BMC Public Health

RESEARCH

Open Access

The impact of restricted community accessibility on needle and syringe sharing among drug users in Baise city: based on the event study method

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Abstract

Objective To investigate the effect of the restricted access to clean needles and syringes on needle and syringe sharing behavior like Human Immunodeficiency Virus (HIV) and Hepatitis C Virus (HCV) amongst the people who inject drugs (PWID) in Baise, Guangxi province of China, and to provide the scientific evidence for formulating public health policies aimed at preventing HIV transmission.

Method Using the national unified questionnaire and plan, from 2010 to 2019, snowball sampling was conducted among the community drug users under sentinel surveillance in Baise City's county districts every April to June. During face-to-face interviews with each participant, a structured questionnaire was used to collect demographic, behavioral, and venous blood for serological surveillance. All of this information was input into the HIV/AIDS Comprehensive Response Information Management System (CRIMS). Following China's enforcement of the Regulation on Supervision and Administration of Medical Devices(hereinafter referred to as the Regulation) in June 2014, which limited the sale of clean needles and syringes by community pharmacies. Therefore, we divided the period from 2010 to 2019 into from 2010 to 2015 and from 2016 to 2019. Utilizing the trends of HIV/HCV prevalences during these periods and taking them as indicators to measure the occurrence of needle and syringe sharing behavior. Employing the Event Study Method to verify the influence of community accessibility to needles and syringes for individuals of traditional drug users(TDU) on needle and syringe sharing, focusing on cumulative abnormal positive rates as a key metric. TDU came from the National HIV/AIDS CRIMS in 2010–2019 as the object, whose trend changes of annual HIV/HCV prevalences serve as a generation indicator of needle and syringe sharing. We set the period from 2010 to 2015 as the estimation window and from 2016 to 2019 as the event window, using the Chi-square trend tests to examine the changing trends in annual HIV/HCV prevalences. To construct a linear regression model based on the HIV/HCV prevalences from 2010 to 2015, the model was used to predict the expected prevalences from 2016 to 2019, which were compared with the actual prevalences from 2016 to 2019 to calculate the abnormal prevalences

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and the cumulative abnormal prevalences. Robustness tests were conducted on the cumulative abnormal prevalences to exclude the random changes in prevalences.

Result In the event window, The actual trend of HIV/HCV prevalences were both statistically significant from 2010 to 2015($_{trend}^{2}$ = 7.479, P = 0.006 and $_{trend}^{2}$ = 9.717, P < 0.001), but weren't both statistically significant from 2016 to 2019($_{trend}^{2}$ = 0.604, P = 0.437 and $_{trend}^{2}$ = 0.134, *P* = 0.715). The Linear regression model indicates the HIV prevalence showed a negative correlation with time(adjusted R^2 = 0.911, *P* < 0.001), and the HCV prevalence also exhibited a negative correlation with time from 2010 to 2015(adjusted R^2 = 0.869, *P* < 0.001). During the event window from 2016 to 2019, the expected HIV and HCV prevalences were as follows: for HIV, 8.24%, 5.62%, 3.01%, and 0.39%; for HCV, 34.55%, 30.56%, 26.56%, and 22.57%. The abnormal HIV/HCV prevalences during this period were: for HIV, 3.29%, 6.26%, 9.56%, and 7.88%; for HCV, 4.71%, 10.69%, 15.28%, and 14.35%. The cumulative abnormal HIV/HCV prevalences were 3.29%, 9.55%, 19.11%, 26.99% for HIV, and 4.71%, 15.40%, 30.68%, 45.03% for HCV; the robustness test results indicated that the changes in HIV and HCV prevalences during the event window were not random events(U = 12.371, P < 0.001 for both Cumulative abnormal HIV/HCV prevalence).

Conclusion When individuals practice injecting drugs, the important factor in needle and syringe sharing among TDU groups is the restricted access to clean needles and syringes from the community. The community commercial channel for needles and syringes should serve as a public health resource, addressing access to clean needles and syringes for individuals and reducing the frequency of needle and syringe sharing among community-active TDU groups. Public health policies aimed at preventing HIV epidemics in TDU populations should fully consider the accessibility of needles and syringes for the TDU groups in the community, thereby enhancing the effectiveness of public health measures.

Keywords People who inject drugs, Needle and syringe sharing, Accessibility, Individual behavior, Public health, The event study method, Community

Introduction

It is estimated that there were 13.20 million PWID worldwide in 2020, with HIV/HCV infection rates of approximately 12.70% and 39.4%, respectively [1, 2]. Needle and syringe sharing during drug injection not only leads to high HIV/HCV infection rates among PWID [3] but also acts as a bridge for the spread of infections across different regions [4]. Therefore, reducing needle and syringe sharing behavior and the risk of HIV infection has become a consensus in the field of public health.

The international standard indicates that the ratio of explicit to implicit PWUD in the community is estimated to be 1:5 [5, 6], for example, in the Americas, it is estimated that there were 1.48 million registered drug users [7], then suggesting that the actual number of drug users in the community could be as high as 7.41 million. The widespread presence of both explicit to implicit drug users in the community poses a significant challenge to achieving public health goals, particularly in preventing the spread of HIV. It is globally recognized that the strategies for reducing needle and syringe behavior include the Needle and Syringe Exchange Program (NSEP), Methadone Maintenance Therapy (MMT), and Compulsory Treatment and Rehabilitation Services (CTRS) [8–11]. However, the HIV infection rate has been found to vary significantly across countries and regions after the implementation of these measures [12–14]. This suggests that NSEP, MMT, and CTRS may struggle to reach all unregistered drug users in the community [15–17], and also highlights the presence of overlooked factors in the community that contribute to needle and syringe sharing behavior.

