



Implementing an Updated “Break the Cycle” Intervention to Reduce Initiating Persons into Injecting Drug Use in an Eastern European and a US “opioid epidemic” Setting

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Abstract

We tested the hypothesis that an updated “Break the Cycle” (BtC) intervention, based in social cognitive theory and motivational interviewing, would reduce the likelihood that current persons who inject drugs (PWID) would assist persons who do not inject drugs (non-PWID) with first injections in Tallinn, Estonia and Staten Island, New York City. 402 PWID were recruited, a baseline interview covering demographics, drug use, and assisting non-PWID with first drug injections was administered, followed by BtC intervention. 296 follow-up interviews were conducted 6 months post-intervention. Percentages assisting with first injections declined from 4.7 to 1.3% (73% reduction) in Tallinn ($p < 0.02$), and from 15 to 6% (60% reduction) in Staten Island ($p < 0.05$). Persons assisted with first injections declined from 11 to 3 in Tallinn ($p = 0.02$) and from 32 to 13 in Staten Island. ($p = 0.024$). Further implementation research on BtC interventions is urgently needed where injecting drug use is driving HIV/HCV epidemics and areas experiencing opioid epidemics.

Keywords Injecting drug use · Initiation · First injection · Break the cycle · HIV · Opioid epidemic

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Introduction

The transition from non-injecting to injecting drug use greatly increases the likelihood of both individual and societal adverse consequences of illicit drug use. Injecting is more likely to lead to transmission of blood-borne viruses (HIV, hepatitis B and C), abscesses and other bacterial infections, fatal overdoses, and more rapid development of substance use disorders [1, 2]. The worldwide HIV/HCV epidemics among persons who inject drugs (PWID) and the current opioid epidemic in the United States [3, 4] have generated renewed interest in transitions to injecting drug use and how such transitions might be reduced [5–7].

Injecting an illicit drug is a complicated and often dangerous procedure, and almost everyone who begins injecting requires the assistance of an experienced injector for their first injection [8, 9]. This almost universal requirement for beginning to inject drugs led Hunt et al. to develop “Break the Cycle,” (BtC) a motivational-interviewing based intervention to discourage persons currently injecting drugs (PWID) from initiating persons who do not inject drugs (non-PWID) into injection drug use [10]. The original Break the Cycle intervention was delivered by counselors. Strike

et al. modified Break the Cycle to “Change the Cycle,” [11] for delivery by peers. Pre-post assessments of both the original Break the Cycle and Change the Cycle showed reduction in assisting and no indications of potential harm to the participants.

We have updated/adapted BtC (renamed Break the Cycle for Avant Garde, BtCag) for use in an Eastern European city (Tallinn, Estonia) and Staten Island, a semi-suburban borough of New York City.

Estonia is a small Baltic nation neighboring Latvia and Russia which regained independence after the break-up of the Soviet Union. Estonia experienced an epidemic of injecting drug use in the 1990s and an epidemic of HIV among PWID (greater than 50% prevalence) beginning in the 2000s [12, 13]. Estonia has had the highest rate of fatal drug overdose in Europe for the last decade [14]. Tallinn is the capital and largest city of Estonia and the majority of PWID in Estonia reside in Tallinn and the surrounding Harju county. While the injecting drug use epidemic and the HIV epidemic among PWID in Tallinn have been declining [15, 16], persons beginning to inject drugs in Tallinn are at high risk of becoming infected with HIV and Hepatitis C [17].

Staten Island, New York City, is a mostly White, semi-suburban borough of New York City. Of the five boroughs, Staten Island has the smallest population [18], the lowest population density [19], and the second highest median household income (after Manhattan) [20]. It is the only borough where non-Hispanic Whites comprise a majority of the population [21]. The public transportation system is limited and primarily organized to bring commuters to Manhattan and Brooklyn. Over the last two decades, Staten Island has experienced epidemic increases in injection drug use and fatal overdoses. Between 2011 and 2014, Staten Island had unintentional opioid analgesic overdose death rates 1.8 to 3.2 times higher than the next closest borough, the Bronx [22], and alternated with the Bronx for the borough with the highest unintentional overdose death rates involving heroin [23].

Tallinn and Staten Island may thus be considered appropriate sites for implementing interventions to reduce initiation into injecting drug use.

Methods

Intervention—Break the Cycle for Avant Garde (BtCag)

The intervention consisted of one individual session with a trained interventionist (social workers, psychologists, and harm reduction workers who were experienced in working with people who use drugs). They participated in a 2-day intervention training led by two clinical psychologists with

extensive experience in motivational interviewing with drug using populations—combining didactic information, skill modelling, role playing, and feedback. At the end of training, the trainers assessed mock sessions for fidelity to the intervention. All interventionists were found to have demonstrated fidelity. Most interventionists also had formal training in Motivational Interviewing (MI) prior to the study.

