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Awareness, Possession, and Use of Take-Home Naloxone Among Illicit Drug Users, Vancouver, British Columbia, 2014-2015

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Abstract

Objectives: Although take-home naloxone (THN) programs are integral in strategies to prevent overdose deaths among opioid users, the uptake of THN among people who use drugs (PWUD) (including non-opioid users) is unknown. The objectives of this study were to determine awareness, possession, and use of THN among PWUD in Vancouver, Canada, and identify barriers to adopting this strategy.

Methods: From December 1, 2014, to May 29, 2015, participants in 2 prospective cohort studies of PWUD in Vancouver completed a standardized questionnaire, which asked about awareness, possession, and use of THN; sociodemographic characteristics; and drug use patterns. We conducted multivariable logistic regression analyses to determine factors independently associated with awareness and possession of THN.

Results: Of 1137 PWUD, 727 (64%) reported at least 1 previous overdose ever, and 220 (19%) had witnessed an overdose in the previous 6 months. Although 769 (68%) participants overall reported awareness of THN, only 88 of 392 (22%) opioid users had a THN kit, 18 (20%) of whom had previously administered naloxone. Factors that were positively associated with awareness of THN included witnessing an overdose in the previous 6 months (adjusted odds ratio [aOR] = 2.23; 95% confidence interval [CI], 1.49-3.34; $P < .001$), possession of THN (aOR = 1.85; 95% CI, 1.11-3.06; $P = .02$), younger age (aOR = 1.02; 95% CI, 1.01-1.04; $P = .003$), white race (aOR = 1.67; 95% CI, 1.27-2.19; $P < .001$), hepatitis C infection (aOR = 1.63; 95% CI, 1.13-2.36; $P = .01$), residing in Vancouver's Downtown Eastside neighborhood (aOR = 1.93; 95% CI, 1.47-2.53; $P < .001$), and at least daily heroin injection (aOR = 1.69; 95% CI, 1.09-2.62; $P < .02$).

Conclusion: Efforts to improve knowledge of and participation in the THN program may contribute to reduced opioid overdose mortality in Vancouver.

Keywords

illicit drug use, naloxone, opioids, opioid overdose, take-home naloxone

After the United States, Canada has the highest per-capita consumption of opioids among high-income countries, and rates of pharmaceutical opioid use in Canada have tripled during the past decade.[1-3] In parallel with high rates of opioid consumption, rates of opioid-related overdose and mortality have also increased. Although no national data exist for overdose mortality in Canada, data do exist for the province of British Columbia, where the number of deaths resulting from illicit drug overdose between 2010 and 2016 increased 340% (from 211 in 2010 to 931 in 2016).[4] The 931 illicit drug overdose deaths in British Columbia in 2016 represented a mortality rate not seen since the 1990s, when the intravenous

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heroin epidemic was at its peak, with fentanyl being detected in 62% of cases.[5]

To reduce the number of overdose deaths related to the growing epidemic of opioid use, take-home naloxone (THN) programs have become an integral overdose prevention strategy.[6] These programs train participants to recognize and respond to an opioid overdose and to provide participants with a packaged kit that includes naloxone, an opioid antagonist that temporarily reverses opioid toxicity. Several similar programs have been implemented in Australia, Europe, and the United States.[7-9] A 2016 systematic review, which included studies from Canada, the United States, and the United Kingdom, found a strong association between THN programs and overdose survival, with 2249 successful overdose reversals among 2336 THN administrations.[10]

A literature review in 2015 characterized research on THN programs as being focused on 5 key themes: program evaluation, experiences and attitudes of program participants, willingness of medical providers to prescribe naloxone, comparison of different routes of naloxone administration, and cost-effectiveness of naloxone.[11] Currently absent from the existing literature, however, is the effectiveness of community-based THN programs in promoting awareness and subsequent enrollment among a population known to be at high risk for opioid overdose. Knowing the effectiveness of such programs will not only characterize uptake of THN among at-risk populations but will also identify people who are not THN program participants (and who may benefit from more targeted intervention) and highlight barriers to THN program enrollment.

British Columbia is the site of one of Canada's oldest operational provincial THN programs.[12-14] Launched in 2012, the program is well-positioned to address these existing knowledge gaps. The primary objective of our study was to evaluate awareness and possession of THN among people who use drugs (PWUD) in Vancouver, British Columbia. A secondary objective was to determine THN use and barriers to adopting this harm-reduction strategy.