The accessibility of public health services is the degree to which these services and intervention measures are obtained timely and conveniently by those in need [18–20]. Research in other fields of public service has noticed that community medical services are an important factor that influences individual utilization behavior of medical services [18, 19]. From the perspective of the Personal Behavior Formation Theory, an individual's spatial activity is also an important factor that influences the individual utilization behavior of medical services [21]. Qualitative research suggests that commercial resources from community pharmacies are the preferred channels for PWUD groups to obtain needles and syringes, due to the convenience in terms of distance and time. However, it has not been confirmed whether needle and syringe-related behaviors are causally related to the accessibility of clean needles and syringes [22], nor whether such access influences the needle and syringe sharing behavior in the community PWUD groups from the perspective of individual behavior formation, potentially contributing to the spread of HIV.

Due to ethical concerns and the widespread, concealed distribution of the PWUD groups in the community, conducting experimental research is not feasible. In June

2014, China issued the Regulation on the Supervision and Administration of Medical Devices [23] (Regulation) to strengthen the supervision and safety of medical devices, including a strict limitation on the sale of clean needles and syringes in community pharmacies. However, this Regulation did not legally restrict other supply channels for needles and syringes, thus providing a natural experiment to test the hypothesis. To verify the causal relationship between the strict restriction on the sale of clean needles and syringes on the needle and syringe sharing behavior in community pharmacies, We applied the Event Study Method to verify the impact of access to needles and syringes on individual sharing behavior [24, 25]. Firstly, This methodology is used in social sciences to evaluate the causal relationship between a policy or event and the specific indicator, allowing for statistical inference to understand the underlying phenomena. Currently, this method has not been widely applied in public health research to explore the influencing factors related to the usage of needles and syringes among PWID. In addition, Previous research has indicated that long-term surveillance data can evaluate the true impact of an event [26].

This study plans to use the HIV/HCV prevalences as the indicators of the frequency of needle and syringe sharing behavior, Data will be sourced from CRIMS for TDU in China, ranging from 2010 to 2019. By employing the Event Study Method, the study aims to assess the causal relationship between the access to needles and syringes in the community and needle and syringe sharing behavior from the individual behavior, thereby providing scientific support for the development of HIV prevention public health strategies.

Methods

Study setting

From 2010 to 2019, continuous cross-sectional sentinel surveillance using snowball sampling was conducted within the communities of Baise City's county districts during the annual year. PWUD aged above 14, regardless of the type of drugs they use, were recruited into the study from April to June each year. At the same time, the surveillance objects were surveyed and venous blood was collected according to the unified questionnaire and plan, Blood samples were tested for HIV antibodies and HCV antibodies using the Enzyme-Linked Immunosorbent Assay (ELISA), (Wantai Biological Pharmacy Enterprise Co., Ltd., Beijing, China). Preliminarily positive HCV samples are going on retesting with the same reagent. The positive HIV samples are diagnosed by Western blotting (WB) validation (HIV Blot 2.2 WB; Genelabs Diagnostic, Singapore) [27]. Preliminarily positive samples are going on retesting with another reagent. The experimental procedures are carried out under the instructions of each kit and the national AIDS testing technical specifications. If the retested results of HIV and HCV antibodies are positive, the final result can be regarded as positive. The surveillance data is input into the CRIMS, which is configured to perform logical validation to prevent input errors. Training before the start of monitoring and on-site quality control during the survey is implemented to control the quality of the study.

Category of the DU

According to the drug classification standards in China's CRIMS program, individuals who self-report using heroin, cocaine, opium, marijuana, and morphine are classified as TDU; those who use methamphetamine, ketamine, ecstasy, and marijuana are referred to as the New-type Drug Users (NDU).

Object

It has not been found that new-type drugs are used through injection in Guangxi, China [27, 28]. However, both injecting and non-injecting behaviors can occur simultaneously, as identified by self-reported drug use behavior among TDU groups in the community. To minimize bias in the provision of sensitive information by surveyed subjects, this study selects self-reported TDU groups, including MDU groups who report using both traditional and new-type drugs, as the research subjects.

Behavioral indicator

The HIV/HCV antibody-positive rates of the China CRIMS are regarded as the indicator to assess the changes in needle and syringe sharing behavior [29].

The event study method

Event window

The event window refers to the time during which a policy or event is believed to have an impact. This period can accurately reflect the real effect of the policy or event on the indicator. The event date point, marking the starting time when the policy or event is determined to have an impact on the indicator, should fall within the event window.

Because the monitoring system was set in 2009, and to avoid the impact of the COVID-19 pandemic on the effectiveness of the monitoring, this study ultimately conducted a secondary analysis of the HIV/HCV prevalences from 2010 to 2019. Although the regulations were enforced in June 2014 [30], their full implementation in Baise City, Guangxi, considering the delayed effect on community pharmacies' inventory digestion and the adjustment period for law enforcement, was not formalized until the end of June 2015. The surveillance data,

collected annually between April and June, offers insights into the HIV/HCV infection status among TDU groups from the previous year. To accurately analyze the impact of the ban on the sale of needles and syringes in community pharmacies on the HIV/HCV prevalences in TDU following the implementation of the Regulation, this study determined that the policy's influence on the commercial needle and syringe channel began in 2016, thus designating 2016 as the time point of occurrence ($T_0 = 2016$). Consequently, the event window period was set from 2016 to 2019.

Estimated window

The estimation window is the period preceding the event window, during which the expected return($\boldsymbol{ER_t}$) is predicted before policy implementation. Consequently, the estimation window of this study is from 2010 to 2015.