The “Break the Cycle” (BTC) intervention [10] was aimed at enhancing current injectors’ motivation and skills to avoid helping non-PWID transition to injection drug use. It was informed by two main approaches to behavior change: Social Cognitive Theory, which explains behavior change as the result of peer modelling, expectancies about the target behavior, and perceived self-efficacy to carry out the target behavior [24, 25]; and Motivational Interviewing [26]. It is a client-centered approach that proceeds from the premise that individuals have ambivalence about behavior change. MI is aimed at articulating and resolving that ambivalence in the direction of healthier behavior and pinpointing next action steps.

Our enhanced BtCag intervention had seven main parts: (1) discussion of own first time injecting drugs; (2) discussion of injection “promoting” and “assisting” behaviors, and experiences with and attitudes toward these behaviors; (3) discussion of the health, legal, social, and emotional risks of injection (including a module on safe injection practices); (4) role-plays of behaviors and scripts for avoiding or refusing requests to help non-PWID inject for the first time; (5) role-plays of talking with other PWID about not encouraging non-PWID to start injecting; (6) discussion of coaching non-PWID in safer injection practices, should they feel helping is their best option; and (7) discussion of how naloxone can be used to reverse overdoses. Guided by prior qualitative interviews with PWID in both sites, we augmented the original BTC with parts 5, 6, and 7.

Six persons conducted interventions in Tallinn, and six in Staten Island. Intervention fidelity was maintained through audio recordings and review of 10% of intervention sessions. In group supervision meetings, the supervisor and team provided feedback, practical advice, and support to the interventionists.

Participant Eligibility

PWID were eligible for the study if they were at least 18 years of age, spoke Estonian or Russian (Tallinn) or English (Staten Island), reported injecting in the previous 2 months, and were able and willing to provide informed consent.

Participant Recruitment

Tallinn: Respondent Driven Sampling (RDS) [27, 28] was used in Tallinn from August 2016 to January 2017. The Needle and Syringe Program (NSP) of the non-governmental organization “Convictus” served as the research field site. Convictus has served as research site for several previous RDS studies of PWID in Tallinn [29, 30]. Standard RDS procedures were used: recruitment began with the purposive selection of seeds ($n=8$) known to the field team to represent PWID diverse by age, gender, ethnicity, main type of drug used, and HIV status. After study participation, subjects were provided coupons for recruiting up to three peers who inject drugs. Coupons were uniquely coded to link participants to their survey responses and to biological specimens, and for monitoring recruitment lineages. When a new participant came to the research site and participated in the study, the person who had recruited this participant received an additional honorarium for recruiting. This process of honoraria for both participation and for recruiting new participants was continued until the desired sample size (300) was reached. The coupons were used for tracking the recruitment linkages. [17]

Staten Island: Participants were recruited between October 2016 and January 2018 at the mobile syringe exchange van operated by our community collaborator Community Health Action of Staten Island (CHASI), a multi-service health and social services agency. Space for conducting research on the van was limited—there was only one private area for working with a subject, and no place for potential subjects to wait, or for subjects to collect reimbursement for their recruitment coupons, so that it was not possible to use RDS. Program staff on the mobile unit were made familiar with the study eligibility criteria and referred every consecutive potentially eligible participant to research staff who made the formal determination of eligibility.

Study Procedures

After determining eligibility and obtaining informed consent, participants completed a face-to-face interviewer-administered structured questionnaire in private spaces at each site. The questionnaire was based on the WHO Drug Injecting Study Phase II survey [31]. Questions covered demographics, injecting and non-injecting drug use, use of harm reduction and substance use services, and behaviors related to initiating non-PWID into injecting drug use.

Measuring “Assisting with a First Injection” and “Injection Promoting”

We defined “assisting with a first injection” to participants as “explaining, describing or demonstrating how to inject

to a non-PWID who then injected for their first time,” or actually injecting a person who had not injected before. Participants were asked about assisting with first injections in lifetime and in the last 6 months and the number of persons they had assisted with first injections in last 6 months.

Distinct from assisting, we asked participants about engaging in “injection promoting” behaviors: speaking positively about injecting to non-PWID, injecting in front of non-PWID, and offering to give a first injection to non-PWID in the past 6 months.

Administration of the Intervention

The intervention was administered immediately after the collection of the baseline data. The intervention required approximately 30 min.

Follow-Up Procedures

At baseline, staff collected the participant’s name, street and email addresses, and phone number(s). We also asked participants to provide the same information on up to two other people who would best know their whereabouts if we were to lose contact with the participant. We gave each participant a card listing the date, time, and (same as the baseline) location of their follow-up appointment, and a staff name and phone number, so participants could reschedule appointments or update contact information.

We attempted to contact participants on at least two occasions during the 6-month follow-up period: at about 3 months and within a week before their follow-up appointment. At each attempt, we used all contact information until we made contact. If these approaches failed to yield contact, we reached out to the other people for whom they provided contact information, without disclosing the nature of the study. If participants missed their follow-up appointments, we pursued the same strategies to reschedule.

