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Awareness, Predictors, and Outcomes of Drug Alerts Among People Who Access Harm Reduction Services in British Columbia, Canada: Findings from a 2021 Cross-Sectional Survey

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ABSTRACT

Objectives: To assess the awareness and predictors of seeing/hearing a drug alert in British Columbia (BC) and subsequent drug use behaviour after seeing/hearing an alert.

Methods: This study analyzed the 2021 BC Harm Reduction Client Survey (HRCS) – a cross-sectional self-reported survey administered at harm reduction sites throughout the province and completed by participants using the services.

Results: In total, N = 537 respondents participated and N = 482 (89.2%) responded to the question asking if they saw/heard a drug alert. Of those, N = 300 (62.2%) stated they saw/heard a drug alert and almost half reported hearing from a friend or peer network; the majority (67.4%) reported altering their drug use behaviour to be safer after seeing/hearing a drug alert. The proportion of individuals who saw/heard a drug alert increased with each ascending age category. Amongst health authorities there were significant differences in the odds of seeing/hearing an alert. In the past 6 months, the odds of participants that attended harm reduction sites a few times per month seeing/hearing an alert were 2.73 (95% CI: 1.17-6.52) times the odds of those who did not. Those who attended more frequently were less likely to report seeing/hearing a drug alert. The odds of those who witnessed an opioid-related overdose in the past 6 months seeing/hearing an alert were 1.96 (95% CI: 0.86-4.50) times the odds of those who had not.

Conclusion: We found that drug alerts were mostly disseminated through communication with friends or peers and that most participants altered their drug use behaviour after seeing/hearing a drug alert. Therefore, drug alerts can play a role in reducing harms from substance use and more work is needed to reach diverse populations, such as younger people, those in differing geographical locations, and those who attend harm reduction sites more frequently.

Keywords: Harm reduction, opioid epidemic, public health, epidemiology

ARTICLE SUMMARY

Strengths and Limitations of this Study

- Provides insight into the lived and living experiences of PWUD.
- Identifies strengths and weaknesses in the communication of drug alerts.
- Enhances our understanding of the efficacy of drug alerts and the effect on drug use behaviour.

- Uses cross-sectional data, thus, preventing establishment of temporal relationships.
- Not representative of all PWUD, only those who attend harm reduction sites.

INTRODUCTION

More than 100,000 drug overdose deaths were identified in the United States in 2021 (1). In Canada, there were 32,632 reported opioid toxicity deaths between January 2016 and March 2022 (2). During the same time period there were 33,493 opioid-related and 14,606 stimulant-related poisoning hospitalizations reported (3). From January to June 2022, nearly half (47%) of the reported accidental opioid toxicity deaths also involved a stimulant (2). In addition to the strain put on hospitals, emergency first responders have also been challenged to respond to the effects of toxic drug supply. In 2021, there were more than 41,600 Emergency Medical Services responses to suspected opioid-related overdoses in Canada (4).

These challenges are not limited to healthcare professionals. The COVID-19 pandemic and public health measures such as physical distancing introduced to prevent virus transmission further exacerbated this complex issue. During the first two years of the pandemic, there was a 91% increase in opioid-related toxicity deaths in Canada, compared to the two years before (3). As harm reduction services became less available and overdoses increased, peers (people with lived experience of substance use who use that experience in their work) took on a greater burden of supporting people who use drugs, but, reported increasing burnout, fatigue and grief (5).

B.C declared a public health emergency in April 2016 in response to increasing overdoses fuelled by fentanyl (6). Since 2016, B.C. has had the highest rate of opioid-related overdoses of all provinces and reported 2,267 illicit drug toxicity deaths in 2021, the highest annual number of overdose deaths ever reported (7). On August 16th, 2022, the BC Coroners Service reported reaching the tragic milestone of 10,000 lives lost to the toxic drug supply since the public health emergency was declared (8). Post-mortem toxicology in B.C has detected fentanyl or its analogues in more than 80% of deaths since 2017 (9). The proportion of cases where benzodiazepines were detected in decedents increased from 15% in July 2020 to 52% in January 2022 (9). In addition, between January 2019 to March 2020 extreme fentanyl concentrations (>50micrograms/litre) were identified in 8% of decedents and doubled to 16% between

November 2021 to August 2022 (9). Drug toxicity deaths are preventable, and advocates are calling for improved policies, treatment and harm reduction measures to support and provide resources to people who use drugs (PWUD) (5).

Initiatives to address the illicit drug toxicity crisis in B.C. include the implementation and expansion of harm reduction services such as opioid agonist treatment, take-home naloxone kits, supervised consumption, overdose prevention sites, and drug checking. Another strategy is the use of drug alerts to warn PWUD, members of the public, and service providers about the current risks of the circulating drug supply. In 2020, there were 160 drug alerts issued in B.C. with more than half implicating fentanyl as a concern (10). Alerts may be disseminated when harms are identified following the use of an unknown substance, or when analyses of substances identify a particular drug, combination of drugs or drug concentration of concern. Timely identification is often through drug checking services which are increasingly available across B.C., such as those provided through and in partnership with the BC Centre on Substance Use (11) and the Vancouver Island Drug Checking Project (12). Analysis of enforcement samples and decedent toxicology supplement this information but is usually delayed and thus not appropriate for timely drug alerts.

Drug alerts are distributed through different forms of media, including provincial, regional, and harm reduction service websites; social media and social networks; as well as being distributed through outreach activities including posters and word of mouth (13). The content of drug alerts varies from general warnings about drug use to specific details related to a single drug – details may include different names it is being sold under, colour, form, and area where it is believed to be circulating. Alerts developed and distributed by B.C. health authorities are collated by the BC Centre for Disease Control and published on the public website towardtheheart.com (14).

Drug alerts provide an opportunity to provide life-saving information quickly and efficiently. B.C. health authorities and community organizations utilize different methods to distribute drug alerts in order to reach PWUD who use a variety of information sources. There are also important considerations for disseminating drug alerts as well. For example, language

matters when issuing information related to the circulating drug supply. Information that may warn individuals about a drug's potency may lead individuals to seek out this drug because of its stronger effect (15). Furthermore, drug alerts need to focus on maintaining human dignity and respecting a person's autonomy while being informative and clear.

Notably, drug alerts are intended to reach individuals responsible for manufacturing the substance(s) as well as those using them. In 2012, the B.C. Drug Overdose and Alert Partnership (DOAP) issued alerts provincially and locally when paramethoxymethamphetamine (PMMA), a toxic substance, was identified in people who died after using what they believed was ecstasy (16, 17). Drug alerts are also being used globally, such as in the Netherlands, where there was an observed association between drug alerts and reduced drug-associated adverse health outcomes, compared to jurisdictions not using drug alerts (18-20).

Our study analyzed data from the 2021 BC Harm Reduction Client Survey (HRCS), which sampled people using harm reduction supply distribution sites around the province. Our aim was to determine the characteristics of who reported seeing/hearing drug alerts, where they saw/heard the alerts and if they reported safer use when they saw/heard an alert in order to improve the alerting process.

MATERIALS AND METHODS

Data Source

The 2021 BC HRCS gathered information on substance use patterns, associated harms, stigma, and utilization of harm reduction services to inform harm reduction planning and to evaluate current practices (21). The cross-sectional HRCS was piloted in 2012 and has been administered annually since (except 2016, 2017 and 2020). Each iteration of the survey contains questions relevant to emerging issues and the priorities of stakeholders. Stakeholders, including PWUD, provided input and piloted questions on awareness of drug alerts included in the 2021 HRCS. Locations for data collection were selected from a provincial network of sites that distribute supplies for safer substance use, using two-stage convenience sampling. Harm reduction program coordinators from each regional health authority identified potential sites for participation; sites were then recruited based on willingness to participate and their capacity for

recruitment and data collection. In total, 17 harm reduction sites participated in the 2021 HRCS between March 2021 and January 2022. Trained site staff and volunteers recruited participants who received $15 CAD and the sites received $5 CAD per participant recruited. The anonymous paper-based survey took approximately 20 minutes to complete.

The eligibility criteria for participants included: being 19 years of age or older, having used or currently using any illegal substance(s) other than or in addition to cannabis in the past 6 months, and being able to provide verbal informed consent. Data entry and analysis occurred at the British Columbia Center for Disease Control (BCCDC) in Vancouver, B.C.. Data collection methods have been described elsewhere (10).

Study Variables

We assessed who reported recently seeing/hearing a drug alert and associations with demographic and drug use data from responses to the question "*have you recently seen or heard an alert about recent drug overdoses, toxic drugs found e.g., from drug checking/testing and other possible issues with street drugs?*" We thematically analysed responses to the question "*where did you notice these alerts?*" We assessed if seeing/hearing a drug alert led participants to report using drugs more safely by the response to "*Do you take any steps to be safer (get drugs checked/tested, use overdose prevention sites, use with a buddy etc.) when you see an alert about drugs you may use*?"

Demographic and drug use variables included: B.C. health authority (Fraser, Interior, Island, Northern, and Vancouver Coastal) and urbanicity (large urban, medium and small population centres) of the site where the survey was administered (see Fig. 1), age category (≤29, 30-39, 40-49, ≥50, unknown), gender (cis woman, cis man, trans and gender expansive, unknown), self-reported Indigenous identity (First Nations, Métis, Inuit, non-Indigenous, unknown), employment status (employed [working full-time, part-time or paid volunteer], not employed, unknown), housing status (stably housed [living in a private residence or living in another residence - hotel/motel, rooming houses, single room occupancy, or social/supportive housing)], not stably housed [living in a shelter or having no regular place to stay -homeless, couch surfing, no fixed address], unknown), how frequently the client picked up supplies from a

harm reduction site in the last six months (never, every day, few times per week, few times per month, once a month or less, unknown), had a cell phone (yes, no, unknown), had a naloxone kit (yes, no, unknown), used an overdose prevention site in the past 6 months (yes, no, unknown), perceived risk of overdose from opioid (yes, no, don't know, unknown), injected any drug in the past 6 months (yes, no, unknown), frequency of drug use in the past month (none, every day, few times per week, few times per month, prefer not to say), witnessed or experienced an opioid overdose in the last 6 months (yes, no, don't know, unknown). Variables that had 'prefer not to say' and 'unknown' were combined into 'unknown'. Urbanicity was derived using the Population and Rural Area Classification 2016 system developed from Statistics Canada.

Fig.1. Map of sites participating in 2021 Harm Reduction Client Survey

Statistical Analysis

Descriptive statistics and bivariable analyses with chi-square tests of independence were conducted for all variables to describe characteristics of PWUD that responded to having seen or heard of a drug alert (Table 1). Bivariate logistic regression assessing the relationship between explanatory variables and the outcome variable was conducted for all variables (Table 1). A Cochran-Armitage trend test was performed to assess for a trend between age category and the awareness of drug alerts.