Building the predicting model

The return (Rt) during the estimated period is used to predict the expected return (***ERt***) within the event window based on the construction of a statistical model. It has been found that there are regional disparities in the HIV/HCV prevalences among PWUD groups in China, as summarized in the research [31], so it is not possible to predict the $\boldsymbol{ER_t}$ of the local event window based on changes in HIV/HCV prevalences in other regions. Therefore, this study calculated the $\boldsymbol{ER_t}$ for the years 2016–2019 by establishing a predictive model:

Based on the premise that the prevalence from 2010 to 2015 shows a linear trend over time, a linear regression model was developed to verify its relationship [32]. If the model is validated, the predictive model will be constructed using the following formula for the prevalence Rt during 2010–2015and time **Ti**:

$$R_t = \alpha + \beta \, \mathrm{T_i} + \varepsilon$$

Here, Rt represents the HIV/HCV prevalences of the study subjects from 2010 to 20159, $\boldsymbol{T_i}$ represents the time value within 2010–2015, α and β are the parameters to be estimated. ε is the residual term in the regression model.

Abnormal Returns((ARt)

During the event window, the abnormal return (AR_t) is defined as the difference between the actual return (Rt) and the expected return by the model. It is calculated using the formula:

$$AR_t = R_t - ER_t$$

Cumulative abnormal return

The Cumulative Abnormal Return (CAR), which is the cumulative change of annual Abnormal Returns (ARt) within the event window, helps to reflect the overall impact of abnormal situations. Plot the cumulative abnormal prevalence on the vertical axis and time $\boldsymbol{T_i}$ on the horizontal axis of the chart. If the Regulation has promoted the increase of the prevalence, the CAR line will be positioned above the horizontal axis; conversely, if it has slowed the increase, the CAR line will be below the horizontal axis

Robustness test

The study aims to exclude the possibility that the changes in the prevalences from 2016 to 2019 were due to random events. This study posits two hypotheses: H_0 states that the changes in the cumulative abnormal prevalences are not significant, suggesting that any observed changes in the prevalence are random. H_1 asserts that the changes in the cumulative abnormal prevalences are significant, indicating that the observed changes are not random. The robustness of the conclusion is contingent upon whether the impact on behavioral indicators is statistically significant. If significant, the conclusion is considered robust; otherwise, it is not. The choice of statistical test depends on the distribution of the cumulative abnormal prevalences: a one-sample t-test is used if it follows a normal distribution and a rank sum test is used if it follows a skewed distribution.

Statistical methods

Using the SPSS version 25.0 to perform a robustness test on the cumulative prevalence and analyze the trend change in the prevalence, the trend change in the prevalence before and after the implementation of the Regulation are tested by trend ^{2}. A P value < 0.05 was considered statistically significant.

Ethical statement

This study utilized annual HIV/HCV prevalence data from the TDU groups, sourced from the Baise Center for Disease Control and Prevention (Baise CDC). The data were obtained through an anonymous monitoring system in compliance with the Infectious Disease Prevention and Control Law, ensuring that no personal privacy or other sensitive information was involved. Consequently, informed consent was waived for this study by the Graduated Department of Youjiang Medical University for Nationalities. Ethical approval was granted by the Ethics Committee of Youjiang Medical University for Nationalities (Approval No: 2024071201)

Results

The basic situation of the HIV/HCV prevalences from 2010 to 2019

The HIV prevalence decreased from 21.21% in 2010 to 8.27% in 2019. The HCV prevalence decreased from 54.91% in 2010 to 36.92% in 2019 (Table 1)

Table 1 The HIV/HCV prevalences of the TDU groups from 2010 to 2019 [%(n/N)]

Variables	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
HIV prevalence	21.21 (190/896)	22.71 (208/916)	16.46 (145/881)	16.24 (160/985)	12.51 (107/855)	9.82 (94/957)	11.53 (109/945)	11.88 (93/783)	12.57 (94/748)	8.27 (43/520)
HCVprevalence	54.91 (492/896)	58.30 (534/916)	49.04 (432/881)	43.45 (428/985)	43.86 (375/855)	38.24 (366/957)	39.26 (371/945)	41.25 (323/783)	41.84 (313/748)	36.92 (192/520)

n refers to the number of individuals positive for HIV/HCV antibodies, N refers to the number of TDU

Annual trend analysis

From 2010 to 2015: The HIV prevalence decreased from 21.21% to 9.82%, and the trend ^{2} test showed statistical significance ($_{trend}^2 = 7.479$, $P = 0.006$). The HCV prevalence decreased from 54.91% to 38.24% (Fig. 1 and Fig. 2), and the trend ^{2} test shows statistical significance ($_{trend}^2 = 9.717$, $P < 0.001$).

From 2016 to 2019

The HIV prevalence changed from 11.53% to 8.27%, and the trend ^{2} test showed no statistical significance ($_{trend}^2 = 0.604$, $P = 0.437$). The HCV prevalence changed from 39.26% to 36.92% (Fig. 1 and Fig. 2), and the trend ^{2} test showed no statistical significance(Fig. 1 and Fig. 2) ($_{trend}^2 = 0.134$, P = 0.715).

The predicted model and outcome

A linear regression prediction model was established to predict the expected HIV prevalences for 2016–2019 as 8.24%, 5.62%, 3.01%, and 0.39%, and the expected HCV prevalences as 34.55%, 30.56%, 26.56%, and 22.57% (Table 2). The model demonstrates a negative relationship between HIV/HCV prevalences and time from 2010 to 2015, with HIV: ($adjusted\ R^2 = 0.911$, $P < 0.001$); HCV: ($adjusted\ R^2 = 0.869$, $P < 0.001$).

$$ER_t = -2.616\ \mathrm{T}_i + 5282.094$$

The predicted formula of expected HIV prevalence:

$$ER_t = -3.995\ \mathrm{T}_i + 8088.474$$

Abnormal HIV/HCV prevalences and cumulative abnormal HIV/HCV prevalences

From 2016 to 2019, the abnormal HIV prevalence increased from 3.29% to 7.88%, and the HCV prevalence increased from 4.71% to 14.35%(Table 2). The cumulative abnormal HIV/HCV prevalences from 2016 to 2019 increased from 3.29% to 26.99% and increased from 4.71% to 45.03%, respectively(Table 2 and Fig. 3).