Compensation for Interviews

In Staten Island, participants were compensated \$30 in cash for each of the baseline and follow-up interviews. In Tallinn, participants who completed the initial interview received a primary incentive (a 10-euro grocery store voucher) and a secondary incentive (a 5-euro grocery store voucher) for each eligible peer recruited. Participants also received a supermarket voucher with a 10-euro grocery store voucher for the follow-up interview. The compensation was based on customary amounts and payment methods for the two sites.

Statistical Analyses

For the Tallinn data, we first compared the primary data to RDS weighted data. For almost all variables, there was little difference between the weighted and unweighted values (less than 5%, see Electronic Supplementary Materials). We therefore used the unweighted values in order to facilitate comparisons with other BtC studies that did not use RDS recruitment.

We tested the hypotheses that participation in Break the Cycle would be associated with pre- versus post-intervention reductions in the percentages of PWID reporting (1) assisting with first injections, and (2) in reporting “injection promoting” behaviors from the 6-month period prior to intervention to the 6-month period post-intervention. Based on previous BtC research showing findings of such declines, and the international importance of developing interventions to reduce initiation into injecting drug use, we used directional hypothesis testing, examining only the probability of reductions in promoting and assisting behaviors. We used the sign test and the McNemar test to assess reductions in promoting and assisting behaviors from the 6-month period prior to intervention to the 6-month period post-intervention.

The outcome data were analyzed in three stages. We first analyzed results separately for the two sites. Second, we compared the effect sizes for the primary outcome across the sites to determine consistency across the two sites. Inconsistent results would preclude a meaningful combined analysis. As the effect sizes were consistent across the sites, we then analyzed results for the combined sample as a single multi-site trial. (Note that the study design met criteria for a multi-site trial—same participant eligibility criteria, same dosage of the same intervention, same outcome measures, and same time period for follow-up.)

The McNemar test was used to assess the statistical significance of changes from the pre-intervention baseline period to the post-intervention follow-up period.

We used statistical environment R (R Development Core Team 2008) and Stata [32] for analyses.

Sensitivity Analyses

There were substantial numbers of participants who did not participate in follow up: 23% in Tallinn and 36% in Staten Island. From our discussions with participants, this was due to concerns about increased police activity in Tallinn and to the limited public transportation system on Staten Island. We therefore conducted sensitivity analysis using conservative assumptions about the behavior of participants who were not retained.

We also conducted a sensitivity analysis to examine the possibility of social desirability leading to misreporting of

ceasing to assist from pre-intervention baseline to post-intervention follow-up.

Ethical Approval

Ethical approval for the study was obtained from the Ethics Review Board of the University of Tartu, Estonia and from the Mount Sinai Beth Israel Medical Center Institutional Review Board in New York, USA. The study is registered at ClinicalTrials.gov (NCT03502525).

Results

Demographics and Drug Use Behaviors

Table 1 presents demographic characteristics, drug use, and injection initiation related behaviors for the full Staten Island and Tallinn samples at the baseline/pre-intervention interview. There were differences in demographic characteristics between the Staten Island and the Tallinn participants—the Staten Island participants were older, more likely to be female and had greater variation in years since first injection.

There were major differences in the drugs injected across the two sites. Heroin was injected by almost all (95%) Staten Island participants, with substantial minorities also injecting cocaine (by itself or in combination with heroin as a “speedball”) and a modest percentage (15%) reported injecting opioid analgesics. Tallinn participants reported fentanyl and amphetamine/methamphetamine as the primary drugs injected. The Staten Island participants were more than twice as likely than the Tallinn participants to report daily injecting (58% vs. 25%).

There were also major differences in non-injecting drug use, with a much higher percentage reporting any non-injecting use in Staten Island (93%) than in Tallinn (67%). Differences in the types of non-injected drugs paralleled the differences in the types of drugs injected.

Standard statistical comparisons of the drugs used in the two sites are not meaningful. All subjects at both sites met the study eligibility criteria (18 years or older, injecting in previous 2 months and capable of giving informed consent), but the two samples clearly come from qualitatively different PWID populations.

The percentages assisting with a first injection in the 6 months prior to the baseline interview differed across the two sites: 14/103 (13%) in Staten Island and 14/299 (5%) in Tallinn.

Retained Versus Lost to Follow-Up Comparisons

Table 2 compares characteristics of subjects who did and did not participate in the follow-up interviews in each site.