Based on purposeful model building, all covariates with at least one level with a p-value of 0.25 or less in bivariable regression were assessed for inclusion in the final model. In addition, owning a cellphone was included for assessment in the model despite having a p-value greater than 0.25 because conceptually it is believed that having regular access to communication and the internet increases the likelihood of seeing a drug alert. After developing the full model, we used backwards selection and Akaike Information Criterion (AIC) to determine which covariates to include in the final model. Although gender was not statistically significant in the bivariable regression, it was included in the model because of the known effects on health outcomes. We

used variance inflation factor (VIF) to assess for collinearity and no VIF was above 4; as such, no further investigation was required, and all covariates of interest remained in the model.

In developing the multivariable logistic regression model, we assessed the following variables as candidates for inclusion in the final model: age category; gender; health authority; urbanicity; owning a cellphone; owning a naloxone kit; Indigenous identity; perceived risk of opioid overdose; injecting any drug in the past 6 months; frequency of substance use in the past month other than or in addition to cannabis, alcohol, or tobacco; experiencing an unintentional opioid overdose in the past 6 months; witnessing an accidental opioid overdose in the past 6 months; use of an overdose prevention site in the past 6 months; and frequency of harm reduction supply pick up in the last 6 months.

Using backwards selection based on which model resulted in the smaller AIC value, we retained the following variables in the final model: age category, gender, health authority, frequency of harm reduction supply pick up in the past 6 months, and witnessing an opioid-related overdose in the past 6 months. Age category and gender were included despite not being selected for using backwards selection because of their known effects on health.

Adjusted odds ratios (AOR) and 95% confidence intervals (95% CI) were included in the final multivariable logistic regression model. Odds ratios with a p-value ≤ 0.05 were considered statistically significant. We used R version 4.2.0 (2022-04-22) and R Studio version 2022.2.3.492 to conduct all analyses.

Patient and Public Involvement

To ensure our analyses represent the realities of PWUD, we consulted the Professionals for Ethical Engagement of Peers (PEEP) – an advisory group of leaders with past or current illicit drug use – on our analyses and interpretations (22, 23).

RESULTS

Surveys were completed by 537 eligible participants from across B.C. and 482 (89.8%) participants had valid responses to the question "*have you recently seen or heard an alert?"* and were included in our analysis, of these 300 (62.2%) stated they saw/heard an alert (see Fig. 2)

Of the 261 participants who responded to the question asking if they took steps to be safer when using substances after seeing/hearing a drug alert, 176 (67.4%) reported they did subsequently take safer steps (Fig. 2).

Fig. 2. Summary of responses to the outcome variables of interest.

Table 1 shows the characteristics of respondents. About a third of respondents were ≥50 years old (33.0%) and participants from small urban centers accounted for 29.5%, from medium urban centers for 36.1%, and from large urban centers for 34.4%. Most respondents were cis men (62.2%), had used an overdose prevention site in the past 6 months (67.2%), did not perceive themselves at risk of an opioid overdose (58.7%), used drugs daily in the past month (66.4%), had not experienced an opioid overdose in the past 6 months (69.3%), and had witnessed an overdose due to opioids in the past 6 months (65.4%). Interior was used as the health authority reference category as it had the largest sample size. With respect to age categories, a Cochran-Armitage trend test indicated that there was an increasing trend with known age and the observation of a drug alert ($p < 0.03$).

Table 1: *Characteristics of 2021 Harm Reduction Client Survey Participants that Responded to Seeing/Hearing a Drug Alert (N = 482)*

Characteristics	Saw/heard alert (n=300) n (%)	Did not see/hear alert (n=182) n (%)	Total (n= 482) n (%)	Chi-Square P-value	Bivariable Regression P-value
Demographics:					
Age category				0.46	
≤ 29	34 (53.1)	30 (46.9)	64 (13.3)		Reference
30-39	72 (61.0)	46 (39.0)	118 (24.5)		0.30
40-49	81 (63.3)	47 (36.7)	128 (26.6)		0.18
≥ 50	102 (64.2)	57 (35.8)	159 (33.0)		0.13
Unknown	11 (84.6)	2 (15.4)	13 (2.6)		0.050
Gender				0.059	
Cis man	183 (61.0)	117 (39.0)	300 (62.2)		Reference
Cis woman	104 (62.7)	62 (37.3)	166 (34.4)		0.73
Trans and gender expansive*	9 (100.0)	0 (0.0)	9 (1.9)		0.98
Unknown	4 (57.1)	3 (42.9)	7 (1.5)		0.84
Health Authority				0.041	
Fraser	52 (61.2)	33 (38.8)	85 (17.6)		0.61
Interior	75 (57.7)	55 (42.3)	130 (27.0)		Reference
Island	81 (70.4)	34 (29.6)	115 (23.9)		0.039
Northern	44 (52.4)	40 (47.6)	84 (17.4)		0.45
Vancouver Coastal	48 (70.6)	20 (29.4)	68 (14.1)		0.077
Urbanicity				0.99	
Large urban	103 (62.0)	63 (38.0)	166 (34.4)		Reference
Medium urban	108 (62.1)	66 (37.9)	174 (36.1)		1.00
Small urban	89 (62.7)	53 (37.3)	142 (29.5)		0.91
Indigenous Identity				0.27	
Non-Indigenous	164 (65.5)	86 (34.5)	250 (51.9)		Reference
Indigenous	117 (57.4)	87 (42.6)	204 (42.3)		0.072
Unknown	19 (67.9)	9 (32.1)	28 (5.8)		0.81
Current employment**				0.65	
Unemployed	219 (61.3)	138 (38.7)	357 (74.1)		Reference
Employed	67 (64.4)	37 (35.6)	104 (21.6)		0.57
Unknown	14 (66.7)	7 (33.3)	21 (4.3)		0.63
Currently stably housed***				0.88	
Yes	175 (62.7)	104 (37.3)	279 (57.9)		Reference
No	111 (61.3)	70 (38.7)	181 (37.6)		0.76
Unknown	14 (63.6)	8 (34.4)	22 (4.5)		0.93
Harm Reduction (HR) Characteristics:					
Frequency of HR supply pick up in the past 6 months				0.061	
Never	15 (41.7)	21 (58.3)	36 (7.5)		Reference
Every day	84 (65.6)	44 (34.4)	128 (26.6)		0.011
Few times/week	107 (61.1)	68 (38.9)	175 (36.3)		0.034
Few times/mo	58 (67.4)	28 (32.6)	86 (17.8)		0.0092
Once a month or less	25 (69.4)	11 (30.6)	36 (7.5)		0.019
Unknown	11 (52.4)	10 (47.6)	21 (4.3)		0.44
Have a cell phone				0.51	
No	121 (60.2)	80 (39.8)	201 (41.7)		Reference
Yes	161 (63.6)	92 (36.4)	253 (52.5)		0.45
Unknown	18 (64.3)	10 (35.7)	28 (5.8)		0.68
Have a naloxone kit				0.014	
No	47 (50.5)	46 (49.5)	93 (19.3)		Reference
Yes	242 (65.2)	130 (34.8)	372 (77.2)		0.010
Unknown	11 (64.7)	6 (35.3)	17 (3.5)		0.29

Used overdose prevention site in the last 6 months				0.011	
No	191 (59.0)	133 (41.0)	324 (67.2)		Reference
Yes	96 (72.2)	37 (27.8)	133 (27.6)		0.0083
Unknown	13 (52.)	12 (48.0)	25 (5.2)		0.50
Drug Use Characteristics:					
Perceived risk of opioid OD				0.0089	
No	164 (58.0)	119 (42.0)	283 (58.7)		Reference
Yes	106 (73.1)	39 (26.9)	145 (30.1)		0.0023
Don't Know	24 (63.2)	14 (36.8)	38 (7.9)		0.54
Unknown	6 (37.5)	10 (62.5)	16 (3.3)		0.12
Injected any type of drug in the last 6 months				0.090	
No	152 (58.7)	107 (41.3)	259 (53.7)		Reference
Yes	135 (66.8)	67 (33.2)	202 (41.9)		0.074
Unknown	13 (61.9)	8 (38.1)	21 (4.4)		0.77
Frequency of use of illicit drugs in the past month				0.45	
Did not use drugs	6 (46.2)	7 (53.8)	13 (2.7)		Reference
Every day	198 (61.9)	122 (38.1)	320 (66.4)		0.26
Few times a week	57 (67.9)	27 (32.1)	84 (17.4)		0.14
Few times a month	18 (60.0)	12 (40.0)	30 (6.2)		0.40
Unknown	21 (60.0)	14 (40.0)	35 (7.3)		0.39
Experienced an opioid OD in the past 6 months				0.29	
No	201 (60.2)	133 (39.8)	334 (69.3)		Reference
Yes	81 (67.5)	39 (32.5)	120 (24.9)		0.16
Don't Know	4 (50.0)	4 (50.0)	8 (1.7)		0.56
Unknown	14 (70.0)	6 (30.0)	20 (4.1)		0.39
Witnessed an opioid OD in the past 6 months				0.000072	
No	68 (47.9)	74 (52.1)	142 (29.5)		Reference
Yes	217 (68.9)	98 (31.1)	315 (65.4)		0.000022
Don't know	4 (80.0)	1 (20.0)	5 (1.0)		0.19
Unknown	11 (55.0)	9 (45.0)	20 (4.1)		0.55

*Includes trans man, trans woman, gender non-conforming, and other specified gender.
**Employed includes working part-time, full-time or being a paid volunteer.
***Stably housed includes living in a private residence, living in another residence (hotel/motel, rooming houses, single room occupancy, or social/supportive housing). Not stably housed includes living in a shelter or having no regular place to stay (homeless, couch surfing, no fixed address).

Table 2 shows where participants reported seeing/hearing drug alerts. Responses were not mutually exclusive as participants were able to select more than one option on the survey. Almost half (N = 143) of the participants reported they became aware of the alert through a friend or peer.

Table 2. Where and how participants reported seeing or hearing a drug alert

Where Alerts Were Noticed	No. Of clients* (%)**
Heard from a friend or peer network	143 (48)
At a site attended	
Harm reduction site/e.g., SCS/OPS or community organization	127 (42)
Healthcare provider	36 (12)
Public dissemination	
Posters on the street	70 (23)
On the news/media	61 (20)
Through phone or internet	
On social media e.g., Facebook or Twitter	47 (16)
Received an email or text	24 (8)
Other	38 (13)

*Responses are not mutually exclusive
**% of N = 300 who report seeing/hearing a drug alert

We performed bivariable regression analysis on harm reduction supply pick up frequency and perceived opioid overdose risk; a chi square test indicated the two variables are associated ($p<0.0000001$), suggesting that confounding is likely. Therefore, despite perceived risk of opioid overdose being included in backwards selection it was removed from the final model because of its potential confounding effects on harm reduction supply pick up frequency. We retained frequency of supply pick up as every level with a known frequency of supply pick up was statistically significant in the bivariable regression and, conceptually, individuals who use harm reduction services more frequently would be more likely to observe a drug alert.