Stability test result

According to the Single-sample Wilcoxon signed-rank test: $U \neq 0$, $P < 0.001$(Table 3), we reject the H_0. The cumulative abnormal HIV/HCV prevalences from 2016 to 2019 showed non-random events ($U = 12.371$).

Discussion

Based on unified survey timing, standards, and other quality control measures, the anonymously collected HIV/HCV prevalence of PWID groups in the community activities from the China CRIMS system can evaluate and analyze the prevention and control effect and influencing factors of local PWID groups [4]. Given the widespread and covert distribution of the PWID groups in the community, and the fact that actual injecting drugs and needle and syringe sharing behavior cannot be collected through direct observation, the long-term systematic monitoring with consistent standards enables the PWID populations to be considered as study observation population with low systematic errors and strong representation in this research. Whose monitoring serological indicators of HIV/HCV prevalences serve as an objectively sensitive indicator of the changing needle and syringe sharing frequency. In Baise City, Guangxi Province, the first place where HIV prevalence occurred in the PWID groups in China [27], the HIV prevalence in this population reached 21.21% in 2010. As an earlier prevalent blood-borne virus, the HCV prevalence also highly reached 54.91% in 2010. The high HIV/HCV prevalences among the PWID groups in the early time indicated that there was a very high proportion of injection and needle and syringe sharing behavior within the PWID in the community. In addition, considering that the individual probably coexists with both injection and non-injection drug use behaviors, the study concludes that injection drug use behavior is characterized by universality and complexity among the PWID. Although the HIV/HCV prevalences continuously decreased from 2010 to 2015, it only indicates that the frequency of needle and syringe sharing decreased, and it does not indicate that the frequency of injection behavior in PWID groups also decreased in community activities. It is highly susceptible to resulting in selection and information bias when we distinguish between injecting and non-injecting groups based solely on self-reported drug-injecting behavior among PWID. Therefore this study directly takes the PWID in the CRIMS system as the object, focusing specifically on the changes in HIV/HCV prevalence caused by needle and syringe sharing. At the same time, Once taking the needle and syringe sharing behavior, HIV/HCV infectious rates among TDU are extremely high and sensitively reflected in the changes in annual HIV/HCV prevalent rates in serological tests.

During the period from 2010 to 2015, the HIV prevalence decreased from 21.21% to 9.82%, and the HCV prevalence decreased from 54.91% to 38.24%. Both of the Chi-square trends from 2010 to 2015 are statistically significant. The continuous decline in HIV/HCV prevalence rates during this period reflects the near-zero incidence of needle and syringe sharing behavior among PWID groups in local communities [27]. From the perspective of the formation of the individual behavior model [33], As a marginalized community group [34], the explicit and implicit PWID can realize safe injecting behaviors when injecting drugs [21, 35] under the combined effects