Methods

Study Sample

We used data from 2 open prospective cohort studies in Vancouver—the Vancouver Injection Drug Users Study (VIDUS) and the AIDS Care Cohort to Evaluate Access to Survival Services (ACCESS)—which have been described previously.[15-17] The studies comprise PWUD who are either human immunodeficiency virus (HIV) negative (VIDUS) or HIV positive (ACCESS). In brief, participants are included if they are aged ≥18, live in the greater Vancouver region at enrollment, report using an illicit drug other than cannabis at least once in the past 30 days (ACCESS) or injecting a drug at least once in the previous month (VIDUS), and provide written informed consent. Recruitment for both cohorts began in 1996 and occurs through snowball sampling and street outreach. Data collection, enrollment, and follow-up procedures are identical for both cohorts to allow for merged data and combined analyses.

We chose not to restrict the study sample to only opioid-using PWUD when we assessed THN awareness because of the marked increase in fentanyl-detected deaths among all illicit drug overdoses that occurred in British Columbia in 2012 (5% [12/269] compared with 2016 (62% [575/931]).[5] A review of 325 fentanyl-detected illicit drug overdose deaths in British Columbia in 2016 revealed the presence of stimulants (cocaine [50% of deaths] or methamphetamine/amphetamine [34% of deaths]) to be more common than heroin (32% of deaths).[5] We did, however, restrict the study sample to only opioid-using PWUD with previous awareness of THN when we assessed THN possession, given that British Columbia's eligibility criteria at the time for a THN kit included only opioid-using PWUD (although friends, family, or service providers were eligible for THN training).

Study Assessments

At baseline, participants complete an interviewer-administered questionnaire that collects data on sociodemographic characteristics, drug use patterns, and risk behaviors. Participants provide blood for hepatitis C virus (HCV) and HIV antibody testing (for HIV-negative participants) or clinical monitoring (for HIV-positive participants). Participants receive a $30 honorarium (Canadian dollars) and, if appropriate, basic medical care or a referral to specialty health care services. The study protocols for the VIDUS and ACCESS cohorts were approved by the University of British Columbia/Providence Health Care research ethics board.

Study Measures

Questions about THN were added to the cohort questionnaire in December 2014. As such, all VIDUS and ACCESS participants who completed a study visit between December 1, 2014, and May 29, 2015, were included in this study. We ascertained awareness and possession of THN, the primary outcomes of interest, through the following questions: "Have you heard about a take-home Narcan rescue kit that you can keep with you for an opiate overdose?" and "Do you currently own a take-home Narcan rescue kit?" To determine past use of THN, opioid-using PWUD who answered yes to the question, "Do you currently own a take-home Narcan rescue kit?" were also asked, "Have you ever administered Narcan to anyone?" Those who answered yes were further asked to quantify the number of times (1 or 2, 3 or 4, or ≥5). We assessed reasons for not possessing a THN kit among opioid-using PWUD using an open-answer format and a predefined list of answers that included the following: "I don't know where to get one; I don't feel comfortable using it; I haven't picked up a new kit after using my previous one; I don't think I need one; I've never been offered one; I don't

use or hang out with people who use opiates; or other." Participants could check all applicable answers.

Explanatory variables of interest were chosen a priori according to what we hypothesized would result in increased awareness and possession of THN. We hypothesized that specific drug use patterns would be associated with increased awareness and possession of THN, given that opioid-using PWUD were targeted by British Columbia's THN program. Thus, past 6-month drug use variables included at least daily noninjection use of illicit prescription opioids (defined as any prescription opioid used that was not prescribed to the participant or was taken only for the experience or feeling it caused) (yes/no), heroin (yes/no), cocaine (yes/no), or crack smoking (yes/no), as well as at least daily injection of illicit prescription opioids (yes/no), heroin (yes/no), cocaine (yes/no), or crystal methamphetamine (yes/no). Research also shows that younger PWUD are less familiar with harm-reduction services than are older PWUD.[18-20] We hypothesized increased awareness and possession of THN among more entrenched substance users, which we defined as those who were homeless (yes/no), infected with HIV (VIDUS vs ACCESS), infected with HCV (yes/no), or resided in Vancouver's Downtown Eastside (DTES) neighborhood in the preceding 6 months (a district with an open drug market and high levels of poverty, homelessness, and HIV infection) (yes/no). We hypothesized increased awareness and possession of THN among PWUD with overdose risk factors, which we defined as a past history of ever having overdosed (yes/no), having overdosed in the previous 6 months (yes/no), having witnessed an overdose in the preceding 6 months (yes/no), and public injection or noninjection drug use (yes/no). We collected information on demographic characteristics: age (per year younger), sex, race, relationship (married/common law/regular partner, other), and education.