Unadjusted and adjusted odds ratios are presented in Table 3 for the variables included in the final model. The adjusted odds for participants from the Island Health Authority seeing/hearing a drug alert were 2.14 times the odds (95% CI: 1.20-3.85) the participants from the Interior Health Authority seeing/hearing a drug alert. In addition, the odds of participants that picked up harm reduction supplies a few times per month in the past 6 months seeing/hearing a drug alert were 2.73 (95% CI: 1.17-6.52) times the odds of participants who had not picked up harm reduction supplies in the past 6 months. Interestingly, the more often participants picked up harm reduction supplies, the odds of them reporting seeing/hearing a drug alert decreased. For example, the odds of a participant picking up harm reduction supplies every day and seeing/hearing a drug alert were 1.96 (95% CI: 0.86-4.50) times the odds of a participant that had not picked up harm reduction supplies in the past 6 months. This is elaborated on in the discussion. Witnessing an opioid-related overdose also provided significant findings – data indicates that the odds of participants who witnessed an opioid-related overdose in the past 6

months seeing/hearing a drug alert were 2.76 (95% CI: 1.76-4.36) times the odds of participants who did not witness an opioid-related overdose in the past 6 months.

***Table 3**: Unadjusted (UOR) and adjusted odds ratios (AOR) for variables included in the final model (N = 482)*

Characteristics	UOR (95% CI)	*p*-value for UOR	AOR (95% CI)	*p*-value for AOR
Demographics:				
Age category				
≤ 29	Reference		Reference	
30-39	1.38 (0.75-2.56)	0.30	1.22 (0.63-2.38)	0.55
40-49	1.52 (0.83-2.80)	0.18	1.34 (0.69-2.59)	0.38
≥ 50	1.58 (0.88-2.85)	0.13	1.23 (0.63-2.38)	0.54
Unknown	4.85 (1.18-33.01)	0.050	6.55 (1.41-48.14)	0.029
Gender				
Cis man	Reference		Reference	
Cis woman	1.07 (0.73-1.59)	0.73	1.04 (0.68-1.58)	0.86
Trans and gender expansive*	3,680,000 (0.00-∞)	0.98	8,500,000 (0.00-∞)	0.98
Unknown	0.85 (0.18-4.39)	0.84	0.44 (0.08-2.53)	0.33
Health Authority				
Interior	Reference		Reference	
Fraser	1.16 (0.66-2.03)	0.61	1.13 (0.62-2.07)	0.68
Island	1.75 (1.03-2.99)	0.039	2.14 (1.20-3.85)	**0.010***
Northern	0.81 (0.46-1.40)	0.45	0.84 (0.46-1.52)	0.56
Vancouver Coastal	1.76 (0.95-3.34)	0.077	1.88 (0.96-3.75)	0.070
Harm Reduction (HR) Characteristics:				
Frequency of HR supply pick up in the past 6 months				
Never	Reference		Reference	
Every day	2.67 (1.26-5.78)	0.011	1.96 (0.86-4.50)	0.11
Few times/week	2.20 (1.07-4.64)	0.034	1.79 (0.83-3.96)	0.14
Few times/month	2.90 (1.31-6.57)	0.0092	2.73 (1.17-6.52)	**0.021***
Once a month or less	3.18 (1.23-8.64)	0.019	2.72 (0.99-7.79)	0.055
Unknown	1.54 (0.52-4.62)	0.44	1.21 (0.36-4.11)	0.76
Drug Use Characteristics:				
Witnessed an opioid OD in the past 6 months				
No	Reference		Reference	
Yes	2.41 (1.61-3.63)	0.000022	2.76 (1.76-4.36)	**0.00001***
Don't know	4.35 (0.62-86.29)	0.19	3.91 (0.47-82.13)	0.25
Unknown	1.33 (0.52-3.49)	0.55	1.68 (0.60-4.85)	0.32

*Includes trans man, trans woman, gender non-conforming, and other specified gender.

DISCUSSION

In a 2021 cross-sectional survey administered at harm reduction sites across B.C., we found over 60% of participants reported seeing/hearing a recent drug alert, and more than two-thirds who saw/heard an alert reported changing their substance use behaviour to be safer. Like previous studies we found, the most common source of alert information for our participants was from peers or through a peer network (24). Other studies confirm that the source of information is a valuable element in risk assessment when using drugs (25). For instance, participants in one study expressed a high level of trust for their drug dealers, that was based on the length of the relationship, drug supply consistencies, and their communication (25). Our study highlights that drug alerts have a role to play in encouraging safer substance use and also the value of peer networks in transmitting information. Therefore methods of disseminating accurate information through peer networks in order to effectively and timely share critical information should be further explored and enhanced.

Based on our analysis, those that picked up harm reduction supplies a few times per month (compared to those who did not pick up supplies in the past 6 months) and those that witnessed an opioid-related overdose in the past 6 months (compared to those who had not) were statistically significantly more likely to report seeing/hearing a drug alert. Additionally, the proportion of people who reported seeing/hearing a drug alert increased with each age category.

Compared to participants from Interior Health, those from Island Health had significantly higher odds of reporting seeing/hearing a drug alert, despite the number of alerts being fewer in Island Health (58 and 38 respectively). This may be due to Island Health alerts being more targeted and informed by Vancouver Island Drug Checking (12). Caution should be used in the interpretation of these findings as participants are not randomly selected and the sample size is small.

A Cochran-Armitage trend test indicated that the proportion of individuals that reported seeing/hearing a drug alert increases with each age category. An important consideration is that individuals from different age groups may have different methods of communication. For example, younger individuals may prefer digital methods while older age groups may prefer word of mouth and belong to larger networks of people who use drugs (26). This is an important

consideration when disseminating drug alerts to ensure that individuals receive the message in a timely and accessible manner. Consultation with PEEP also suggested that younger individuals may be less aware of drug alerts for the following reasons: they may feel that they are less at risk when using substances and they may intentionally ignore messaging surrounding drug use because of the stigma associated with it (27).

Paradoxically, it was found that individuals that attended harm reduction sites more frequently were not statistically significantly likely to report seeing/hearing a drug alert. We hypothesize that this may be due to the psychological phenomenon of change blindness that may occur the more habituated one is with an environment (28, 29). A previous study found that individuals that defined their substance use as a chronic condition expressed that they were de-sensitized to the risk of overdose (30). During our consultation with PEEP, members suggested that those who attend harm reduction supply sites frequently may only be there for a brief time period, while those who attend sites less frequently may be there for longer as they may collect more supplies. This may partially explain the trend we observed, however, we cannot determine differences in drug use behaviour or time spent at the sites between those who visited harm reduction service sites more and less frequently.

Individuals who witnessed an opioid-related overdose in the past 6 months are thought to be more sensitized to information surrounding drug alerts; however, due to the cross-sectional nature of this study, we are unable to determine causality.

Limitations

The data used in this study are cross-sectional and as such we cannot make conclusions about temporal relationships. Additionally, generalizability is limited in this study as participants were a convenience sample of PWUD that accessed harm reduction services/sites and thus the findings may not apply to all PWUD in the province. The survey also relied on individuals' reporting and recollection of their behaviours which introduces recall bias. Data for this study was collected during the ongoing COVID-19 pandemic. However, the immediate restrictions and decreased availability of harm reduction services seen in spring 2020 had been addressed and individuals were able to access in-person harm reduction services in 2021.

CONCLUSIONS

Harm reduction is a non-judgemental approach which provides PWUD with resources and support services to provide them with autonomy to make informed decisions about their substance use. Drug alerts disseminate important and timely information about the circulating drug supply to enable people to use more safely. Our study found most people using harm reduction services were aware of drug alerts – mainly through hearing about them through a friend or peer, and that two-thirds who became aware of an alert subsequently changed their drug use behaviour to be safer. Considering communication with friends and peers was the most common method of information sharing, developing effective strategies to disseminate critical information related to the drug supply amongst social networks should be a priority when developing drug alerts. Drug alerts must use a variety of modes to ensure they are accessible to those who need to know. Further research is needed to ensure alerts are reaching the appropriate audiences and identify how to better communicate to younger PWUD.

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Contributors

KD conducted the initial thematic analysis and data analysis. Authors MF, LL, and JAB provided data interpretation. JAB was the principal investigator and directed data interpretation as well as project coordination. All authors provided constructive feedback on the synthesis of the manuscript. JAB is responsible for the overall content as guarantor.

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Competing interests - None declared.

Data availability statement - Data are available on reasonable request.

Ethical Considerations

The HRCS, 2021 was approved by the University of British Columbia Office Behavioural Research Ethics (#H07-00570). Verbal informed consent was obtained from each participant prior to commencing the survey.

REFERENCES

1. Ahmad F, Cisewski J, Rossen L, *et al.* Vital Statistics Rapid Release - Provisional Drug Overdose Data [online]. Centers for Disease Control and Prevention. 2022. https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm (accessed 24 Oct 2022).
2. Special Advisory Committee on the Epidemic of Opioid Overdoses. Apparent opioid and stimulant toxicity deaths: Surveillance of opioid- and stimulant-related harms in Canada [online]. Ottawa: Public Health Agency of Canada; Dec 2022. 101 p. https://health-infobase.canada.ca/src/doc/SRHD/Update_Deaths_2022-12.pdf (accessed 22 Dec 2022).
3. Special Advisory Committee on the Epidemic of Opioid Overdoses. Opioid and stimulant poisoning hospitalizations: Surveillance of opioid- and stimulant-related harms in Canada [online]. Ottawa: Public Health Agency of Canada; Dec 2022. 67 p. https://health-infobase.canada.ca/src/doc/SRHD/Update_Hospitalizations _2022-12.pdf (accessed 22 Dec 2022).
4. Special Advisory Committee on the Epidemic of Opioid Overdoses. Suspected opioid-related overdoses based on emergency medical services: Surveillance of opioid- and stimulant-related harms in Canada [online]. Ottawa: Public Health Agency of Canada; 2022 Jun. 28 p. https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants/ (accessed 24 July 2022).
5. Olding M, Boyd J, Kerr T, *et al.* "And we just have to keep going": Task shifting and the production of burnout among overdose response workers with lived experience. *Soc Sci Med* 2021;**270**:113631. doi:10.1016/j.socscimed.2020.113631
6. Ministry of Health. Provincial health officer declares public health emergency [online]. BC Gov News. 2016 Apr 14. https://news.gov.bc.ca/releases/2016HLTH0026-000568 (accessed 26 Apr 2022).
7. BC Coroners Service. Illicit drug toxicity deaths in BC: January 1, 2012 – August 31, 2022 [online]. Vancouver: Ministry of Public Safety & Solicitor General. 2022 Sep 28. https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/statistical/illicit-drug.pdf (accessed 24 Oct 2022).
8. Public Safety and Solicitor General. Ten thousand lives lost to illicit drugs since declaration of public health emergency [online]. BC Gov News. 2022 Aug 16. https://news.gov.bc.ca/releases/2022PSSG0056-001250 (accessed 7 Sep 2022).