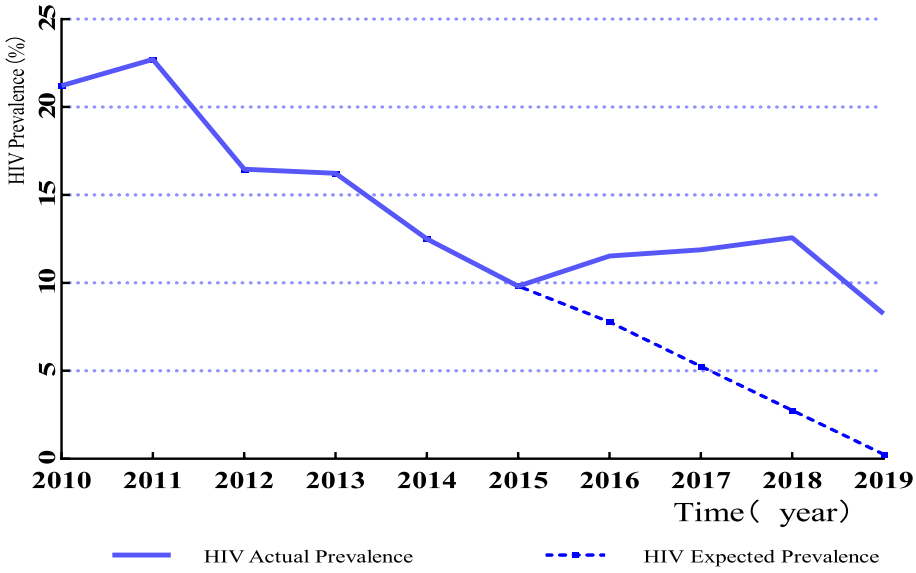

Fig. 1 The actual and expected trend prevalences of HIV from 2010 to 2019

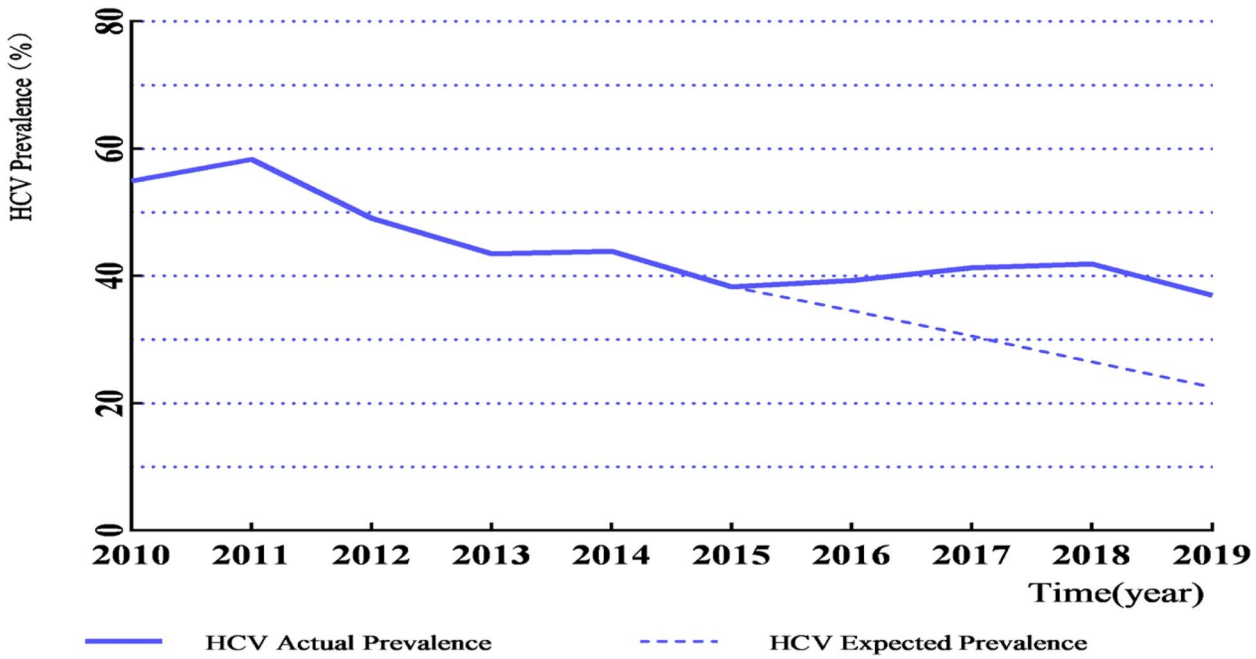

Fig. 2 The actual and expected trend prevalences of HCV from 2010 to 2019

of known factors such as NSEP, MMT, CTRS, pharmacies, private clinics, and other unknown factors. From the perspective of prevention effect in public the health field, the continuous declines of HIV/HCV prevalence rates in six years have suggested that the local community environment not only ensures safe injecting behavior in explicit and implicit PWID but also achieves the sustainability and equity of public health prevention and control measures [3], finally sustaining a "zero" new infections rate for HIV/HCV for six years.

Following the implementation of the Regulation, which severely restricted access to needles and syringes by community pharmacies, HIV/HCV prevalence remained stable from 2016 to 2019, marking a significant departure from the continuous decline observed between 2010 and 2015. The insufficient sample size in 2019 may lead to an

Table 2 The abnormal HIV/HCV prevalences and the cumulative abnormal HIV/HCV prevalences: from 2016 to 2019

Variable	Time (year)	T	Prevalence (Rt%)	Expected prevalence (ERt%)	Abnormal prevalence (ARt%)	Cumulative abnormal prevalences (CARt%)
HIV prevalence	2016	0	11.53	8.24	3.29	3.29
	2017	1	11.88	5.62	6.26	9.55
	2018	2	12.57	3.01	9.56	19.11
	2019	3	8.27	0.39	7.88	26.99
HCV prevalence	2016	0	39.26	34.55	4.71	4.71
	2017	1	41.25	30.56	10.69	15.40
	2018	2	41.84	26.56	15.28	30.68
	2019	3	36.92	22.57	14.35	45.03

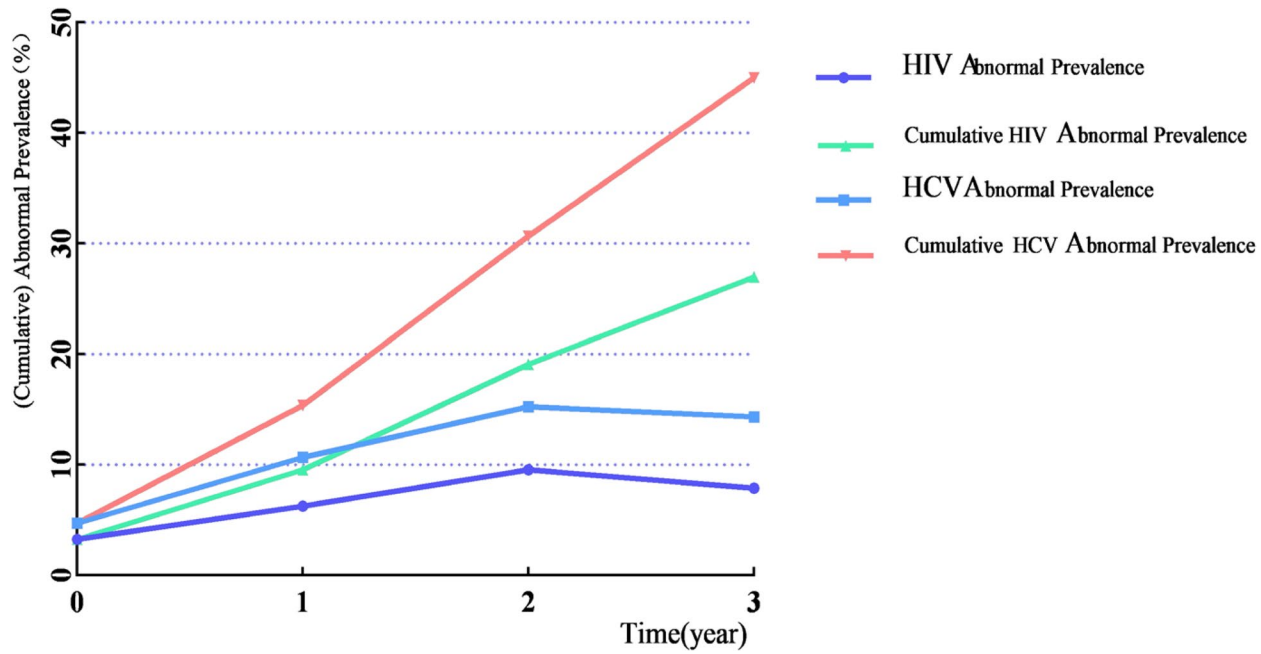

Fig. 3 Trend chart of abnormal prevalences and cumulative abnormal prevalences of HIV/HCV