Statistical Analyses

We stratified baseline characteristics of participants according to our 2 primary outcomes of interest. We tested associations with awareness or possession of THN in bivariate analyses using separate logistic regression models for each outcome of interest. We also conducted a separate multivariate analysis for each outcome of interest, adjusting for cohort of recruitment and all of the explanatory variables that had $P < .10$ in the bivariate analyses. We considered 2-sided $P < .05$ to be significant. We performed all analyses using SAS version 9.4.[21]

Results

From December 1, 2014, to May 29, 2015, 1137 participants completed study enrollment, of whom 751 (66.1%) were male, 641 (56.4%) were white, 501 (44.1%) were HIV positive, and 957 (84.2%) were HCV antibody positive. The median age was 50 years (interquartile range, 42-55). A total of 727 (63.9%) participants had ever had a nonfatal overdose, 83 (7.3%) had had a nonfatal overdose in the previous 6 months, and 220 (19.3%) had witnessed an overdose in the previous 6 months. Furthermore, 506 (44.5%) participants reported opioid use in the previous 6 months, 199 (39.3%) of whom reported at least daily heroin injection (Table 1).

A total of 769 (67.6%) study participants reported awareness of THN, 392 (51.0%) of whom were opioid users. Of the 392 opioid users who were eligible for a THN kit, 88 (22.4%) reported currently having a THN kit (Table 1).

In bivariate analyses, factors positively associated with awareness of THN included younger age (adjusted odds ratio [aOR] = 1.02; 95% confidence interval [CI], 1.01-1.04; $P < .001$), white race (aOR = 1.44; 95% CI, 1.12-1.85; $P = .004$), homelessness (aOR = 2.31; 95% CI, 1.51-3.53; $P < .001$), HCV positivity (aOR = 1.64; 95% CI, 1.17-2.30; $P = .004$), stable relationship (aOR = 0.73; 95% CI, 0.55-0.97; $P = .03$), DTES residence (aOR = 2.22; 95% CI, 1.72-2.86; $P < .001$), ≥daily heroin (aOR = 2.79; 95% CI, 1.88-4.16; $P < .001$) or crystal methamphetamine (aOR = 2.34; 95% CI, 1.34-4.08; $P = .003$) injection, and overdose (ever overdosed: aOR = 1.47; 95% CI, 1.14-1.89; $P = .003$; witnessed an overdose in the previous 6 months: aOR = 2.80; 95% CI, 1.92-4.09; $P < .001$) (Table 2). Factors positively associated with possession of a THN kit among opioid-using PWUD with THN knowledge included age (per year younger) (aOR = 1.04; 95% CI, 1.02-1.06; $P = .001$) and witnessed an overdose in the previous 6 months (aOR = 1.96; 95% CI, 1.20-3.22, $P = .007$) (Table 3).

In the multivariate model, after adjusting for cohort designation, homelessness, relationship, ≥daily crystal methamphetamine injection, overdose (ever or in the previous 6 months), and public injection or noninjection drug use, factors that were independently positively associated with awareness of THN included age (per year younger) (aOR = 1.02; 95% CI, 1.01-1.04; $P = .003$), white race (aOR = 1.67; 95% CI, 1.27-2.19; $P < .001$), HCV positivity (aOR = 1.63; 95% CI, 1.13-2.36; $P = .01$), DTES residence (aOR = 1.93; 95% CI, 1.47-2.53; $P < .001$), ≥daily heroin injection (aOR = 1.69; 95% CI, 1.09-2.62; $P = .02$), and having witnessed an overdose in the previous 6 months (aOR = 2.23; 95% CI, 1.49-3.34; $P < .001$) (Table 2). Age (per year younger) (aOR = 1.04; 95% CI, 1.01-1.06; $P = .006$) and having witnessed an overdose in the previous 6 months (aOR = 1.85; 95% CI, 1.11-3.06; $P = .02$) were the only factors that were significantly and positively associated with having a THN kit (Table 3).