9. BC Coroners Service. Illicit drug toxicity type of drug data: data to August 31, 2022. Vancouver: Ministry of Public Safety & Solicitor General [online]. 2022 Sept 28, 2022. https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/statistical/illicit-drug-type.pdf (accessed 01 Oct 2022).
10. BCCDC Harm Reduction Services. Information For Alerts and People Who Use Substances [online]. Toward the heart. https://towardtheheart.com/alerts (accessed 18 Oct 2022).
11. BC Centre for Substance Use. Drug Checking [online]. BCCSU. https://www.bccsu.ca/drug-checking/ (accessed 18 Oct 2022).
12. University of Victoria. Vancouver Island drug checking project [online]. UVic. https://substance.uvic.ca/ (accessed 01 Oct 2022).
13. Giné CV, Espinosa IF, Vilamala MV. New psychoactive substances as adulterants of controlled drugs. A worrying phenomenon? *Drug Testing and Analysis* 2014;**6**:819–24. doi:10.1002/dta.1610
14. Toward The Heart. https://towardtheheart.com/for-pwus (accessed 26 Oct 2022).
15. Kerr T, Small W, Hyshka E, *et al.* "It's more about the heroin": injection drug users' response to an overdose warning campaign in a Canadian setting. *Addiction* 2013;**108**:1270–6. doi:10.1111/add.12151
16. Buxton JA, Spearn B, Amlani A, *et al.* The British Columbia Drug Overdose and Alert Partnership: Interpreting and sharing timely illicit drug information to reduce harms: *Journal of Community Safety and Well-Being* 2019;**4**:4–9. doi:10.35502/jcswb.92
17. Nicol JJE, Yarema MC, Jones GR, *et al.* Deaths from exposure to paramethoxymethamphetamine in Alberta and British Columbia, Canada: a case series. *CMAJ Open* 2015;**3**:E83-90. doi:10.9778/cmajo.20140070
18. Smit-Rigter LA, Van der Gouwe D. The neglected benefits of drug checking for harm reduction. *Internal Medicine Journal* 2020;**50**:1024–1024. doi:10.1111/imj.14953
19. Keijsers L, Bossong MG, Waarlo AJ. Participatory evaluation of a Dutch warning campaign for substance-users. *Health, Risk & Society* 2008;**10**:283–95. doi:10.1080/13698570802160913
20. Smit-Rigter LA, Van der Gouwe D. The drugs information and monitoring system (DIMS): Factsheet on drug checking in the Netherlands [online]. 2019.

https://www.trimbos.nl/docs/cd3e9e11-9555-4f8c-b851-1806dfb47fd7.pdf (accessed 22 Dec 2022).

21. Kuo M, Shamsian A, Tzemis D, *et al.* A drug use survey among clients of harm reduction sites across British Columbia, Canada, 2012. *Harm Reduction Journal* 2014;**11**:13. doi:10.1186/1477-7517-11-13
22. Xavier J, Greer A, Pauly B, *et al.* "There are solutions and I think we're still working in the problem": The limitations of decriminalization under the good Samaritan drug overdose act and lessons from an evaluation in British Columbia, Canada. *Int J Drug Policy* 2022;**105**:103714. doi:10.1016/j.drugpo.2022.103714
23. Song K, Buxton JA. Peer engagement in the BCCDC harm reduction program: A narrative summary [online]. Vancouver, BC: BC Centre for Disease Control. 2021. 12 p. https://www.llbc.leg.bc.ca/public/PubDocs/bcdocs2022/725438/725438_Peer_engagement_in_the_BCCDC_harm_reduction_program.pdf (accessed 22 Dec 2022).
24. Soukup-Baljak Y, Greer AM, Amlani A, *et al.* Drug quality assessment practices and communication of drug alerts among people who use drugs. *Int J Drug Policy* 2015;**26**:1251–7. doi:10.1016/j.drugpo.2015.06.006
25. Bardwell G, Boyd J, Arredondo J, *et al.* Trusting the source: The potential role of drug dealers in reducing drug-related harms via drug checking. *Drug Alcohol Depend* 2019;**198**:1–6. doi:10.1016/j.drugalcdep.2019.01.035
26. Loyal J, Buxton JA. Exploring the communication of drug alerts with people who use drugs and service providers [online]. Vancouver, BC: BC Centre for Disease Control. 2021. 35p. https://towardtheheart.com/assets/uploads/1637875132V20vRO8kYDO7akKH2KdKTOP5wZtk8P70uMca4lP.pdf (accessed 22 Dec 2022).
27. Gunn CM, Maschke A, Harris M, *et al.* Age-based preferences for risk communication in the fentanyl era: "A lot of people keep seeing other people die and that's not enough for them." *Addiction* 2021;**116**:1495–504. doi:10.1111/add.15305
28. Mutlu-Bayraktar D. Evaluation of change blindness in multimedia learning environment with cognitive process. *Interactive Learning Environments* 2019;**27**:871–94. doi:10.1080/10494820.2018.1530682
29. Simons DJ, Rensink RA. Change blindness: past, present, and future. *Trends in Cognitive Sciences* 2005;**9**:16–20. doi:10.1016/j.tics.2004.11.006

30. Harris MTH, Bagley SM, Maschke A, *et al.* Competing risks of women and men who use fentanyl: "The number one thing I worry about would be my safety and number two would be overdose." *J Subst Abuse Treat* 2021;**125**:108313. doi:10.1016/j.jsat.2021.108313

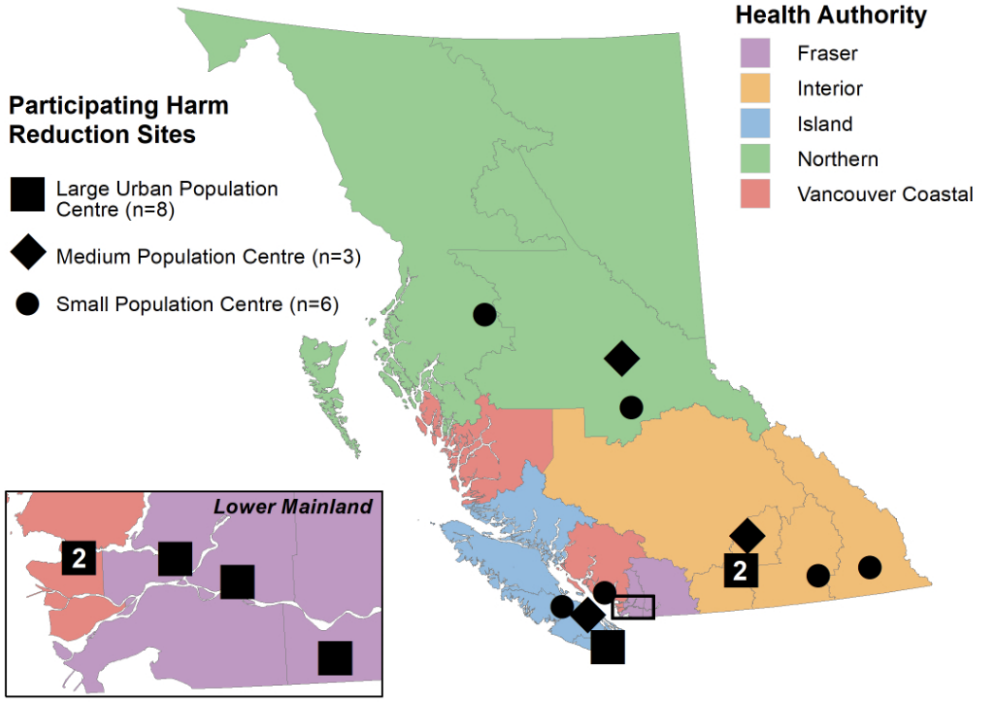

Fig.1. Map of sites participating in 2021 Harm Reduction Client Survey

Map of sites participating in 2021 Harm Reduction Client Survey

181x153mm (144 x 144 DPI)

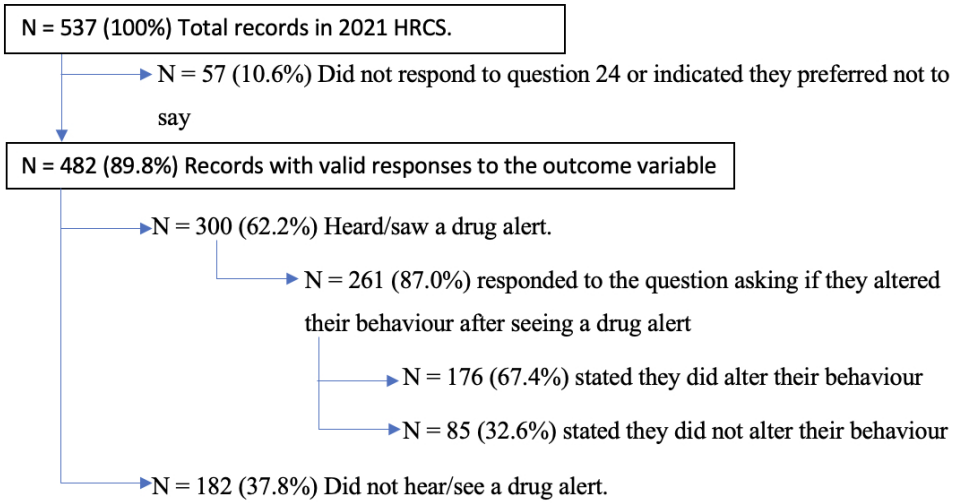

Fig. 2. Summary of responses to the outcome variables of interest.

Summary of responses to the outcome variable of interest

196x115mm (144 x 144 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract **(p 1)**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **(p 2)**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **(p 3)**
Objectives	3	State specific objectives, including any prespecified hypotheses **(p 6)**
Methods		
Study design	4	Present key elements of study design early in the paper **(p 6)**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **(p 6)**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **(p 7)**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **(p 7)**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at **(p 7)**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why **(p 8)**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **(p 8)**
		(*b*) Describe any methods used to examine subgroups and interactions **(p 8)**
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy **(p 8)**
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **(p 10)**
		(b) Give reasons for non-participation at each stage **(p 10)**
		(c) Consider use of a flow diagram **(p 10)**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **(p 10)**
		(b) Indicate number of participants with missing data for each variable of interest **(p 10)**
Outcome data	15*	Report numbers of outcome events or summary measures **(p 10)**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **(p 13)**
		(*b*) Report category boundaries when continuous variables were categorized **(p 7)**
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **(p 10, 13)**

Discussion		
Key results	18	Summarise key results with reference to study objectives **(p 15)**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **(p 16)**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **(p 16)**
Generalisability	21	Discuss the generalisability (external validity) of the study results **(p 16)**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **(p 18)**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Awareness, Predictors, and Outcomes of Drug Alerts Among People Who Access Harm Reduction Services in British Columbia, Canada: Findings from a 2021 Cross-Sectional Survey

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Awareness, Predictors, and Outcomes of Drug Alerts Among People Who Access Harm Reduction Services in British Columbia, Canada: Findings from a 2021 Cross-Sectional Survey

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ABSTRACT

Objectives: To assess the awareness and predictors of seeing/hearing a drug alert in British Columbia (BC) and subsequent drug use behaviour after seeing/hearing an alert.

Methods: This study analyzed the 2021 BC Harm Reduction Client Survey (HRCS) – a cross-sectional self-reported survey administered at harm reduction sites throughout the province and completed by participants using the services.