Table 3 Robustness test results of the cumulative abnormal HIV/HCV prevalence during the event window

Variable	*U*	*P*
Cumulative abnormal HIV prevalence	12.371	<0.001
Cumulative abnormal HCV prevalence	12.371	<0.001

inability to accurately estimate the HIV/HCV prevalence, which in turn may result in the chi-square trend tests for the trend from 2016 to 2019 not being statistically significant. Firstly, this indicates that the goal of zero new infections has been compromised during the drug injection process within the local community, resulting in new HIV/HCV infections. Secondly, from the perspective of the formation of the individual behavior model [35], it is noted that not all needle and syringe sharing behaviors with companions occur within the PWID groups. Since the Regulation does not restrict the distribution by other medical institutions, clinics, and designated qualified sales outlets, individuals within the PWID group who engage in injection behavior may still obtain needles and syringes through these channels [36], conversely, under the influence of strong physiological drug dependence and within the confines of limited community activity

spaces, individuals may be fully cognizant of the risks of infectious diseases associated with needle and syringe sharing behavior, yet still participate in such behaviors with others [9, 11], leading to new HIV/HCV infections.

This study confirms that community pharmacies are an important source for community-active PWID groups to obtain needles and syringes and also verifies that access to needles and syringes from the community is a significant factor influencing needle and syringe sharing among PWID groups. The Event Study detects a causal relationship between the Regulation, which strictly limited the supply of needles and syringes by community pharmacies, and the change in HIV/HCV prevalences in the PWID groups. The cumulative abnormal HIV/HCV prevalences, serving as indicators for assessing the causal relationship, exhibit an upward trend. The cumulative abnormal HIV/HCV prevalences are 3.29%, 9.55%, 19.11%, and 26.99% for HIV, and 4.71%, 15.40%, 30.68%, and 45.03% for HCV, respectively. Moreover, robustness tests indicate that the changes in HIV/HCV prevalences after the implementation of the Regulation are not random events. The qualitative study indicates that obtaining needles and syringes from community pharmacies and clinics is the most convenient approach [22]. This study found that HIV/HCV prevalences in PWID groups changed immediately after the sale of needles and syringes in community pharmacies was strictly restricted, without changes in other social environmental factors. As previously mentioned, because the pharmacies are widely spread in the community, needles and syringes provided can cover the implicit PWID groups in the community. At the same time, PWIDs can obtain needles and syringes quickly when needed, due to the proximity and extended business hours of community pharmacies, thus resulting in minimal or no needle and syringe sharing behavior and no new HIV/HCV infections. The natural experiment study has confirmed that community pharmacies are one of the important approaches for obtaining clean needles and syringes [37], and are also important supports for the individual's safe injection behavior. From the perspective of a causal relationship, the study has verified that in the absence of adequate cleaning needles and syringes and a timely supply environment, the strict limitation on the sale of needles and syringes by community pharmacies has immediately caused a change in the HIV/HCV prevalence rates among the PWID groups. This suggests that due to the strong physiological dependence on drugs, and the limited activity range of individuals, the behavior of passively needle and syringe sharing behavior with others has been triggered, leading to an increase in the HIV and HCV infections among the community PWID. Therefore, the study has demonstrated that access to needles and syringes for PWID in the community is a factor that requires close attention when formulating public health policies or strategies. At the same time, as a marginalized community group, this study and past research suggest that locations providing needles and syringes should be devoid of discrimination and free from threats to their safety. Additionally, from the perspective of public health intervention activities, they should consider the following important characteristics: proximity to PWID residences or activity areas, flexible business hours, strong sustainability, and other factors [16, 38]. All of the above factors may account for the noticeable differences in HIV infection outcomes across different regions.

Currently, public health policies such as NSEP, MMT, and CTRS are the focal points of attention in various countries and regions, However, they often overlook the actual demand and the accessibility of public health service for TDU when using clean needles and syringes [8, 11], finally affecting the effectiveness of local public health policies in preventing and reducing the risk of HIV prevalence. So considering the demand for clean needles and syringes and access to public health services among both the explicit and implicit PWID groups, a further survey about the source of community-commercial clean needles and syringes should be conducted before formulating measures. When designing a surveillance system, observational indicators such as individual access to needles and syringes should be included from the perspective of behavior formation. After comprehensive assessment and analysis, reasonable public health strategies and measures should be proposed.