Table 1 Baseline demographics, drug use characteristics, and promoting behaviors among PWID^a in Tallinn and Staten Island

	Tallinn, Estonia		Staten Island, NY	
	N	%	N	%
Total	299	100	103	100
Avg. age (SD)	33 (7)	–	44 (12)	–
Avg. years since first injection (SD)	14 (6)	–	17 (14)	–
Gender				
Male	230	77	63	61
Female	69	23	39	38
Non-binary	–	–	–	1
Race or ethnicity				
White	–	–	52	50
Black	–	–	22	21
Latinx	–	–	13	13
Staten Island, NYC other	–	–	16	16
Estonian	41	14	–	–
Russian	240	80	–	–
Tallinn other	18	6	–	–
Injecting drug use				
Heroin	1	<1	98	95
Cocaine	1	<1	38	37
Speedball	0	0	40	39
Opiate analgesics	3	1	15	15
Fentanyl	214	72	6	6
Amphetamine or methamphetamine	191	64	8	8
Any injecting	299	100	103	100
Daily injecting	74	25	60	58
Non-injecting drug use				
Any non-injected drug use	201	67	96	93
Heroin	0	0	58	56
Cocaine	0	0	43	42
Speedball	0	0	48	48
Opiate analgesics	45	15	57	55
Fentanyl	102	34	5	5
Amphetamine or methamphetamine	45	15	12	12
Injection promoting behavior				
Talk positively about injecting to non-injector	21	7	26	25
Inject in front of non-injectors	77	26	25	24
Offer to inject	3	1	5	5
Assisted with first injection last 6 months	14	5	14	14

^aTime frame for drug use and injection related behaviors is previous 6 months

There were no significant differences in demographic characteristics and drug-related behaviors among either the Tallinn and the Staten Island participants.

Changes in Injection Promoting Behaviors and Assisting with First Injections

As shown in Table 3, there were significant pre-post reductions in the percentages of participants engaging in injecting in the presence of non-PWID in Tallinn. There were significant reductions in the percentages of persons assisting with first injections at both sites. The percentage reductions in the numbers of PWID assisting from pre-intervention to post-intervention periods were similar across the two sites—from 4.7 to 1.3%, (a 73% percentage reduction) in Tallinn and from 15 to 6% in Staten Island (a 60% percentage reduction in Staten Island). In Tallinn, the total number of persons who were assisted with first injections decreased from 11 in the pre-intervention period to 3 in the post-intervention period, a 73% reduction, ($p=0.02$ by Wilcoxon matched-pairs sign-rank test), and in Staten Island the total number of persons who were assisted with first injections decreased from 32 during the 6-month pre-intervention period to 13 in the 6-month post-intervention period, a 59% reduction ($p=0.024$ by Wilcoxon).

The effect sizes for the two sites in terms of reduction in the percentage of participants assisting with first injections—73% in Tallinn and 60% in Staten Island—and in terms of the reduction in persons who were assisted—73% in Tallinn and 59% in Staten Island were quite similar.

Table 4 presents the data on participants who changed or did not change in assisting with first injections from the pre-intervention to the post-intervention follow-up period. These change/no change data were used in the statistical significance testing with the McNemar test. The combined/multi-site sample shows a preponderance of changes from assisting to not assisting (17) compared to changes from not assisting to assisting (3), ($p=0.002$ by McNemar test).

Lack of Secular Trend in Persons Assisting with First Injections

One potential explanation for the reduction in the percentages of participants assisting during the baseline period to the follow up period would be a strong secular trend towards reductions in assisting over time. Data collection in Tallinn occurred over a short time period, with no overlap between collection of baseline period and follow-up period data. The data collection in Staten Island occurred over a sufficiently long period of time that we were able to examine the possibility of secular trends in assisting with first injections.

Baseline interviews were conducted from October 2016 to March 2018 in Staten Island. During the first 6 months of baseline data collection (October 2016 to March 2017), we conducted baseline interviews with 62 participants, of whom 8 (13%) reported that they had assisted with first injections. During the next 12 months (April 2017 to March 2018) we

Table 2 Baseline demographics, drug use characteristics, and injection promoting behaviors among PWID by followed or lost to contact in Tallinn and Staten Island

	Tallinn, Estonia		Staten Island, NY	
	Not followed-up N = 69 (100%) (%)	Followed-up N = 230 (100%) (%)	Not followed-up N = 37 (100%) (%)	Followed-up N = 66 (100%) (%)
Avg. age (SD)	32 (6)	34 (7)	41 (11)	45 (12)
Avg. years injecting (SD)	13 (7)	14 (6)	14 (13)	18 (14)
Gender				
Male	84	75	65	59
Female	16	25	35	39
Non-binary	–	–	–	2
Race or ethnicity				
White	–	–	59	45
Black	–	–	11	27
Latinx	–	–	19	9
Other	–	–	11	18
Estonian	6	16	–	–
Russian	88	78	–	–
Other	6	6	–	–
Injecting drug use				
Heroin	0	<1	92	97
Cocaine	<1	0	43	33
Speedball	0	0	32	42
Opiate analgesics	0	1	14	15
Fentanyl	70	72	8	5
Amphetamine or methamphetamine	62	64	5	9
Any injecting	100	100	100	100
Daily injecting	25	25	59	58
Non-injecting drug use				
Any non-injected drug use	70	67	97	91
Heroin	0	0	59	55
Cocaine	0	0	46	39
Speedball	0	0	41	50
Opiate analgesics	19	14	54	56
Fentanyl	43	31	5	5
Amphetamine or methamphetamine	13	16	5	15
Injection promoting behavior				
Talk positively about injecting	3	8	27	24
Inject in front of non-injectors	22	27	27	23
Offer to inject a non-injector	0	1	5	5
Helped inject last 6 months	4	5	11	15

conducted baseline interviews with additional 41 participants, of whom 6 (15%) reported that they had assisted with first injections. ($p = 1.0$ by Fisher's exact test for change in percentage of persons assisting with first injections.)