Results: In total, N = 537 respondents participated and N = 482 (89.8%) responded to the question asking if they saw/heard a drug alert. Of those, N = 300 (62.2%) stated they saw/heard a drug alert and almost half reported hearing from a friend or peer network; the majority (67.4%) reported altering their drug use behaviour to be safer after seeing/hearing a drug alert. The proportion of individuals who saw/heard a drug alert increased with each ascending age category. Amongst health authorities there were significant differences in the odds of seeing/hearing an alert. In the past 6 months, the odds of participants that attended harm reduction sites a few times per month seeing/hearing an alert were 2.73 (95% CI: 1.17-6.52) times the odds of those who did not. Those who attended more frequently were less likely to report seeing/hearing a drug alert. The odds of those who witnessed an opioid-related overdose in the past 6 months seeing/hearing an alert were 1.96 (95% CI: 0.86-4.50) times the odds of those who had not.

Conclusion: We found that drug alerts were mostly disseminated through communication with friends or peers and that most participants altered their drug use behaviour after seeing/hearing a drug alert. Therefore, drug alerts can play a role in reducing harms from substance use and more work is needed to reach diverse populations, such as younger people, those in differing geographical locations, and those who attend harm reduction sites more frequently.

Keywords: Harm reduction, opioid epidemic, public health, epidemiology

ARTICLE SUMMARY

Strengths and Limitations of this Study

- Provides insight into the lived and living experiences of PWUD.
- Identifies strengths and weaknesses in the communication of drug alerts.
- Enhances our understanding of the efficacy of drug alerts and the effect on drug use behaviour.

- Uses cross-sectional data, thus, preventing establishment of temporal relationships.
- Not representative of all PWUD, only those who attend harm reduction sites.

INTRODUCTION

More than 100,000 drug overdose deaths were identified in the United States in 2021 (1). In Canada, 32,632 opioid toxicity deaths were reported between January 2016 and March 2022 (2). During the same time period 33,493 opioid-related and 14,606 stimulant-related poisoning hospitalizations were reported (3). In addition to the strain put on hospitals, emergency first responders are also challenged to respond to the effects of toxic drug supply. In 2021, there were more than 41,600 Emergency Medical Services responses to suspected opioid-related overdoses in Canada (4).

These challenges are not limited to healthcare professionals. The COVID-19 pandemic and public health measures such as physical distancing introduced to prevent virus transmission further exacerbated this complex issue. As harm reduction services became less available and overdoses increased, peers (people with lived experience of substance use who use that experience in their work) took on a greater burden of supporting people who use drugs (5).

B.C declared a public health emergency in April 2016 in response to increasing overdoses fuelled by fentanyl (6). B.C. has the highest rate of opioid-related overdoses of all provinces, in 2021 B.C reported 2,267 illicit drug toxicity deaths, the highest annual number of deaths ever reported (7). In August 2022, the BC Coroners Service reported reaching the tragic milestone of 10,000 lives lost to the toxic drug supply since the public health emergency was declared (8). Post-mortem toxicology in B.C has detected fentanyl or its analogues in more than 80% of deaths since 2017 (9). The proportion of cases where benzodiazepines were detected in decedents increased from 15% in July 2020 to 52% in January 2022 (9). In addition, identification of extreme fentanyl concentrations (>50micrograms/litre) doubled from 8% of decedents January 2019 to March 2020 to 16% November 2021 to August 2022 (9). Drug toxicity deaths are preventable, and advocates are calling for improved policies, treatment and harm reduction measures to support and provide resources to people who use drugs (PWUD) (5).

Initiatives to address the illicit drug toxicity crisis in B.C. include the implementation and expansion of harm reduction services such as opioid agonist treatment, take-home naloxone kits,

supervised consumption and overdose prevention sites, and drug checking. Another strategy is the use of drug alerts to warn PWUD, members of the public, and service providers about the current risks of the circulating drug supply. In 2020, there were 160 drug alerts issued in B.C., a few alerts were province wide but most were disseminated to a specific region or town, with more than half implicating fentanyl as a concern (10). Alerts may be disseminated when harms are identified following the use of an unknown substance, or when analyses of substances identify a particular drug, combination of drugs or drug concentration of concern. Timely identification is often through drug checking services which are increasingly available across B.C., such as those provided through and in partnership with the BC Centre on Substance Use (11) and the Vancouver Island Drug Checking Project (12). Analysis of enforcement samples and decedent toxicology supplement this information but is usually delayed and thus not appropriate for timely drug alerts.

Drug alerts are distributed through different forms of media, including provincial, regional, and harm reduction service websites; social media and social networks; as well as being distributed through outreach activities including posters and word of mouth (13). The content of drug alerts varies from general warnings about drug use to specific details related to a single drug – details may include different names it is being sold under, colour, form, and area where it is believed to be circulating. Alerts developed and distributed by B.C. health authorities are collated by the BC Centre for Disease Control and published on the public website towardtheheart.com (14).

Drug alerts provide an opportunity to provide life-saving information quickly and efficiently. B.C. health authorities and community organizations utilize different methods to distribute drug alerts in order to reach PWUD who use a variety of information sources. There are also important considerations for disseminating drug alerts as well. For example, language matters when issuing information related to the circulating drug supply. Information that may warn individuals about a drug's potency may lead individuals to seek out this drug because of its stronger effect (15). Furthermore, drug alerts need to focus on maintaining human dignity and respecting a person's autonomy while being informative and clear.

Notably, drug alerts are intended to reach individuals responsible for manufacturing the substance(s) as well as those using them. In 2012, the B.C. Drug Overdose and Alert Partnership (DOAP) issued alerts provincially and locally when paramethoxymethamphetamine (PMMA), a toxic substance, was identified in people who died after using what they believed was ecstasy (16, 17). Drug alerts are also being used globally, such as in the Netherlands, where there was an observed association between drug alerts and reduced drug-associated adverse health outcomes, compared to jurisdictions not using drug alerts (18-20).

Our study analyzed data from the 2021 BC Harm Reduction Client Survey (HRCS), which sampled people using harm reduction supply distribution sites around the province. Our aim was to determine the characteristics of who reported seeing/hearing drug alerts, where they saw/heard the alerts and if they reported safer use when they saw/heard an alert in order to improve the alerting process.

MATERIALS AND METHODS

Data Source

The 2021 BC HRCS gathered information on substance use patterns, associated harms, stigma, and utilization of harm reduction services to inform harm reduction planning and to evaluate current practices (21). The cross-sectional HRCS was piloted in 2012 and has been administered annually since (except 2016, 2017 and 2020). Each iteration of the survey contains questions relevant to emerging issues and the priorities of stakeholders. Stakeholders, including PWUD, provided input and piloted questions on awareness of drug alerts included in the 2021 HRCS. Locations for data collection were selected from a provincial network of sites that distribute supplies for safer substance use, using two-stage convenience sampling. Harm reduction program coordinators from each regional health authority identified potential sites for participation; sites were then recruited based on willingness to participate and their capacity for recruitment and data collection. In total, 17 harm reduction sites participated in the 2021 HRCS between March 2021 and January 2022. Trained site staff and volunteers recruited participants who received $15 CAD and the sites received $5 CAD per participant recruited. The anonymous paper-based survey took approximately 20 minutes to complete and participants are informed that they may only complete the survey once.

The eligibility criteria for participants included: being 19 years of age or older, having used or currently using any illegal substance(s) other than or in addition to cannabis in the past 6 months, and being able to provide verbal informed consent. Data entry and analysis occurred at the British Columbia Center for Disease Control (BCCDC) in Vancouver, B.C. Data collection methods have been described elsewhere (10).

Study Variables

We assessed who reported recently seeing/hearing a drug alert and associations with demographic and drug use data from responses to the question "*have you recently seen or heard an alert about recent drug overdoses, toxic drugs found e.g., from drug checking/testing and other possible issues with street drugs?*" We thematically analysed responses to the question "*where did you notice these alerts?*" We assessed if seeing/hearing a drug alert led participants to report using drugs more safely by the response to "*Do you take any steps to be safer (get drugs checked/tested, use overdose prevention sites, use with a buddy etc.) when you see an alert about drugs you may use*?"

Demographic and drug use variables included: B.C. health authority (Fraser, Interior, Island, Northern, and Vancouver Coastal) and urbanicity (large urban, medium and small population centres) of the site where the survey was administered (see Fig. 1), age category (≤29, 30-39, 40-49, ≥50, unknown), gender (cis woman, cis man, trans and gender expansive, unknown), self-reported Indigenous identity (First Nations, Métis, Inuit, non-Indigenous, unknown), employment status (employed [working full-time, part-time or paid volunteer], not employed, unknown), housing status (stably housed [living in a private residence or living in another residence - hotel/motel, rooming houses, single room occupancy, or social/supportive housing)], not stably housed [living in a shelter or having no regular place to stay -homeless, couch surfing, no fixed address], unknown), how frequently the client picked up supplies from a harm reduction site in the last six months (never, every day, few times per week, few times per month, once a month or less, unknown), had a cell phone (yes, no, unknown), had a naloxone kit (yes, no, unknown), used an overdose prevention site in the past 6 months (yes, no, unknown), perceived risk of overdose from opioid (yes, no, don't know, unknown), injected any drug in the past 6 months (yes, no, unknown), frequency of drug use in the past month (none, every day, few

times per week, few times per month, prefer not to say), witnessed or experienced an opioid overdose in the last 6 months (yes, no, don't know, unknown). Variables that had 'prefer not to say' and 'unknown' were combined into 'unknown'. Urbanicity was derived using the Population and Rural Area Classification 2016 system developed from Statistics Canada.

Fig.1. Map of sites participating in 2021 Harm Reduction Client Survey

Statistical Analysis

Descriptive statistics and bivariable analyses with chi-square tests of independence were conducted for all variables to describe characteristics of PWUD that responded to having seen or heard of a drug alert (Table 1). Bivariate logistic regression assessing the relationship between explanatory variables and the outcome variable was conducted for all variables (Table 1). A Cochran-Armitage trend test was performed to assess for a trend between age category and the awareness of drug alerts.

Based on purposeful model building, all covariates with at least one level with a p-value of 0.25 or less in bivariable regression were assessed for inclusion in the final model. In addition, owning a cellphone was included for assessment in the model despite having a p-value greater than 0.25 because conceptually it is believed that having regular access to communication and the internet increases the likelihood of seeing a drug alert. After developing the full model, we used backwards selection and Akaike Information Criterion (AIC) to determine which covariates to include in the final model. Although gender was not statistically significant in the bivariable regression, it was included in the model because of the known effects on health outcomes. We used variance inflation factor (VIF) to assess for collinearity and no VIF was above 4; as such, no further investigation was required, and all covariates of interest remained in the model.

In developing the multivariable logistic regression model, we assessed the following variables as candidates for inclusion in the final model: age category; gender; health authority;

urbanicity; owning a cellphone; owning a naloxone kit; Indigenous identity; perceived risk of opioid overdose; injecting any drug in the past 6 months; frequency of substance use in the past month other than or in addition to cannabis, alcohol, or tobacco; experiencing an unintentional opioid overdose in the past 6 months; witnessing an accidental opioid overdose in the past 6 months; use of an overdose prevention site in the past 6 months; and frequency of harm reduction supply pick up in the last 6 months.

Using backwards selection based on which model resulted in the smaller AIC value, we retained the following variables in the final model: age category, gender, health authority, frequency of harm reduction supply pick up in the past 6 months, and witnessing an opioid-related overdose in the past 6 months. Age category and gender were included despite not being selected for using backwards selection because of their conceptual relevance and known differences in health outcomes.