Of the 88 participants who were eligible for and had a THN kit, 18 (20.5%) reported previous naloxone administration (9 had administered the medication 1 or 2 times, 3 had administered it 3 or 4 times, and 6 had administered it ≥5 times). Of the 304 participants who were eligible for but did not have a THN kit, 260 (85.5%) stated reasons for not possessing a kit, the most common of which were "I don't think I need one" (n = 81, 31.1%), "I've never been offered

Table 1. Demographic characteristics of people who use drugs (PWUD), by awareness of a take-home naloxone (THN) kit among PWUD and possession of a THN kit by opioid users, Vancouver, British Columbia, December 1, 2014, to May 29, 2015[a]

	No. (%)				
		Awareness of THN Among PWUD (n = 1137)		Possession of THN Among Opioid Users (n = 392)	
Characteristic	Overall (n = 1137)	Yes (n = 769)	No (n = 368)	Yes (n = 88)	No (n = 304)
Cohort					
VIDUS	636 (55.9)	430 (55.9)	206 (56.0)	52 (59.1)	184 (60.5)
ACCESS	501 (44.1)	339 (44.1)	162 (44.0)	36 (40.9)	120 (39.5)
Sociodemographic characteristics					
Median age (IQR)	49 (42-55)	49 (41-54)	51 (44-57)	44 (35-51)	49 (41-53)
Male sex	751 (66.1)	499 (64.9)	252 (68.5)	51 (58.0)	198 (65.1)
White race	641 (56.4)	456 (59.3)	185 (50.3)	57 (64.8)	172 (56.6)
Homelessness[b]	156 (13.7)	127 (16.5)	29 (7.9)	20 (22.7)	65 (21.4)
HIV infection	501 (44.1)	339 (44.1)	162 (44.0)	36 (40.9)	120 (39.5)
Hepatitis C infection	957 (84.2)	663 (86.2)	294 (79.9)	79 (89.8)	264 (86.8)
Stable relationship[c]	285 (25.1)	178 (23.1)	107 (29.1)	21 (23.9)	59 (19.4)
High school education	547 (48.1)	363 (47.2)	184 (50.0)	45 (51.1)	138 (45.4)
DTES residence[b]	624 (54.9)	471 (61.2)	153 (41.6)	65 (73.9)	200 (65.8)
Substance-use related					
Opioid use[b,d]	506 (44.5)	392 (51.0)	114 (31.0)	N/A	N/A
<Daily opioid use[b]	252 (22.2)	184 (23.9)	68 (18.5)	33 (37.5)	151 (49.7)
≥Daily noninjection prescription opioid use[b]	23 (2.0)	18 (2.3)	5 (1.4)	4 (4.5)	14 (4.6)
≥Daily noninjection heroin use[b]	9 (0.8)	6 (0.8)	3 (0.8)	1 (1.1)	5 (1.6)
≥Daily prescription opioid injection[b]	46 (4.0)	36 (4.7)	10 (2.7)	11 (12.5)	25 (8.2)
≥Daily heroin injection[b]	199 (17.5)	166 (21.6)	33 (9.0)	45 (51.1)	121 (39.8)
Other substance use[b]					
≥Daily noninjection cocaine use[b]	4 (0.4)	3 (0.4)	1 (0.3)	1 (1.1)	2 (0.7)
≥Daily crack smoking[b]	121 (10.6)	83 (10.8)	38 (10.3)	10 (11.4)	45 (14.8)
≥Daily cocaine injection[b]	55 (4.8)	40 (5.2)	15 (4.1)	4 (4.5)	13 (4.3)
≥Daily crystal methamphetamine injection[b]	90 (7.9)	74 (9.6)	16 (4.3)	14 (15.9)	34 (11.2)
Ever overdosed	727 (63.9)	514 (66.8)	213 (57.9)	68 (77.3)	219 (72.0)
Recent overdose[b]	83 (7.3)	67 (8.7)	16 (4.3)	13 (14.8)	37 (12.2)
Witnessed an overdose[b]	220 (19.3)	183 (23.8)	37 (10.1)	37 (42.0)	82 (27.0)
Public injection drug use[b]	223 (19.6)	177 (23.0)	46 (12.5)	39 (44.3)	107 (35.2)
Public noninjection drug use[b]	228 (20.1)	165 (21.5)	63 (17.1)	26 (29.5)	85 (28.0)