Follow-up interviews were conducted from April 2017 to September 2018. During the first 6 months of follow up data collection (April 2017 to September 2017), we conducted follow-up interviews with 43 participants, of whom

2 (5%) reported assisting with first injections. During the next months of follow-up data collection (October 2017 to September 2018), we conducted follow-up interviews with an additional 23 participants, of whom 2 (9%) assisted with first injections. ($p = 0.62$ by Fisher's exact test, but in the opposite direction of a secular trend towards a reduction in assisting with first injections.) There clearly were no secular trends towards reduced assistance with first

Table 3 Baseline and follow-up injection promoting behaviors among PWID who were followed up in Tallinn and Staten Island

	Tallinn, Estonia N=230 (100%)		Staten Island, NY N=66 (100%)	
	Baseline (%)	Follow-up (%)	Baseline (%)	Follow-up (%)
Any promoting behavior	33	20*	33	29
Talk positively about injecting	8	7	24	17
Injected in front of non-injectors	27	15*	23	15
Offered to inject	1	1	5	2
Assisted with first injection last 6 months	5	1*	15	6*

* $p < 0.05$ **Table 4** Change and stability in assisting with first injections from baseline to follow-up period in Tallinn and Staten Island

	Not assisting no change (N)	Assisting no change (N)	Not assisting to assisting (N)	Assisting to not assisting (N)	<i>p</i> value*
Tallinn	217	1	2	10	0.020
Staten Island, New York City	55	3	1	7	0.030
Combined sample	272	4	3	17	0.002

*McNemar's test

Table 5 Being asked to assist and assisting with first injections during baseline and follow-up periods in Tallinn and Staten Island

	Baseline period	Follow-up period
Tallinn		
Asked to assist	42	34
Assisted among those asked*	8	1
Staten Island		
Asked to assist	29	29
Assisted among those asked	8	4
Combined sample		
Asked to assist	71	63
Assisted among those asked**	16	5

* $p = 0.03$ by Fisher's exact test** $p = 0.015$ by Fisher's exact test

injections within either the baseline period or the follow-up period in Staten Island.

Being Asked to Assist with a First Injection

For a PWID, being asked by a non-PWID to assist with a first injection may be a critical step in actually providing assistance. Table 5 shows the numbers of PWID who reported being asked to assist and the numbers who reported that they did assist after being asked for the pre-intervention and post-intervention period for the two sites. The numbers of PWID asked to assist changed over the pre- to the post-intervention periods from 42 to 34 in Tallinn, but remained

constant at 29 in Staten Island), but the number of PWID who did assist after being asked declined significantly (from 8 to 1 in Tallinn, from 8 to 4 in Staten Island). (For the combined/multi-site data, $p = 0.015$ by Fisher's exact test.)

Ceasing to Inject and Ceasing to Assist with First Injections

Current injecting drug use (injecting within the previous two months) was an eligibility requirement for participating in the study. There were reductions in the percentages of participants who were injecting drugs from the baseline period to the follow-up period, a reduction of 8% in Tallinn and of 15% in Staten Island. The cessation of injecting by these participants, however, did not generate the reductions in assisting with first injections. There were only 2 participants (1 from each site) who reported ceasing to inject and ceasing to assist with first injections during the follow-up period. If these two subjects are omitted from the analysis of the reduction of assisting with first injections, the reduction in assisting is still significant ($p = 0.0043$ by McNemar test for the combined data).

Sensitivity Analyses

Substantial numbers of persons were lost to follow-up at each site (23% in Tallinn and 36% in Staten Island). We therefore conducted sensitivity analysis to assess how different assumptions about the behavior among persons lost to follow-up might affect statistical significance of the

reduction in persons assisting with first injections in the combined sample.

We examined scenarios in which: (1) the intervention effects were half as strong among non-retained participants as among the retained participants, (2) there were no changes in behavior from pre-to post-intervention among non-retained participants, and (3) a “very bad case” situation in which all non-retained participants who assisted in the pre-intervention period continued to assist in the post-intervention period and the rate of change from not assisting to assisting among non-retained participants was three times the observed rate among retained participants (generating 9 assisting in the post period among 106 participants not retained versus 7 among the 299 retained). In all of these scenarios, the reduction in assisting remained statistically significant for a combined sample of retained and non-retained participants ($p=0.012$, 0.002 , 0.028 respectively for the 3 scenarios by McNemar tests).