Adjusted odds ratios (AOR) and 95% confidence intervals (95% CI) were included in the final multivariable logistic regression model. Odds ratios with a p-value ≤0.05 were considered statistically significant. We used R version 4.2.0 (2022-04-22) and R Studio version 2022.2.3.492 to conduct all analyses.

Patient and Public Involvement

To ensure our analyses represent the realities of PWUD, we consulted the Professionals for Ethical Engagement of Peers (PEEP) – an advisory group of leaders with past or current illicit drug use – on our analyses and interpretations (22, 23).

RESULTS

Surveys were completed by 537 eligible participants from across B.C. and 482 (89.8%) participants had valid responses to the question "*have you recently seen or heard an alert?"* and were included in our analysis, of these 300 (62.2%) stated they saw/heard an alert (see Fig. 2)

Of the 261 participants who responded to the question asking if they took steps to be safer when using substances after seeing/hearing a drug alert, 176 (67.4%) reported they did subsequently take safer steps (Fig. 2).

Fig. 2. Summary of responses to the outcome variables of interest.

Table 1 shows the characteristics of respondents. A third of respondents were ≥50 years old and the distribution across urbanicity categories of the site where they participated in the survey were fairly even (29.5% were from small urban centers; 36.1% from medium urban centers and 34.4% from large urban centers). Most respondents were cis men (62.2%), had used an overdose prevention site in the past 6 months (67.2%), did not perceive themselves at risk of an opioid overdose (58.7%), used drugs daily in the past month (66.4%), had not experienced an opioid overdose in the past 6 months (69.3%), and had witnessed an overdose due to opioids in the past 6 months (65.4%). Interior was used as the health authority reference category as it had the largest sample size. With respect to age categories, a Cochran-Armitage trend test indicated that there was an increasing trend with known age and the observation of a drug alert ($p < 0.03$).

Table 1: *Characteristics of 2021 Harm Reduction Client Survey Participants that Responded to Seeing/Hearing a Drug Alert (N = 482)*

Characteristics	Saw/heard alert (n=300) n (%)	Did not see/hear alert (n=182) n (%)	Total (n= 482) n (%)	Chi-Square P-value	Bivariable Regression P-value
Demographics:					
Age category				0.46	
≤ 29	34 (53.1)	30 (46.9)	64 (13.3)		Reference
30-39	72 (61.0)	46 (39.0)	118 (24.5)		0.30
40-49	81 (63.3)	47 (36.7)	128 (26.6)		0.18
≥ 50	102 (64.2)	57 (35.8)	159 (33.0)		0.13
Unknown	11 (84.6)	2 (15.4)	13 (2.6)		0.050
Gender				0.059	
Cis man	183 (61.0)	117 (39.0)	300 (62.2)		Reference
Cis woman	104 (62.7)	62 (37.3)	166 (34.4)		0.73
Trans and gender expansive*	9 (100.0)	0 (0.0)	9 (1.9)		0.98
Unknown	4 (57.1)	3 (42.9)	7 (1.5)		0.84
Health Authority				0.041	
Fraser	52 (61.2)	33 (38.8)	85 (17.6)		0.61
Interior	75 (57.7)	55 (42.3)	130 (27.0)		Reference
Island	81 (70.4)	34 (29.6)	115 (23.9)		0.039
Northern	44 (52.4)	40 (47.6)	84 (17.4)		0.45
Vancouver Coastal	48 (70.6)	20 (29.4)	68 (14.1)		0.077
Urbanicity				0.99	
Large urban	103 (62.0)	63 (38.0)	166 (34.4)		Reference
Medium urban	108 (62.1)	66 (37.9)	174 (36.1)		1.00
Small urban	89 (62.7)	53 (37.3)	142 (29.5)		0.91
Indigenous Identity				0.27	
Non-Indigenous	164 (65.5)	86 (34.5)	250 (51.9)		Reference
Indigenous	117 (57.4)	87 (42.6)	204 (42.3)		0.072
Unknown	19 (67.9)	9 (32.1)	28 (5.8)		0.81
Current employment**				0.65	
Unemployed	219 (61.3)	138 (38.7)	357 (74.1)		Reference
Employed	67 (64.4)	37 (35.6)	104 (21.6)		0.57
Unknown	14 (66.7)	7 (33.3)	21 (4.3)		0.63
Currently stably housed***				0.88	
Yes	175 (62.7)	104 (37.3)	279 (57.9)		Reference
No	111 (61.3)	70 (38.7)	181 (37.6)		0.76
Unknown	14 (63.6)	8 (34.4)	22 (4.5)		0.93
Harm Reduction (HR) Characteristics:					
Frequency of HR supply pick up in the past 6 months				0.061	
Never	15 (41.7)	21 (58.3)	36 (7.5)		Reference
Every day	84 (65.6)	44 (34.4)	128 (26.6)		0.011
Few times/week	107 (61.1)	68 (38.9)	175 (36.3)		0.034
Few times/mo	58 (67.4)	28 (32.6)	86 (17.8)		0.0092
Once a month or less	25 (69.4)	11 (30.6)	36 (7.5)		0.019
Unknown	11 (52.4)	10 (47.6)	21 (4.3)		0.44
Have a cell phone				0.51	
No	121 (60.2)	80 (39.8)	201 (41.7)		Reference
Yes	161 (63.6)	92 (36.4)	253 (52.5)		0.45
Unknown	18 (64.3)	10 (35.7)	28 (5.8)		0.68
Have a naloxone kit				0.014	
No	47 (50.5)	46 (49.5)	93 (19.3)		Reference
Yes	242 (65.2)	130 (34.8)	372 (77.2)		0.010
Unknown	11 (64.7)	6 (35.3)	17 (3.5)		0.29
Used overdose prevention site in				0.011	

the last 6 months					
No	191 (59.0)	133 (41.0)	324 (67.2)		Reference
Yes	96 (72.2)	37 (27.8)	133 (27.6)		0.0083
Unknown	13 (52.)	12 (48.0)	25 (5.2)		0.50
Drug Use Characteristics:					
Perceived risk of opioid OD				0.0089	
No	164 (58.0)	119 (42.0)	283 (58.7)		Reference
Yes	106 (73.1)	39 (26.9)	145 (30.1)		0.0023
Don't Know	24 (63.2)	14 (36.8)	38 (7.9)		0.54
Unknown	6 (37.5)	10 (62.5)	16 (3.3)		0.12
Injected any type of drug in the last 6 months				0.090	
No	152 (58.7)	107 (41.3)	259 (53.7)		Reference
Yes	135 (66.8)	67 (33.2)	202 (41.9)		0.074
Unknown	13 (61.9)	8 (38.1)	21 (4.4)		0.77
Frequency of use of illicit drugs in the past month				0.45	
Did not use drugs	6 (46.2)	7 (53.8)	13 (2.7)		Reference
Every day	198 (61.9)	122 (38.1)	320 (66.4)		0.26
Few times a week	57 (67.9)	27 (32.1)	84 (17.4)		0.14
Few times a month	18 (60.0)	12 (40.0)	30 (6.2)		0.40
Unknown	21 (60.0)	14 (40.0)	35 (7.3)		0.39
Experienced an opioid OD in the past 6 months				0.29	
No	201 (60.2)	133 (39.8)	334 (69.3)		Reference
Yes	81 (67.5)	39 (32.5)	120 (24.9)		0.16
Don't Know	4 (50.0)	4 (50.0)	8 (1.7)		0.56
Unknown	14 (70.0)	6 (30.0)	20 (4.1)		0.39
Witnessed an opioid OD in the past 6 months				0.000072	
No	68 (47.9)	74 (52.1)	142 (29.5)		Reference
Yes	217 (68.9)	98 (31.1)	315 (65.4)		0.000022
Don't know	4 (80.0)	1 (20.0)	5 (1.0)		0.19
Unknown	11 (55.0)	9 (45.0)	20 (4.1)		0.55

*Includes trans man, trans woman, gender non-conforming, and other specified gender.
**Employed includes working part-time, full-time or being a paid volunteer.
***Stably housed includes living in a private residence, living in another residence (hotel/motel, rooming houses, single room occupancy, or social/supportive housing). Not stably housed includes living in a shelter or having no regular place to stay (homeless, couch surfing, no fixed address).

Table 2 shows where participants reported seeing/hearing drug alerts. Responses were not mutually exclusive as participants were able to select more than one option on the survey. Almost half (N = 143) of the participants reported they became aware of the alert through a friend or peer.

Table 2. Where and how participants reported seeing or hearing a drug alert

Where Alerts Were Noticed	No. Of clients* (%)**
Heard from a friend or peer network	143 (48)
At a site attended	
Harm reduction site/e.g., SCS/OPS or community organization	127 (42)
Healthcare provider	36 (12)
Public dissemination	
Posters on the street	70 (23)

On the news/media	61 (20)
Through phone or internet	
On social media e.g., Facebook or Twitter	47 (16)
Received an email or text	24 (8)
Other	38 (13)

*Responses are not mutually exclusive
**% of N = 300 who report seeing/hearing a drug alert

We performed bivariable regression analysis on harm reduction supply pick up frequency and perceived opioid overdose risk; a chi square test indicated the two variables are associated ($p<0.0000001$), suggesting that confounding is likely. Therefore, despite perceived risk of opioid overdose being included in backwards selection it was removed from the final model because of its potential confounding effects on harm reduction supply pick up frequency. We retained frequency of supply pick up as every level with a known frequency of supply pick up was statistically significant in the bivariable regression and, conceptually, individuals who use harm reduction services more frequently would be more likely to observe a drug alert.

Unadjusted and adjusted odds ratios are presented in Table 3 for the variables included in the final model. The adjusted odds for participants from the Island Health Authority seeing/hearing a drug alert were 2.14 times the odds (95% CI: 1.20-3.85) the participants from the Interior Health Authority seeing/hearing a drug alert. In addition, the odds of participants that picked up harm reduction supplies a few times per month in the past 6 months seeing/hearing a drug alert were 2.73 (95% CI: 1.17-6.52) times the odds of participants who had not picked up harm reduction supplies in the past 6 months. Interestingly, the adjusted odds of participants who picked up harm reduction supplies more frequently (every day or a few times per week) seeing/hearing a drug alert was not significantly different from those who had not picked up supplies in the past 6 months. Witnessing an opioid-related overdose also provided significant findings – data indicates that the odds of participants who witnessed an opioid-related overdose in the past 6 months seeing/hearing a drug alert were 2.76 (95% CI: 1.76-4.36) times the odds of participants who did not witness an opioid-related overdose in the past 6 months.