Abbreviations: ACCESS, AIDS Care Cohort to Evaluate Access to Survival Services; DTES, Downtown Eastside neighborhood of Vancouver; HIV, human immunodeficiency virus; IQR, interquartile range; VIDUS, Vancouver Injection Drug Users Study.
[a]Data sources: VIDUS[15] and ACCESS[16,17] cohort studies.
[b]In the previous 6 months.
[c]Legally married/common law or regular partner.
[d]Subcategory totals may exceed category total as participants may report multiple types of drug use.

one" (n = 71, 27.3%), and "I don't know where to get one" (n = 43, 16.5%).

Discussion

Although THN programs have been evaluated, most evaluations focus either on program evaluation or on experiences and attitudes of program participants, namely PWUD.[11] A study in 2016 reported a 32% engagement rate and a 5% THN carriage rate among people who inject drugs in a national naloxone program in Scotland.[18] By quantifying rates of THN awareness among a longitudinal cohort of PWUD and describing characteristics of people who do not carry THN but are eligible, our study further contributes to this knowledge.

Despite 67.6% (769/1137) of study participants being aware of THN, 32.4% (368/1137) remained unaware. Ideally, awareness of THN should be 100% among all opioid users, but the degree to which all PWUD (including non-opioid users) should be informed is largely unknown and warrants further study. In British Columbia, the proportion of fentanyl-detected illicit drug overdose deaths increased from 5% (12/269) in 2012 to 62% (575/931) in 2016,[5] suggesting that efforts to support universal education and enrollment in THN programs for willing PWUD may be valuable. In addition, several factors in our study found to be significantly associated with awareness of THN (including hepatitis C positivity, ≥daily heroin injection, and having witnessed an overdose in the previous 6 months) suggest greater awareness of THN among more high-intensity PWUD compared

Table 2. Bivariate and multivariate logistic regression analyses of awareness of take-home naloxone among 1137 people who use drugs, Vancouver, British Columbia, December 1, 2014, to May 29, 2015[a]

Characteristic	Odds Ratio (95% CI)	*P* Value	Adjusted Odds Ratio (95% CI)	*P* Value
Cohort (VIDUS vs ACCESS)	1.00 (0.78-1.28)	.98	0.81 (0.62-1.06)	.13
Age (per year younger)	1.02 (1.01-1.04)	<.001	1.02 (1.01-1.04)	.003
Sex (male vs female)	0.85 (0.65-1.11)	.23	—	
White race[b]	1.44 (1.12-1.85)	.004	1.67 (1.27-2.19)	<.001
Homelessness[b,c]	2.31 (1.51-3.53)	<.001	1.52 (0.94-2.45)	.08
HIV infection[b]	1.00 (0.78-1.29)	.98	—	
Hepatitis C infection[b]	1.64 (1.17-2.30)	.004	1.63 (1.13-2.36)	.01
Stable relationship[b,c]	0.73 (0.55-0.97)	.03	0.77 (0.57-1.04)	.09
High school education[b]	0.86 (0.67-1.11)	.26	—	
DTES residence[b,c]	2.22 (1.72-2.86)	<.001	1.93 (1.47-2.53)	<.001
≥Daily noninjection prescription opioid use[b,c]	1.74 (0.64-4.72)	.28	—	
≥Daily noninjection heroin use[b,c]	0.96 (0.24-3.85)	.95	—	
≥Daily noninjection cocaine use[b,c]	1.44 (0.15-13.86)	.75	—	
≥Daily crack smoking[b,c]	1.05 (0.70-1.78)	.81	—	
≥Daily prescription opioid injection[b,c]	1.76 (0.86-3.58)	.12	—	
≥Daily heroin injection[b,c]	2.79 (1.88-4.16)	<.001	1.69 (1.09-2.62)	.02
≥Daily cocaine injection[b,c]	1.29 (0.70-2.37)	.41		
≥Daily crystal methamphetamine injection[b,c]	2.34 (1.34-4.08)	.003	1.12 (0.61-2.08)	.71
Ever overdosed[b]	1.47 (1.14-1.89)	.003	1.27 (0.96-1.68)	.10
Recent overdose[b,c]	2.10 (1.20-3.68)	.009	1.47 (0.79-2.76)	.23
Witnessed an overdose[b,c]	2.80 (1.92-4.09)	<.001	2.23 (1.49-3.34)	<.001
Public injection drug use[b,c]	2.08 (1.47-2.96)	<.001	1.01 (0.65-1.55)	.98
Public noninjection drug use[b,c]	1.32 (0.96-1.82)	.09	0.93 (0.65-1.34)	.70