Strengths and limitations

This study initially adopts the research methodology from the field of econometrics, using the trend of HIV/HCV prevalences to explore the specific causes from the perspective of individual PWID. The implementation of the Regulation and the long-term serological surveillance data in this study naturally establish a link between the individuals' access to obtaining needles and syringes and changes in needle and syringe sharing. The Event Study Method could be appropriately used to explore the causal relationship between the two through serological analysis of changes. It can add a new confirmatory method for the Medical Statistics of the public health field. Confirmatory thinking in the social science field increases the possibility of validating the risk factors associated with infectious diseases. It is hoped that these findings will be applicable in the field of public health in the future. We take advantage of the whole trend from 2016 to 2019 not being statistically significant and is higher than the level in 2015 to reflect the needle and syringe sharing behavior rising up from 2016 to 2019. PWUD may include injection and non-injection people, so focusing on the TDU groups

as defined by PWID may underestimate the impact of access to needle and syringe sharing. We should define the PWID with specific indicators in the later research. The premise of this Event Study Method is that other social factors are not affected; however, the long time of this study may introduce other influencing factors, for example, the implementation status of needle and syringe exchange programs or the stringency of drug policies, which should be excluded in detail in future studies. Next step, this study should find a control region with a similar HIV/HCV epidemic trend and without the implementation of regulation, furthermore applying the Difference-in-Differences (DID) method to obtain a rigorous causal relationship and enhance the external validity of the research.

Conclusion

Needle and syringe accessibility is a critical factor in needle and syringe sharing behavior among PWID groups when they practice injecting behavior. As a significant social source, The approach of needles and syringes through commercial pharmacies can be regarded as an important public health source in preventing the HIV epidemic and realizing the safe injecting behavior among PWID groups across various regions, particularly in areas lacking public health resources.

Abbreviations

HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus
PWUD	People Who Use Drugs
PWID	People who inject drugs
TDU	Traditional drug user
NDU	New-type Drug User
MDU	Mixed Drug User
NSEP	Needle and Syringe Exchange Program
MMT	Methadone Maintenance Therapy
CTRS	Compulsory Treatment and Rehabilitation Services
CDC	Center(s) for Disease Control and Prevention
Rt	Return
ARt	Abnormal Return
ERt	Expected Return
CAR	Cumulative Abnormal Return
DID	Difference-in-Differences
SPSS	Statistical Package for the Social Science
ELISA	Enzyme-Linked Immunosorbent Assay

Acknowledgements

We are very grateful to the Teachers from the Center for Disease Control and Prevention of Baise City have long insisted on conducting face-to-face field investigations to collect and summarize serological monitoring data of the PWUD groups. Many thanks to teachers X L and G Q for providing innovative ideas and revising the content of this research.

Authors' contributions

LT and JC made the Previous collection and induction of the data. XL and XL for writing Articles and Analyzing Data. XL and GQ conceived and designed the study and content revision. GQ and WZ provided Technical Advisors for Statistical Analysis. RZ assisted review and revision of the format of the articles. RZ, CL, MX, and WL provided an essential literature review and extracted the key points. All authors have read and approved the final hand.

Funding

This research was supported by the Guangxi Province Education Department with the Project Innovation Project of Guangxi Graduate Education (JGY2023284). This study focuses on the achievement of cultivating the ability development of data assessment and the analysis in public health professional students.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to ethical and legal reasons, The datasets are available from the first author on reasonable request[XL:2173374614@qq.com) and LT:Email address: tlf-039@163.com and].

Declarations

Ethics approval and consent to participate

This study obtained approval from the Ethics Committee of Youjiang Medical University for Nationalities (Approval No: 2024071201). The ethics consent for publication is Not applicable. This study was conducted in accordance with the ethical principles outlined in the "Declaration of Helsinki" (World Medical Association, 1964, as revised in [2024]).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 9 November 2024 Accepted: 25 February 2025
Published online: 08 March 2025

References

1. Mahmud S, Chemaitelly H, Alaama AS, et al. Characterizing trends and associations for hepatitis C virus antibody prevalence in the Middle East and North Africa: meta-regression analyses. Sci Rep. 2022;12(1):20637.
2. World Health Organization. Global HIV, Hepatitis and STIs programmes[EB/OL]. https://www.who.int/teams/global-hiv-hepatitis-and-stis-programmes/populations/people-who-inject-drugs. Accessed 30 June 2024.
3. Lunze K, Lunze FI, Raj A, et al. Stigma and human rights abuses against people who inject drugs in Russia—a qualitative investigation to inform policy and public health strategies. PLoS One. 2015;10(8): e0136030.
4. Cai C, Tang H, Qin Q, et al. Behavioral verification and risk factors of HIV cross-population transmission in China: analysis of national surveillance data 1989–2022. BMC Infect Dis. 2024;24(1):49.
5. China Anti-Drug Network. The population of adolescents who inject users in Jiangxi has increased by 30%. http://www.nncc626.com/2015-11/09/c_128407711.htm. Accessed 14 Jul 2024.
6. Tang H, Li M, Yan X, et al. Modeling the dynamics of drug spreading in China. Int J Environ Res Public Health. 2021;18(1): 288.
7. United Nations office on drugs and crime. World drug report 2024. https://www.unodc.org/documents/data-and-analysis/WDR_2024/2411140C.pdf. Acessed 08.2.2024.
8. Evans DS, Harnedy N, Keenan E. Community pharmacy needle exchange programme: what can analysis of the data tell us about the changing drug market in Ireland? Int J Environ Res Public Health. 2024;21(3): 289.
9. Holeksa J. "In Sweden you are worthless. In Denmark you get an identity again": the perspectives of people who use drugs on being perceived and received in two countries with different approaches to drug policy. 2024.