There were 17 participants who reported assisting in pre-intervention/baseline and who reported not assisting in post-intervention/follow-up. Social desirability may have led some of these participants to report that they had ceased assisting during post-intervention when they had actually continued assisting. We conducted a sensitivity analysis to determine how many of these 17 would have had to continue assisting before statistical significance was lost. It would have been necessary for 8 of the 17 to have misreported before significance was lost ($p=0.075$ by McNemar test).

Discussion

We observed significant pre-to-post-intervention reductions in assisting with first injection in both sites—from 4.7 to 1.3% in Tallinn and from 15 to 6% in Staten Island. The percentage reductions—73% in Tallinn and 60% in Staten Island—were similar. These similar reductions occurred in settings with major differences in the drugs injected, in non-injecting drug use and in the stage of the local injecting drug use epidemic, declining in Tallinn and ongoing in Staten Island, and in the percentages of PWID assisting with first injections.

The percentage reductions in the numbers of persons assisted—73%, from 11 persons to 3 in Tallinn, and 59%, from 32 persons to 13 in Staten Island—were also quite similar. The difference in numbers of persons assisted during pre-intervention/baseline in the two sites provides insight into the differences in injecting drug use epidemics. There were only 11 persons who were assisted with first injections by the 230 follow-up participants in Tallinn compared to 32 persons who were assisted by the 66 follow-up participants in Staten Island. Initiation into injecting was occurring at a very low rate in Tallinn and a very high rate in Staten

Island. In addition to fatal drug overdose and incident HCV infections, the rate of persons recently receiving assistance with first injections may be a useful marker for monitoring continuing opioid epidemics in the US.

From our clinical observations and review of the tape-recorded intervention sessions, there were several aspects of the intervention that may contribute to the reductions in assisting. First, the intervention produced strong emotional reactions among many participants. Second, while the intervention was focused on initiation of non-PWID into injecting, many participants used it as an opportunity for self-reflection, and considered how they might reduce harm to their community by not assisting with first injections and harm to themselves through changing their behavior. Third, the interventionists were experienced as empathic and non-judgmental. Many participants noted that it was unusual for them to have an opportunity to discuss drug use in a confidential and non-judgmental context.

Comparison with Previous Studies

We are aware of two previously published studies of Break the Cycle type interventions. Hunt et al. [10], reported at 67% pre- versus post reduction in assisting in the United Kingdom, though the sample size was not sufficient for statistical testing. Strike et al. [11], reported “paired analyses of initiator baseline versus follow-up data showed a 72.7% reduction in initiation (95% CI: 47.7- 83.1).” Thus, there is considerable consistency among the outcomes of these previous studies and our two sites (range of percentage reduction in assisting: 60–73%). It would seem unlikely that each of these studies was coincidentally timed with other factors that created the large pre-post reductions in the percentage of persons assisting with first injections.

Limitations

We used a pre- versus post design to assess changes associated with participation in the intervention. We were able to examine the potential for secular change in Staten Island—there was no evidence for such a trend. Our data also indicated that the reductions in assisting with first injections were not generated by PWID who ceasing injecting. There may, however, have been unknown/uncontrolled factors that influenced the reductions in assisting.

Social desirability effects are always of concern when self-reported behavior is the outcome variable for a study. There is a general consensus that, at a group level, self-report data from persons who use drugs is sufficiently valid to be used in research studies [33, 34] and there is no practical alternative to self-report for the type of study reported here.

We would also note that social desirability may have led to underestimation of an effect of the intervention. Assisting with first injections is generally disapproved in most PWID populations. [35, 36] Social desirability may thus have led some participants to deny assisting with first injections during the pre-intervention/baseline period. These participants might have been particularly responsive to the intervention, which focused on motivation to not assist and provided skills training in refusing requests for assisting, and then actually ceased assisting during the post-intervention follow up period. Such participants would have been assessed as not assisting in either period rather than as ceasing to assist.

Finally, we would note parallels with social desirability issues in research on self-reported reductions in HIV risk behavior. As noted in the Introduction, both New York City and Tallinn experienced high seroprevalence HIV epidemics among PWID. In our experience conducting research in the two cities, the HIV epidemics generated intense social desirability pressure to deny sharing drug injection equipment, but self-reported use of prevention interventions (notably syringe exchange) and self-reported reductions in syringe sharing in both cities were temporally associated with large reductions in HIV infection [37, 38].

Future Research

The present research examined whether an updated Break the Cycle intervention could be implemented in two different injecting drug use settings and whether a large effect size (measured in terms of the percentage reduction in persons assisting with first injections) could be achieved in both sites. Given the need for interventions to reduce initiation into injecting drug use in many different countries, priority was given to avoiding type II error. We did observe relatively large effect sizes in both sites and also noted that there was no evidence for a secular trend over the long data collection period in Staten Island. We believe that there are now multiple possible directions for future research:

- (1) A study that would minimize the likelihood of both type I and type II error. Such a study would probably need a stepped wedge, cluster randomized control design, to account for lack of true equipoise, interviewing itself as an intervention and for potential diffusion effects. Needless to say, this would be a very resource intensive research project, but with the current continuing opioid epidemic in the US and the continuing injecting drug use epidemics in Eastern Europe, Central and Southeast Asia, there should be a sufficient number of appropriate research sites. There are several areas for which additional research on interventions to reduce assisting with first injections would be very useful.