Abbreviations: ACCESS, AIDS Care Cohort to Evaluate Access to Survival Services; CI, confidence interval; DTES, Downtown Eastside neighborhood of Vancouver; HIV, human immunodeficiency virus; VIDUS, Vancouver Injection Drug Users Study. Cells with em dash (—) indicate variable not included in multivariate analysis because *P* > .10 in bivariate analysis.
[a]Data sources: VIDUS[15] and ACCESS[16,17] cohort studies.
[b]Yes vs no.
[c]In the previous 6 months.

with low-intensity PWUD. This finding is supported by previous literature demonstrating that less experienced PWUD are less familiar with harm-reduction services than are more experienced PWUD.[19,20,22] We found that younger age was independently associated with both THN awareness and possession, potentially as a result of THN programs targeting this population. Nevertheless, more emphasis on putting research knowledge into practice for THN in British Columbia could better inform and engage those who are at high risk for an opioid overdose and are unaware of THN. We think that future research should include an examination of the efforts of British Columbia's THN program among young adults (aged <25) and the most effective strategies for educating high-risk populations.

Despite 67.6% of study participants reporting awareness of THN, only 22.4% of opioid users who were eligible to receive a THN kit had one. One study of 142 methadone maintenance participants in the United Kingdom reported a similar discrepancy; 70% of participants expressed support for THN, but only 49% reported a willingness to possess a THN kit, most (89%) of whom were willing to administer naloxone if available during a witnessed overdose.[23] In our study, the most common reason cited for not possessing a THN kit was related to the perception of overdose risk: "I don't think I need one." Inaccurate risk perceptions of overdose by opioid users have been described.[24,25] A cross-sectional study of heroin users in Australia showed that despite half of participants reporting having had a previous opioid overdose and the belief that, on average, 50% of regular heroin users would overdose during their lifetime, 73% had "rarely" or "never" worried about personally overdosing during the previous 6 months.[24] A study of opioid users in the United States revealed that motivation for enrolling in a THN program did not stem from fear of personal overdose but, rather, from the desire to help an overdosing friend or family member.[25] Similarly, in our study, witnessing an overdose in the previous 6 months rather than having overdosed was significantly associated with possession of THN.

Limitations

Our study had several limitations. First, British Columbia's THN program is provincial; our study population enrolled only PWUD residing in Vancouver, and they were not randomly recruited. Furthermore, both the VIDUS and ACCESS cohorts have a high prevalence of injection drug use, HIV infection, and HCV infection. Our results, therefore, may not represent PWUD in other settings or accurately reflect the awareness of or participation in the THN program among PWUD in British Columbia or elsewhere.

Table 3. Bivariate and multivariate logistic regression analyses of possession of take-home naloxone (THN) among 392 opioid-using people who use drugs who report knowledge of THN, Vancouver, British Columbia, December 1, 2014, to May 29, 2015[a]

