The results also show that these HIV-positive IDUs have sex with temporary partners, and that one participant (1/19) never used condoms, even in the sex trade. Also, 1/3 of drug addicts that were HIV-positive IDUs were asexual, and those with sexual partners mostly had a steady partner, but there were still 3 subjects that had a number of sexual partners. It is noteworthy that condom usage among drug addicts with HIV was high, but there were still 4 HIV-positive IDUs (4/19; 21.1%) that used condoms frequently or occasionally and 1 HIV-positive IDU resorted to prostitution for money or heroin, which should be given very careful attention. Studies among HIV-positive IDUs who know their HIV status show high rates of HIV-related risky behaviors, including the sharing of needles and syringes [28] [29], multiple sexual partners [30] and unprotected sexual intercourse [31].

HIV infected patients may use sex or prostitution to obtain heroin, and thereby further spread HIV to others. Therefore, we have the necessary education in the MMTP OPD to promote safe sex and condom use. Overall, up to 82% of these subjects are HCV-positive IDUs and about 44.4% are HBV infected patients; these rates are higher than those in Garten's data from southern China and in Solomon's study [32] [33], but similar to the rates in Kheirandish's report and Lee's report [34] [35]. In those with HCV infection, 80% to 85% will develop chronic hepatitis, and nearly 20% to 30% of subjects will develop liver cirrhosis after 20 years, and possibly even liver cancer [36]. Yen's study also points out that Taiwanese IDUs in the MMTP have a high HIV prevalence, which was associated with syringe sharing and other factors related to social marginalization. Because IDUs commonly share injection equipment needles, and HCV and HIV are transmitted mainly through blood and serum, IDUs are highly susceptible to HCV and HIV [19]-[21]. These patients must know that public health and clinical medical care are extremely important issues, but also more integrated medical services should be provided to heroin-using populations.

### **4.3. The Benefits of Methadone Programs for Public Health**

The government's promotion of clean needle exchange programs and methadone substitution treatment to block future sharing of needles by IDUs and lower the incidence of HIV infection can lead to the avoidance of serious social problems and reduce the burden on the national economy. Providing methadone to heroin users not only limits needle sharing, thereby stemming the spread of infectious diseases, but also treats addiction and the drug-related effects of heroin dependence, which affect the drug user's quality of life. Since 1994, Taiwan has been promoting the MMTP, and the numbers of newly infected Taiwanese HIV-1 patients presenting in 2007 and 2010 have been flat or

down; this is due to the government implementing clean needle exchanges, and the MMTP policy of reducing the HIV, HBV, and HCV epidemic. Lee's study also points out that HIV testing and education was essential for effective HIV control upon implementation of the national pilot harm reduction program (PHRP) [37]. Due to the implementation of the MMTP, drug users, whether through direct (mandatory health education and group psychotherapy) or indirect methods (dissemination of information, etc.), have gained knowledge about HIV and risky sexual behaviors. Our study results also demonstrated that both drug-and sex-related risky behaviors decrease during MMTP, and emphasized the benefits of methadone programs for public health and HIV/HCV prevention, similar to the results of Willner-Reid's data [38].

#### 4.4. The Limitations of Study

The limitations of this study include the small sample size and lack of exhaustive recruitment of IDUs deep within methadone clinics in southern Taiwan, so this study cohort may not constitute a representative sample of Taiwanese heroin users. Second, since risky behavior was assessed through a questionnaire, it was not possible to validate whether the patients answered the questions truthfully. We attempted to alleviate this problem by providing our participants with confidentiality.

### 5. Conclusion

In conclusion, the sharing of needles or dilution solvents within the drug addiction group is the main cause of HIV, HBV, and HCV infection. This is one of the most important problems in public health and clinical care. Since our government has an MMTP policy, the spread of HIV has come under control, but knowledge about HIV and safe sex education still need improvement. It is important for prevention programs to improve awareness of infection status through more regular HIV and HCV screening and to better educate IDUs about the utility of infection status disclosures within their drug injecting networks.

### Author Contributors

Conceived and designed the experiments: JKC YCL MDS MCM ICC. Performed the experiments: JKC YCL MDS. Contributed reagents/materials/analysis tools: JKC YCL MDS. Wrote the paper: JKC YCL MDS MCM ICC.

### Competing Interests

The authors have declared that no competing interests exist.

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