- (2) Identify the mechanisms of behavior change among Break the Cycle participants. As noted above, Hunt et al. suggested that asking questions about assisting others with first injections might lead to emotional engagement and self-reflection, and by itself constitute an intervention to reduce assisting with first injections. Our baseline questionnaire did ask probing questions about assisting, including who was assisted, why assistance was provided, and the likelihood that the PWID would provide similar assistance in the future. On the other hand, our data on PWID who were asked to provide assistance suggest that the roleplay rehearsal of refusing to assist when requested may be a critical component of the intervention. Experimentation with variations in the Break the Cycle intervention might identify the most cost-effective version of the intervention.
- (3) Determine how to implement the intervention on a public health scale in order to have population level effects. This should include strengthening general norms against initiating others into injecting drug use.
- (4) Assess long-term outcomes. Many behavioral interventions decay over time, but interventions that develop social norms in support of the desired behavior may be much more likely to persist.
- (5) Develop, test and implement complementary interventions that may be needed in order to further reduce initiation into injecting drug use. Break the Cycle interventions should not be seen as a panacea for stopping epidemics of injecting drug use. Interventions that work with persons not currently injecting are also necessary [5, 39]. As well as ready access to treatment for substance use disorders.

Conclusions

Similar to the findings in previous Break the Cycle studies, participation in the BtCag intervention was associated with large pre- versus post-intervention decreases in the percentage of PWID assisting with first injections and the numbers of persons who were assisted with first injections. Additional research elucidating the mechanisms of behavior change in Break the Cycle interventions and implementation research on how to create population-level reductions in initiation into injection drug use is needed, particularly for other areas where injecting drug use is driving HIV epidemics and for other areas experiencing continuing opioid epidemics.

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Compliance with Ethical Standards

Conflict of interest All authors have declared that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