Characteristic	Odds Ratio (95% CI)	*P* Value	Adjusted Odds Ratio (95% CI)	*P* Value
Cohort (VIDUS vs ACCESS)	0.94 (0.58-1.53)	.81	0.79 (0.48-1.31)	.36
Age (per year younger)	1.04 (1.02-1.06)	.001	1.04 (1.01-1.06)	.006
Sex (male vs female)	0.74 (0.45-1.20)	.22	—	
White race[b]	1.41 (0.86-2.31)	.17	—	
Homelessness[b,c]	1.08 (0.61-1.91)	.79	—	
HIV infection[b]	1.06 (0.65-1.72)	.81	—	
Hepatitis C infection[b]	1.20 (0.53-2.70)	.66	—	
Stable relationship[b,c]	1.30 (0.74-2.29)	.36	—	
High school education[b]	1.22 (0.76-1.97)	.42	—	
DTES[f] residence[b,c]	1.47 (0.86-2.50)	.16	—	
≥Daily noninjection prescription opioid use[b,c]	0.99 (0.32-3.08)	.98	—	
≥Daily noninjection heroin use[b,c]	0.69 (0.08-5.96)	.73	—	
≥Daily noninjection cocaine use[b,c]	1.74 (0.16-19.38)	.65	—	
≥Daily crack smoking[b,c]	0.74 (0.36-1.53)	.42	—	
≥Daily prescription opioid injection[b,c]	1.59 (0.75-3.38)	.22	—	
≥Daily heroin injection[b,c]	1.58 (0.98-2.55)	.06	1.31 (0.79-2.17)	.30
≥Daily cocaine injection[b,c]	1.07 (0.34-3.36)	.91	—	
≥Daily crystal methamphetamine injection	1.50 (0.77-2.95)	.24	—	
Ever overdosed[b]	1.32 (0.76-2.31)	.33	—	
Recent overdose[b,c]	1.25 (0.63-2.47)	.52	—	
Witnessed an overdose[b,c]	1.96 (1.20-3.22)	.007	1.85 (1.11-3.06)	.02
Public injection drug use[b,c]	1.46 (0.90-2.36)	.12	—	
Public noninjection drug use	1.31 (0.64-1.82)	.77	—	

Abbreviations: ACCESS, AIDS Care Cohort to Evaluate Access to Survival Services; CI, confidence interval; DTES, Downtown Eastside neighborhood of Vancouver; VIDUS, Vancouver Injection Drug Users Study. Cells with em dash (—) indicate variable not included in multivariate analysis because *P* > .10 in bivariate analysis.

[a]Data sources: VIDUS[15] and ACCESS[16,17] cohort studies.

[b]Yes vs no.

[c]In the previous 6 months.

Second, given the fact that this study was cross-sectional and the potential for unmeasured confounders, we cannot infer causation, and the associations we identified could be due to other reasons, such as socially desirable responses or another form of bias. Third, this study was based on self-reported data and collected information about criminalized and socially sensitive behaviors, and participants' responses were subject to social desirability biases. Participants may have been more likely to respond yes to the question about being aware of or having a THN kit if they considered doing so to be more socially desirable. It seems more likely, however, that these biases would affect reporting of drug use patterns or risk behaviors than they would our primary outcomes, which were neither controversial nor illegal. Furthermore, we know of no reason why this bias would have been differentially reported by the various demographic groups in our study (eg, younger patients). Last, because this study was based on self-report, it was not possible to determine if a witnessed or experienced overdose was opioid-related and, thus, whether participants would have benefited from THN availability.

Conclusion

Overdose prevention education programs for PWUD should be expanded to include a strategy for accurate risk assessment of not only personal risk for overdose (particularly among people who inject drugs) but also the risk for witnessing an opioid overdose. Additional efforts to expand British Columbia's THN program could be undertaken with a directed focus on innovative strategies to include greater numbers of PWUD, prioritizing those whose route of administration includes injecting. Given limited carriage rates among PWUD, efforts to expand naloxone carriage among service providers and other groups should be expanded.