***Table 3**: Unadjusted (UOR) and adjusted odds ratios (AOR) for variables included in the final model (N = 482)*

Characteristics	UOR (95% CI)	*p*-value for UOR	AOR (95% CI)	*p*-value for AOR
Demographics:				
Age category				
≤ 29	Reference		Reference	
30-39	1.38 (0.75-2.56)	0.30	1.22 (0.63-2.38)	0.55
40-49	1.52 (0.83-2.80)	0.18	1.34 (0.69-2.59)	0.38
≥ 50	1.58 (0.88-2.85)	0.13	1.23 (0.63-2.38)	0.54
Unknown	4.85 (1.18-33.01)	0.050	6.55 (1.41-48.14)	0.029
Gender				
Cis man	Reference		Reference	
Cis woman	1.07 (0.73-1.59)	0.73	1.04 (0.68-1.58)	0.86
Trans and gender expansive*	3,680,000 (0.00-∞)	0.98	8,500,000 (0.00-∞)	0.98
Unknown	0.85 (0.18-4.39)	0.84	0.44 (0.08-2.53)	0.33
Health Authority				
Interior	Reference		Reference	
Fraser	1.16 (0.66-2.03)	0.61	1.13 (0.62-2.07)	0.68
Island	1.75 (1.03-2.99)	0.039	2.14 (1.20-3.85)	**0.010***
Northern	0.81 (0.46-1.40)	0.45	0.84 (0.46-1.52)	0.56
Vancouver Coastal	1.76 (0.95-3.34)	0.077	1.88 (0.96-3.75)	0.070
Harm Reduction (HR) Characteristics:				
Frequency of HR supply pick up in the past 6 months				
Never	Reference		Reference	
Every day	2.67 (1.26-5.78)	0.011	1.96 (0.86-4.50)	0.11
Few times/week	2.20 (1.07-4.64)	0.034	1.79 (0.83-3.96)	0.14
Few times/month	2.90 (1.31-6.57)	0.0092	2.73 (1.17-6.52)	**0.021***
Once a month or less	3.18 (1.23-8.64)	0.019	2.72 (0.99-7.79)	0.055
Unknown	1.54 (0.52-4.62)	0.44	1.21 (0.36-4.11)	0.76
Drug Use Characteristics:				
Witnessed an opioid OD in the past 6 months				
No	Reference		Reference	
Yes	2.41 (1.61-3.63)	0.000022	2.76 (1.76-4.36)	**0.00001***
Don't know	4.35 (0.62-86.29)	0.19	3.91 (0.47-82.13)	0.25
Unknown	1.33 (0.52-3.49)	0.55	1.68 (0.60-4.85)	0.32

*Includes trans man, trans woman, gender non-conforming, and other specified gender.

DISCUSSION

In a 2021 cross-sectional survey administered at harm reduction sites across B.C., we found over 60% of participants reported seeing/hearing a recent drug alert and more than two-thirds who saw/heard an alert reported changing their substance use behaviour to be safer. We identified associations with seeing/hearing an alert and demographic factors (such as age and geography but not gender), frequency of supply pick up and witnessing an overdose in past six months. However we found no association with substance use factors such as frequency of substance use or injecting drugs.

Like previous studies we found, the most common source of alert information for our participants was from peers or through peer networks (24). Other studies confirm that the source of information is a valuable element in risk assessment when using drugs (25). For instance, participants in one study expressed a high level of trust for their drug dealers, that was based on the length of the relationship, drug supply consistencies, and their communication (25). Our study highlights that drug alerts have a role to play in encouraging safer substance use and also the value of peer networks in transmitting information. Therefore methods of disseminating accurate information through peer networks in order to effectively and timely share critical information should be further explored and enhanced.

A Cochran-Armitage trend test indicated that the proportion of individuals that reported seeing/hearing a drug alert increases with each age category. Individuals from different age groups may have different methods of communication. For example, younger individuals may prefer digital methods while older age groups may prefer word of mouth and belong to larger networks of people who use drugs (26). Age is an important consideration when disseminating drug alerts to ensure that all individuals receive the message in a timely and accessible manner. It also highlights the need for clear and correct information to be made available to ensure messaging by word of mouth is accurate. Consultation with PEEP also suggested that younger individuals may be less aware of drug alerts for the following reasons: they may feel that they are less at risk when using substances and they may intentionally ignore messaging surrounding drug use because of the stigma associated with it (27).

Compared to participants from Interior Health, those from Island Health had significantly higher odds of reporting seeing/hearing a drug alert. The decision to issue a drug alert is generally based on a number of factors including drug toxicity deaths (7), emergency health service calls, drug checking (11, 12) and community input. However, the availability of these factors may vary by region and therefore make it difficult to directly compare health regions. Resources such as drug checking should be made more consistently available across the province to enable standardization of the alerting process.

Based on our analysis, those that picked up harm reduction supplies a few times per month (compared to those who did not pick up supplies in the past 6 months) were statistically significantly more likely to report seeing/hearing a drug alert. Paradoxically, we found that individuals that attended harm reduction sites a couple of times a week or daily were not significantly more likely to report seeing/hearing a drug alert. Although posted drugs alerts are usually removed after two weeks, a person who attends the harm reduction supply site frequently will have been exposed to the same alerts on multiple occasions. Therefore there may be 'alert fatigue', a phenomenon described in healthcare when frequent alerts may desensitize people, and as a result they may ignore or fail to respond appropriately to such warnings (28). Alert fatigue has also been reported in the context of drug alerts (29); therefore ways of minimizing alert fatigue should be further explored. A previous study found that individuals that defined their substance use as a chronic condition expressed that they were de-sensitized to the risk of overdose (30). During our consultation with PEEP, members suggested that those who attend harm reduction supply sites frequently may only be there for a brief time period, while those who attend sites less frequently may be there for longer as they may collect more supplies. This may partially explain the trend we observed, however, we cannot determine differences in drug use behaviour or time spent at the sites between those who visited harm reduction service sites more and less frequently.

Individuals who witnessed an opioid-related overdose in the past 6 months had more than two and a half times the odds of reporting seeing/hearing a drug alert compared to participants who did not witness an opioid-related overdose. Those who witnessed an overdose have previously been found to change harm reduction behaviours; in a cohort study in B.C.,

witnessing an overdose was found to be positively associated with using drug checking services (31). Therefore those who witness an overdose may be more sensitized to information surrounding drug alerts; however, due to the cross-sectional nature of our study, we are unable to determine causality. In contrast, we found no association with experiencing an overdose in the past 6 months and seeing /hearing a drug alert. This is consistent with previous studies which have identified that people often underestimate their own risk of an overdose. For example, despite a high level of fentanyl risk knowledge most did not translate this knowledge into a personal risk of having an overdose (32) and people who used opioids and injected more frequently and those who were older were less likely to perceive themselves as being at risk of an overdose (33). The implications of our findings and contextual realities should be further explored using qualitative methods.

Limitations

The data used in this study are cross-sectional and as such we cannot make conclusions about temporal relationships. Additionally, generalizability is limited in this study as participants were a convenience sample of PWUD that accessed harm reduction services/sites and thus the findings may not apply to all PWUD in the province. The survey also relied on individuals' reporting and recollection of their behaviours which introduces recall bias and there is potential for social desirability for example when asked if they had seen an alert did they take steps to be safer. Data for this study was collected during the ongoing COVID-19 pandemic. However, the immediate restrictions and decreased availability of harm reduction services seen in spring 2020 had been addressed and individuals were able to access in-person harm reduction services in 2021.

CONCLUSIONS

Drug alerts disseminate important and timely information about the circulating drug supply to enable people to use more safely. Our study found most people using harm reduction services were aware of drug alerts – mainly through hearing about them through a friend or peer, and that two-thirds who became aware of an alert subsequently changed their drug use behaviour to be safer. Considering communication with friends and peers was the most common method of information sharing, developing effective strategies to disseminate critical information related to

the drug supply amongst social networks should be a priority when developing drug alerts. Drug alerts must use a variety of modes to ensure they are accessible to those who need to know. Further research is needed to ensure alerts are reaching the appropriate audiences and to identify how to better communicate to younger PWUD.

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Contributors

KD conducted the initial thematic analysis and data analysis. BG led initial data collection and project coordination. Authors MF, LL, and JAB provided data interpretation. JAB was the principal investigator and directed data interpretation as well as project coordination. All authors (KD, MF, BG, JL, LL, JL, KL, BG, JM and JAB) provided constructive input into the manuscript; all authors read and approved the final manuscript prior to submission. JAB is responsible for the overall content as guarantor.

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Competing interests - None declared.

Data availability statement - Data are available on reasonable request.

Ethical Considerations

The HRCS, 2021 was approved by the University of British Columbia Office Behavioural Research Ethics (#H07-00570). Verbal informed consent was obtained from each participant prior to commencing the survey.

REFERENCES

1. Ahmad F, Cisewski J, Rossen L, *et al.* Vital Statistics Rapid Release - Provisional Drug Overdose Data [online]. Centers for Disease Control and Prevention. 2022. https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm (accessed 24 Oct 2022).
2. Special Advisory Committee on the Epidemic of Opioid Overdoses. Apparent opioid and stimulant toxicity deaths: Surveillance of opioid- and stimulant-related harms in Canada [online]. Ottawa: Public Health Agency of Canada; Dec 2022. 101 p. https://health-infobase.canada.ca/src/doc/SRHD/Update_Deaths_2022-12.pdf (accessed 22 Dec 2022).
3. Special Advisory Committee on the Epidemic of Opioid Overdoses. Opioid and stimulant poisoning hospitalizations: Surveillance of opioid- and stimulant-related harms in Canada [online]. Ottawa: Public Health Agency of Canada; Dec 2022. 67 p. https://health-infobase.canada.ca/src/doc/SRHD/Update_Hospitalizations _2022-12.pdf (accessed 22 Dec 2022).
4. Special Advisory Committee on the Epidemic of Opioid Overdoses. Suspected opioid-related overdoses based on emergency medical services: Surveillance of opioid- and stimulant-related harms in Canada [online]. Ottawa: Public Health Agency of Canada; 2022 Jun. 28 p. https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants/ (accessed 24 July 2022).
5. Olding M, Boyd J, Kerr T, *et al.* "And we just have to keep going": Task shifting and the production of burnout among overdose response workers with lived experience. *Soc Sci Med* 2021;**270**:113631. doi:10.1016/j.socscimed.2020.113631
6. Ministry of Health. Provincial health officer declares public health emergency [online]. BC Gov News. 2016 Apr 14. https://news.gov.bc.ca/releases/2016HLTH0026-000568 (accessed 26 Apr 2022).
7. BC Coroners Service. Illicit drug toxicity deaths in BC: January 1, 2012 – August 31, 2022 [online]. Vancouver: Ministry of Public Safety & Solicitor General. 2022 Sep 28. https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/statistical/illicit-drug.pdf (accessed 24 Oct 2022).
8. Public Safety and Solicitor General. Ten thousand lives lost to illicit drugs since declaration of public health emergency [online]. BC Gov News. 2022 Aug 16. https://news.gov.bc.ca/releases/2022PSSG0056-001250 (accessed 7 Sep 2022).