10. Tanguay P, Kamarulzaman A, Aramrattana A, et al. Facilitating a transition from compulsory detention of people who use drugs towards voluntary community-based drug dependence treatment and support services in Asia. Harm Reduct J. 2015;12:1–5.
11. Wu Q, Kamphuis C, Duo L, et al. Coverage of harm reduction services and HIV infection: a multilevel analysis of five Chinese cities. Harm Reduct J. 2017;14:1–12.
12. Fischer B, Murphy Y, Rudzinski K, et al. Illicit drug use and harms, and related interventions and policy in Canada: a narrative review of select key indicators and developments since 2000. Int J Drug Policy. 2016;27:23–35.
13. United Nations Programme on HIV/AIDS (UNAIDS). UNAIDS data 2022[EB/OL]. (2023-01-01)[2024-10-03]. https://www.unaids.org/en/resources/documents/2023/2022_unaids_data.
14. Hser YI, Liang D, Lan YC, et al. Drug abuse, HIV, and HCV in Asian countries. J Neuroimmune Pharmacol. 2016;11(3):383–93.
15. Mumtaz GR. People who inject drugs in the Eastern Mediterranean region. Lancet Glob Health. 2023;11(8):e1146–7.
16. Chayama KL, Ng C, Fleming T, et al. Housing-based syringe services programs to improve access to safer injecting equipment for people who inject drugs in Vancouver, Canada: a spatially oriented qualitative study. Harm Reduct J. 2023;20(1):126.
17. Tempalski B, Cleland CM, Pouget ER, Chatterjee S, Friedman SR. Persistence of low drug treatment coverage for injection drug users in large US metropolitan areas. Substance Abuse Treatment, Prevention, and Policy. 2010;5: 23.
18. Wang X, Guo H. Accessibility: a theoretical perspective on media convergence. News and Writing. 2023;11:24–33.
19. Marotta PL, Stringer K, Beletsky L, et al. Assessing the relationship between syringe exchange, pharmacy, and street sources of accessing syringes and injection drug use behavior in a pooled nationally representative sample of people who inject drugs in the United States from 2002 to 2019. Harm Reduct J. 2021;18:1–8.
20. Hu R, Dong S, Zhao Y, et al. Assessing potential spatial accessibility of health services in rural China: a case study of Donghai County. International journal for equity in health. 2013;12:1–11.
21. Wu Y, Wang Q, Zheng F, et al. Effects of the implementation of transport-driven poverty alleviation policy on health care–seeking behavior and medical expenditure among older people in rural areas: quasi-experimental study. JMIR Public Health Surveill. 2023;9(1): e49603.
22. Harm Reduction International. A global state of harm reduction 2016. Available: https://hri.global/wp-content/uploads/2022/10/GSHR2016_14nov-1.pdf. Accessed 18 Jul 2024. 6
23. Wu YH, Li FA, Fan YT, et al. A study of medical device regulation management model in Asia. Expert Rev Med Devices. 2016;13(6):533–43.
24. Kurek B. Event study methodology–what for, how, and for whom? Zeszyty Teoretyczne Rachunkowości. 2020;108:241–58.
25. Allen ST, Danforth S, Grieb SM, et al. Law enforcement and syringe services program implementation in rural counties in Kentucky: a qualitative exploration. Harm Reduct J. 2022;19(1):109.
26. Ma S, Chen Y, Lai X, et al. Predicting the HIV/AIDS epidemic and measuring the effect of the AIDS conquering project in Guangxi Zhuang Autonomous Region. PLoS One. 2022;17(7): e0270525.
27. Luo T, Lin Z, Wu Z, et al. Trends and associated factors of HIV, HCV, and syphilis infection among different drug users in the China-Vietnam border area: an 11-year cross-sectional study (2010–2020). BMC Infect Dis. 2023;23(1):575.
28. Shuai T, Rongjian L, Zhen J, et al. Prevalence of human immunodeficiency virus infection, syphilis, and hepatitis C virus infection and related risk behaviors in different types of drug users in Guangxi Zhuang Autonomous Region from 2012 to 2021. Disease Surveillance. 2023;38(11):1334–40.
29. Pachuau LN, Tannous C, Chawngthu RL, et al. HIV and its associated factors among people who inject drugs in Mizoram, Northeast India. PLoS One. 2023;18(5): e0286009.
30. The People's Republic of China, regulations on supervision and administration of medical devices. https://www.gov.cn/gongbao/content/2014/content_2654507.htm. Accessed 18 Jul 2024.
31. Qiao Y, Xu Y, Jiang D, et al. Epidemiological analyses of regional and age differences of HIV/AIDS prevalence in China, 2004–2016. Int J Infect Dis. 2019;81:215–20.
32. Rashid M, Ismail H. HCV extinction analysis in district Gujrat, Pakistan by using SARIMA and linear regression models. Medicine. 2021;100(49): e28193.
33. Zhu QZ, Du YY, Gong L. Behavior and cognition characteristics of female heroin abusers based on theory of planned behavior. J Sun Yat-Sen Univ[J] Med Sci. 2015;36:245–50.
34. Jozaghi E. The Opioid Epidemic: Task-Shifting in Health Care and the Case for Access to Harm Reduction for People Who Use Drugs. Int J Health Serv. 2022;52(2):261–8.
35. Khani Jeihooni A, Mohammadkhah F, Bijani M, et al. Changing the high-risk behaviors of injecting drug users in Iran: application theory of planned behavior. Scientific World Journal. 2024;2024(1): 4660336.
36. Meyerson BE, Lawrence CA, Cope SD, et al. I could take the judgment if you could just provide the service: non-prescription syringe purchase experience at Arizona pharmacies, 2018. Harm Reduct J. 2019;16:1–9.
37. Borges M, Gouveia M, Fiorentino F, et al. Costs and consequences of the Portuguese needle-exchange program in community pharmacies. Canadian Pharmacists Journal/Revue des Pharmaciens du Canada. 2020;153(3):170–8.
38. Walker S, Curtis M, Kirwan A, et al. "No-one just does drugs during business hours!": evaluation of a 24/7 primary needle and syringe program in St Kilda, Australia. Harm Reduct J. 2024;21(1):51.

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