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References

1. International Narcotics Control Board. *Report of the International Narcotics Control Board for 2011*. New York, NY: United Nations; 2012. https://www.incb.org/documents/Publications/AnnualReports/AR2011/AR_2011_English.pdf. Accessed June 14, 2017.
2. Shield KD, Jones W, Rehm J, et al. Use and nonmedical use of prescription opioid analgesics in the general population of Canada and correlations with dispensing levels in 2009. *Pain Res Manag*. 2013;18(2):69-74.
3. Fischer B, Argento E. Prescription opioid related misuse, harms, diversion and interventions in Canada: a review. *Pain Physician*. 2012;15(suppl 3):ES191-ES203.
4. British Columbia Coroners Service. Illicit drug overdose deaths in BC, January 1, 2007–March 31, 2017. 2017. http://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/death-investigation/statistical/illicit-drug.pdf. Accessed June 14, 2017.
5. British Columbia Coroners Service. Fentanyl-detected illicit drug overdose deaths, January 1, 2012 to February 28, 2017. 2017. http://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/death-investigation/statistical/fentanyl-detected-overdose.pdf. Accessed June 14, 2017.
6. Canadian Centre on Substance Abuse. Canadian Community Epidemiology Network on Drug Use (CCENDU) Bulletin. The availability of take-home naloxone in Canada. 2016. http://www.ccsa.ca/Resource Library/CCSA-CCENDU-Take-Home-Naloxone-Canada-2016-en.pdf. Accessed June 14, 2017.
7. Chronister KJ, Lintzeris N, Jackson A, et al. Findings and lessons learnt from implementing Australia's first health service based take-home naloxone program [published online April 13, 2016]. *Drug Alcohol Rev*.
8. Barocas JA, Baker L, Hull SJ, et al. High uptake of naloxone-based overdose prevention training among previously incarcerated syringe-exchange program participants. *Drug Alcohol Depend*. 2015;154:283-286.
9. Bird SM, McAuley A, Perry S, et al. Effectiveness of Scotland's National Naloxone Programme for reducing opioid-related deaths: a before (2006-10) versus after (2011-13) comparison. *Addiction*. 2016;111(5):883-891.
10. McDonald R, Strang J. Are take-home naloxone programmes effective? Systematic review utilizing application of the Bradford Hill criteria. *Addiction*. 2016;111(7):1177-1187.
11. Mueller SR, Walley AY, Calcaterra SL, et al. A review of opioid overdose prevention and naloxone prescribing: implications for translating community programming into clinical practice. *Subst Abus*. 2015;36(2):240-253.
12. Oluwajenyo B, Tzemis D, Al-Qutub D, et al. A quantitative and qualitative evaluation of the British Columbia Take Home Naloxone Program. *CMAJ Open*. 2014;2(3): E153-E161.
13. Deonarine A, Amlani A, Ambrose G, et al. Qualitative assessment of take-home naloxone program participant and law enforcement interactions in British Columbia. *Harm Reduct J*. 2016;13(1):17.
14. Klassen D, Buxton JA. *Overdose Recognition and Response in the BC Take Home Naloxone Program. Review of Data up to July 2016*. Vancouver, British Columbia: BC Centre for Disease Control; 2016. http://towardtheheart.com/assets/naloxone/thn-report-aug-final_197.pdf. Accessed June 14, 2017.
15. Strathdee SA, Patrick DM, Currie SL, et al. Needle exchange is not enough: lessons from the Vancouver Injecting Drug Use Study. *AIDS*. 1997;11(8): F59-F65.
16. Strathdee SA, Palepu A, Cornelisse PG, et al. Barriers to use of free antiretroviral therapy in injection drug users. *JAMA*. 1998; 280(6):547-549.
17. Wood E, Hogg RS, Bonner S, et al. Staging for antiretroviral therapy among HIV-infected drug users. *JAMA*. 2004;292(10): 1175-1177.
18. McAuley A, Munro A, Bird SM, et al. Engagement in a National Naloxone Programme among people who inject drugs. *Drug Alcohol Depend*. 2016;162:236-240.
19. Merkinaite S, Grund JP, Frimpong A. Young people and drugs: next generation of harm reduction. *Int J Drug Policy*. 2010; 21(2):112-114.
20. Krug A, Hildebrand M, Sun N. "We don't need services. We have no problems": exploring the experiences of young people who inject drugs in accessing harm reduction services. *J Int AIDS Soc*. 2015;18(2 suppl 1):19442.
21. SAS Institute, Inc. *SAS Version 9.4 for Windows*. Cary, NC: SAS Institute, Inc; 2016.
22. Delany-Moretlwe S, Cowan FM, Busza J, et al. Providing comprehensive health services for young key populations: needs, barriers and gaps. *J Int AIDS Soc*. 2015;18(2 suppl 1):19833.
23. Strang J, Powis B, Best D, et al. Preventing opiate overdose fatalities with take-home naloxone: pre-launch study of possible impact and acceptability. *Addiction*. 1999;94(2):199-204.
24. McGregor C, Darke S, Ali R, et al. Experience of non-fatal overdose among heroin users in Adelaide, Australia: circumstances and risk perceptions. *Addiction*. 1998;93(5):701-711.
25. Worthington N, Markham Piper T, Galea S, et al. Opiate users' knowledge about overdose prevention and naloxone in New York City: a focus group study. *Harm Reduct J*. 2006;3:19.