- Gossop M, Griffiths P, Powis B, Strang J. Severity of dependence and route of administration of heroin, cocaine and amphetamines. *Br J Addict*. 1992;87(11):1527–36.
- Mateu-Gelabert P, Guarino H, Jessell L, Teper A. Injection and sexual HIV/HCV risk behaviors associated with nonmedical use of prescription opioids among young adults in New York City. *J Subst Abuse Treat*. 2015;48(1):13–20.
- Jones CM, Christensen A, Gladden RM. Increases in prescription opioid injection abuse among treatment admissions in the United States, 2004–2013. *Drug Alcohol Depend*. 2017;176:89–95.
- Mack KA, Jones CM, Ballesteros MF. Illicit drug use, illicit drug use disorders, and drug overdose deaths in metropolitan and nonmetropolitan areas—United States. *Am J Transplant*. 2017;17(12):3241–52.
- Des Jarlais DC, Casriel C, Friedman SR, Rosenblum A. AIDS and the transition to illicit drug injection: results of a randomized trial prevention program. *Br J Addiction*. 1992;87:493–8.
- Vlahov D, Fuller CM, Ompad DC, Galea S, Des Jarlais DC. Updating the infection risk reduction hierarchy: preventing transition into injection. *J Urban Health*. 2004;81(1):14–9.
- Werb D, Bluthenthal RN, Kolla G, et al. Preventing injection drug use initiation: state of the evidence and opportunities for the future. *J Urban Health*. 2018;95(1):91–8.
- Kermode M, Longleng V, Singh BC, Hocking J, Langkham B, Crofts N. My first time: initiation into injecting drug use in Manipur and Nagaland, north-east India. *Harm Reduct J*. 2007;4:19.
- Rotondi NK, Strike C, Kolla G, et al. Transition to injection drug use: the role of initiators. *AIDS Beh*. 2014;18(3):486–94.
- Hunt N, Stillwell G, Taylor C, Griffiths P. Evaluation of a brief intervention to prevent initiation into injecting drugs. *Drugs*. 1998;5(2):185–94.
- Strike C, Rotondi M, Kolla G, et al. Interrupting the social processes linked with initiation of injection drug use: results from a pilot study. *Drug Alcohol Depend*. 2014;137:48–54.
- Uuskula A, Kalikova A, Zilmer K, Tammai L, DeHovitz J. The role of injection drug use in the emergence of human immunodeficiency virus infection in Estonia. *Int J Infect Dis*. 2002;6(1):23–7.
- Uuskula A, Kals M, Rajaleid K, et al. High-prevalence and high-estimated incidence of HIV infection among new injecting drug users in Estonia: need for large scale prevention programs. *J Public Health (Oxf)*. 2008;30(2):119–25.
- EMCDDA. European drug report: trends and developments. *Luxembourg: European Union: The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA)*. 2017.
- Uuskula A, Des Jarlais DC, Raag M, Pinkerton SD, Feelemyer J. Combined prevention for persons who inject drugs in the HIV epidemic in a transitional country: the case of Tallinn, Estonia. *AIDS Care*. 2015;27(1):105–11.
- Uuskula A, Rajaleid K, Talu A, Abel-Ollo K, Des Jarlais DC. A decline in the prevalence of injecting drug users in Estonia, 2005–2009. *Int J Drug Policy*. 2013;24:312–8.
- Uuskula A, Barnes DM, Raag M, Talu A, Tross S, Des Jarlais DC. Frequency and factors associated with providing injection initiation assistance in Tallinn, Estonia. *Drug Alcohol Depend*. 2018;188:64–70.
- NYC Department of Planning. Current population estimates. New York, NY: NYC Department of Planning; 2017.
- United States Census Bureau. *2010 Census Summary File 1: Population density by county*. 2010.
- NYC Department of Planning. *DP03: Selected Economic Characteristics; 2015 American Community Survey 1-Year Estimates, New York City and Boroughs* 2016.
- NYC Department of Planning. *DP05: ACS Demographic and Housing Estimates; 2015 American 812 Community Survey 1-Year Estimates, New York City and Boroughs* 2016.
- New York City Department of Health and Mental Hygiene. Unintentional Drug Poisoning (Overdose) Deaths Involving Opioids in New York City, 2011–2014. EPI Data Tables, 66, 1–8. 2015; <http://www.nyc.gov/html/doh/downloads/pdf/epi/datatable66.pdf>.
- New York City Department of Health and Mental Hygiene. Unintentional Drug Poisoning (Overdose) Deaths Involving Opioids in New York City, 2011–2015. 2016; <http://www.nyc.gov/html/doh/downloads/pdf/epi/datatable66.pdf>.
- Luszczynska A, Schwarzer R. Social cognitive theory. In: Conner M, Norman P, editors. *Predicting health behaviour*. California: University of California; 2005. p. 127–69.
- Bandura A. Social cognitive theory and exercise of control over HIV infection. In: Peterson J, DiClemente R, editors. *Preventing AIDS: theory and practice of behavioral interventions*. New York: Plenum Press; 1993.
- Miller WR, Rollnick S. *Motivational interviewing: helping people change*. New York: Guilford Press; 2012.
- Heckathorn D. Respondent-driven sampling: A new approach to the study of hidden populations. *Soc Problems*. 1997;44(2):174–99.
- Heckathorn D, Semaan S, Broadhead RS, Hughes J. Extensions of respondent-driven sampling: a new approach to the study of injection drug users aged 18–25. *AIDS Behav*. 2002;6(1):55–67.
- Uuskula A, Heimer R, Dehovitz J, Fischer K, McNutt LA. Surveillance of HIV, hepatitis B virus, and hepatitis C virus in an Estonian injection drug-using population: sensitivity and specificity of testing syringes for public health surveillance. *J Infect Dis*. 2006;193(3):455–7.
- Uuskula A, McNutt LA, Dehovitz J, Fischer K, Heimer R. High prevalence of blood-borne virus infections and high-risk behaviour among injecting drug users in Tallinn, Estonia. *Int J STD AIDS*. 2007;18(1):41–6.
- Des Jarlais DC, Perlis TE, Stimson GV, Poznyak V, Group WPID-ICS. Using standardization methods for research on HIV and injecting drug use in developing/transitional countries: case study from the WHO drug injection study phase II. *BMC Public Health*. 2006;6:54–6–12.
- StataCorp. *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP; 2015.
- Harrison L, Hughes A. The validity of self-reported drug use: Improving the accuracy of survey estimates (NIH Publication No. 97-4147, NIDA Research Monograph 167). *Rockville, MD: National Institute on Drug Abuse*. 1997.
- Napper LE, Fisher DG, Johnson ME, Wood MM. The reliability and validity of drug users' self reports of amphetamine use among primarily heroin and cocaine users. *Addict Behav*. 2010;35(4):350–4.

35. Kolla G, Strike C, Roy É, et al. Initiation stories: an examination of the narratives of people who assist with a first injection. *Subst Use Misuse*. 2015;50(13):1619–27.
36. Wenger LD, Lopez AM, Kral AH, Bluthenthal RN. Moral ambivalence and the decision to initiate others into injection drug use: a qualitative study in two California cities. *Int J Drug Policy*. 2016;37:42–51.
37. Des Jarlais DC, Marmor M, Paone D, et al. HIV incidence among injecting drug users in New York City syringe-exchange programmes. *Lancet*. 1996;348(9033):987–91.
38. Uuskula A, Des Jarlais DC, Kals M, et al. Expanded syringe exchange programs and reduced HIV infection among new injection drug users in Tallinn, Estonia. *BMC Public Health*. 2011;11:517.
39. Casriel C, Des Jarlais DC, Rodriguez R, Friedman SR, Stepherson B, Khuri E. Working with heroin sniffers: clinical issues in preventing drug injection. *J Subst Abuse Treat*. 1990;7:1–10.

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