9. BC Coroners Service. Illicit drug toxicity type of drug data: data to August 31, 2022. Vancouver: Ministry of Public Safety & Solicitor General [online]. 2022 Sept 28, 2022. https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/statistical/illicit-drug-type.pdf (accessed 01 Oct 2022).
10. BCCDC Harm Reduction Services. Information For Alerts and People Who Use Substances [online]. Toward the heart. https://towardtheheart.com/alerts (accessed 18 Oct 2022).
11. BC Centre for Substance Use. Drug Checking [online]. BCCSU. https://www.bccsu.ca/drug-checking/ (accessed 18 Oct 2022).
12. University of Victoria. Vancouver Island drug checking project [online]. UVic. https://substance.uvic.ca/ (accessed 01 Oct 2022).
13. Giné CV, Espinosa IF, Vilamala MV. New psychoactive substances as adulterants of controlled drugs. A worrying phenomenon? *Drug Testing and Analysis* 2014;**6**:819–24. doi:10.1002/dta.1610
14. Toward The Heart. https://towardtheheart.com/for-pwus (accessed 26 Oct 2022).
15. Kerr T, Small W, Hyshka E, *et al.* "It's more about the heroin": injection drug users' response to an overdose warning campaign in a Canadian setting. *Addiction* 2013;**108**:1270–6. doi:10.1111/add.12151
16. Buxton JA, Spearn B, Amlani A, *et al.* The British Columbia Drug Overdose and Alert Partnership: Interpreting and sharing timely illicit drug information to reduce harms: *Journal of Community Safety and Well-Being* 2019;**4**:4–9. doi:10.35502/jcswb.92
17. Nicol JJE, Yarema MC, Jones GR, *et al.* Deaths from exposure to paramethoxymethamphetamine in Alberta and British Columbia, Canada: a case series. *CMAJ Open* 2015;**3**:E83-90. doi:10.9778/cmajo.20140070
18. Smit-Rigter LA, Van der Gouwe D. The neglected benefits of drug checking for harm reduction. *Internal Medicine Journal* 2020;**50**:1024–1024. doi:10.1111/imj.14953
19. Keijsers L, Bossong MG, Waarlo AJ. Participatory evaluation of a Dutch warning campaign for substance-users. *Health, Risk & Society* 2008;**10**:283–95. doi:10.1080/13698570802160913
20. Smit-Rigter LA, Van der Gouwe D. The drugs information and monitoring system (DIMS): Factsheet on drug checking in the Netherlands [online]. 2019.

https://www.trimbos.nl/docs/cd3e9e11-9555-4f8c-b851-1806dfb47fd7.pdf (accessed 22 Dec 2022).

21. Kuo M, Shamsian A, Tzemis D, *et al.* A drug use survey among clients of harm reduction sites across British Columbia, Canada, 2012. *Harm Reduction Journal* 2014;**11**:13. doi:10.1186/1477-7517-11-13
22. Xavier J, Greer A, Pauly B, *et al.* "There are solutions and I think we're still working in the problem": The limitations of decriminalization under the good Samaritan drug overdose act and lessons from an evaluation in British Columbia, Canada. *Int J Drug Policy* 2022;**105**:103714. doi:10.1016/j.drugpo.2022.103714
23. Song K, Buxton JA. Peer engagement in the BCCDC harm reduction program: A narrative summary [online]. Vancouver, BC: BC Centre for Disease Control. 2021. 12 p. https://www.llbc.leg.bc.ca/public/PubDocs/bcdocs2022/725438/725438_Peer_engagement_in_the_BCCDC_harm_reduction_program.pdf (accessed 22 Dec 2022).
24. Soukup-Baljak Y, Greer AM, Amlani A, *et al.* Drug quality assessment practices and communication of drug alerts among people who use drugs. *Int J Drug Policy* 2015;**26**:1251–7. doi:10.1016/j.drugpo.2015.06.006
25. Bardwell G, Boyd J, Arredondo J, *et al.* Trusting the source: The potential role of drug dealers in reducing drug-related harms via drug checking. *Drug Alcohol Depend* 2019;**198**:1–6. doi:10.1016/j.drugalcdep.2019.01.035
26. Loyal J, Buxton JA. Exploring the communication of drug alerts with people who use drugs and service providers [online]. Vancouver, BC: BC Centre for Disease Control. 2021. 35p. https://towardtheheart.com/assets/uploads/1637875132V20vRO8kYDO7akKH2KdKTOP5wZtk8P70uMca4lP.pdf (accessed 22 Dec 2022).
27. Gunn CM, Maschke A, Harris M, *et al.* Age-based preferences for risk communication in the fentanyl era: "A lot of people keep seeing other people die and that's not enough for them." *Addiction* 2021;**116**:1495–504. doi:10.1111/add.15305
28. Agency for Health Care Research and Quality. Patient Safety Network. Alert Fatigue. [online] 2019. US Department & Human Services. https://psnet.ahrq.gov/primer/alert-fatigue#:~:text=The%20term%20alert%20fatigue%20describes,respond%20appropriately%20to%20such%20warnings. Cited March 31, 2023

29. Soukup-Baljak Y, Greer AM, Amlani A, Sampson O, Buxton JA. Drug quality assessment practices and communication of drug alerts among people who use drugs. *Int J Drug Policy* (2015) 26(12) 1251-7
30. Harris MTH, Bagley SM, Maschke A, *et al.* Competing risks of women and men who use fentanyl: "The number one thing I worry about would be my safety and number two would be overdose." *J Subst Abuse Treat* 2021;**125**:108313. doi:10.1016/j.jsat.2021.108313
31. Beaulieu T, Hayashi K, Nosova E, *et al.* Effect of witnessing an overdose on the use of drug checking services among people who use illicit drugs in Vancouver, Canada. *Am J Drug Alcohol Abuse.* 2020;**46**(4):506-511. doi 10.1080/00952990.2019.1708087
32. Moallef S, Nosova E, Milloy MJ, *et al.* Knowledge of fentanyl and perceived risk of overdose among persons who use drugs in Vancouver, Canada. *Public Health Rep.* 2019; 134(4) 423-431. Doi:10.1177/0033354919857084
33. Rowe C, Santos GM, Behar E, Coffin PO. Correlates of overdose risk perception among illicit opioid users. *Drug Alcohol Depend*. 2016;**159**:234-239. doi:10.1016/j.drugalcdep.2015.12.018

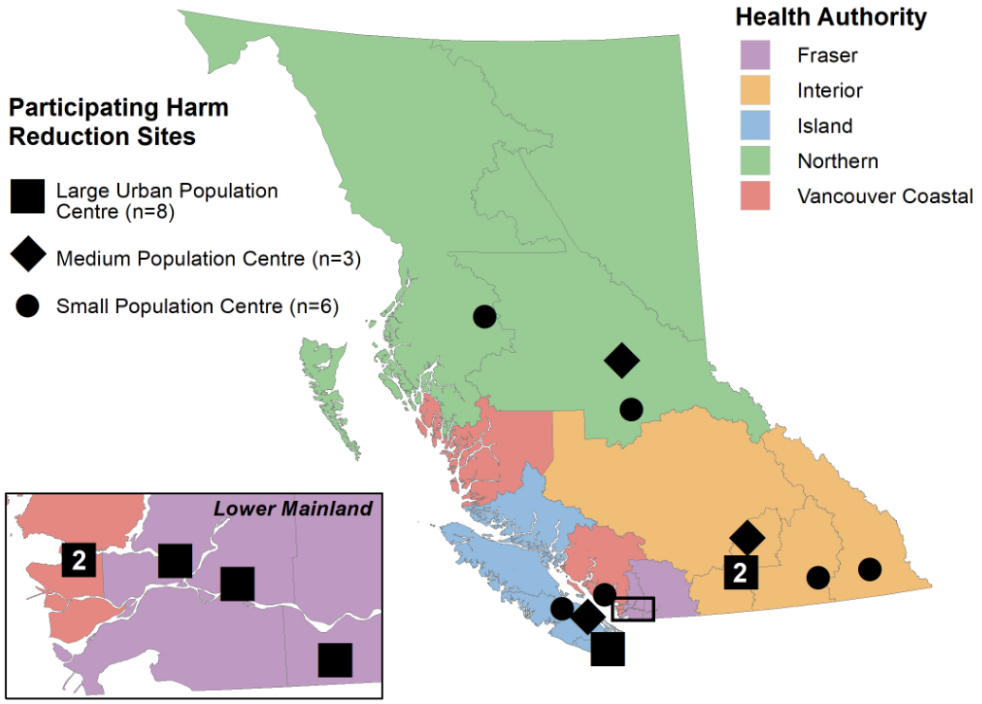

Fig.1. Map of sites participating in 2021 Harm Reduction Client Survey

Map of sites participating in 2021 Harm Reduction Client Survey

181x153mm (144 x 144 DPI)

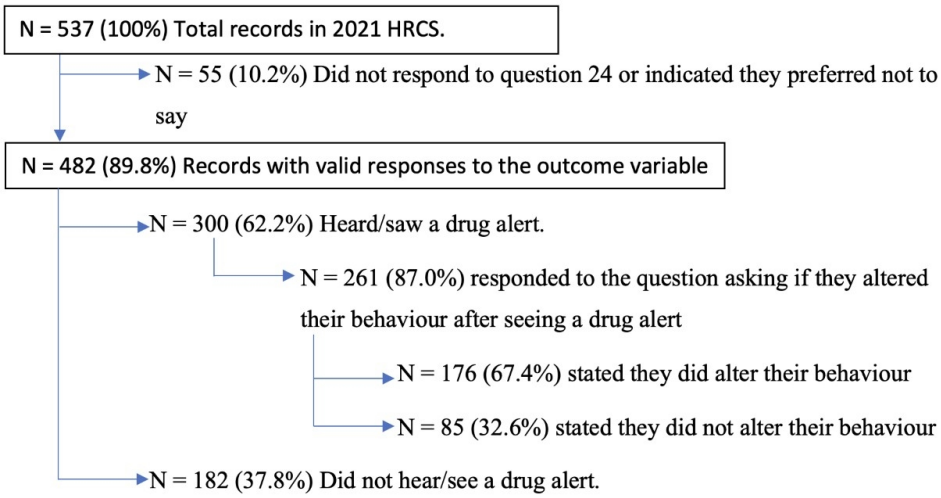

Fig. 2. Summary of responses to the outcome variables of interest.

Fig. 2. Summary of responses to the outcome variables of interest

225x127mm (144 x 144 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract **(p 1)**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **(p 2)**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **(p 3)**
Objectives	3	State specific objectives, including any prespecified hypotheses **(p 6)**
Methods		
Study design	4	Present key elements of study design early in the paper **(p 6)**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **(p 6)**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **(p 7)**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **(p 7)**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at **(p 7)**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why **(p 8)**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **(p 8)**
		(*b*) Describe any methods used to examine subgroups and interactions **(p 8)**
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy **(p 8)**
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **(p 10)**
		(b) Give reasons for non-participation at each stage **(p 10)**
		(c) Consider use of a flow diagram **(p 10)**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **(p 10)**
		(b) Indicate number of participants with missing data for each variable of interest **(p 10)**
Outcome data	15*	Report numbers of outcome events or summary measures **(p 10)**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **(p 13)**
		(*b*) Report category boundaries when continuous variables were categorized **(p 7)**
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **(p 10, 13)**

Discussion		
Key results	18	Summarise key results with reference to study objectives **(p 15)**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **(p 16)**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **(p 16)**
Generalisability	21	Discuss the generalisability (external validity) of the study results **(p 16)**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **(p 18)**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.