International Journal of Drug Policy 25 (2014) 575–582

Contents lists available at ScienceDirect

International Journal of Drug Policy

journal homepage: www.elsevier.com/locate/drugpo

Research paper

Safe havens and rough waters: Networks, place, and the navigation of risk among injection drug-using Malaysian fishermen

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ARTICLE INFO

Article history:
Received 16 April 2013
Received in revised form 6 November 2013
Accepted 13 November 2013

Keywords:
Injection drug use
HIV
Social networks
Place
Risk environment
Fishermen
Malaysia

ABSTRACT

Background: HIV prevalence among Malaysian fishermen is ten times that of the general population. Fishing boats are a key place where drug use occurs, but we know little about how these environments shape HIV risk behaviour. Utilizing Rhodes' 'risk environment' framework, we assessed drug use contexts and how characteristics of place associated with fishing and fishermen's social networks served as key axes along which drug use and HIV risk behaviour occurred.

Methods: Data were collected during 2009–2011 in Kuantan, a fishing port on the eastern coast of Malaysia, and include 28 in-depth interviews and 398 surveys collected using RDS. Logistic regression was used to determine the effect of occupational, network and risk environment characteristics on unsafe injection behaviour and access to clean needles/syringes; qualitative data were coded and analyzed thematically.

Results: Drug injecting was common and occurred on boats, often with other crewmembers. Captains and crewmembers were aware of drug use. Unsafe injection practices were significantly associated with having a larger proportion of drug injectors in network (OR = 3.510, 95% CI = 1.053–11.700) and having a captain provide drugs for work (OR = 2.777, 95% CI = 1.018–7.576). Size of fishermen network (OR = 0.987, 95% CI = 0.977–0.996), crewmembers' knowledge of drug use (OR = 7.234, 95% CI = 1.430–36.604), and having a captain provide drugs for work (OR = 0.134, 95% CI = 0.025–0.720) predicted access to clean needles/syringes. Qualitative analyses revealed that occupational culture and social relationships on boats drove drug use and HIV risk.

Conclusions: While marginalized in broader society, the acceptance of drug use within the fishing community created occupational networks of risk. Fishing boats were spaces of both risk and safety; where drug users participated in the formal economy, but also where HIV risk behaviour occurred. Understanding the interplay between social networks and place is essential for developing HIV prevention and harm reduction policies appropriate for the unique needs of this fishing population.

Introduction

Fishermen are a high-risk group for HIV, having higher HIV rates than other typically at-risk groups, like truck drivers and military personnel (Kissling et al., 2005). Despite this, fishermen and their communities remain under-researched, especially in Southeast Asia. In Malaysia, there is particular cause for concern as estimates suggest that fishing communities have an HIV prevalence rate 10 times that of the general population (Kissling et al., 2005). While only 1.3% of the working population is employed in the fishing industry (Department of Statistics Malaysia, 2005), fishermen constitute 3.8% of the total reported HIV cases in the country (Ministry of Health Malaysia, 2008). The dearth of research on fishing communities underscores the need for a greater understanding of the social determinants of HIV risk among fishermen. Integral to this understanding is an examination of social networks and how local environments and broader social, economic, and occupational factors shape HIV risk behaviour.

Despite the substantial focus in public health on behaviour change models, there is increasing attention to the ways in which health priorities and behaviours are shaped by larger social structures that intersect with biological, psychological and network

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http://dx.doi.org/10.1016/j.drugpo.2013.11.007

processes to determine health and well-being (Farmer, 2005; Krieger, 1994; Parker, Easton, & Klein, 2000; Susser & Susser, 1996). These processes provide both the context within which HIV risk behaviour occurs and the opportunities people have to navigate risk (Cockerham, 2005; Rhodes, 1997). For HIV and drug use, this particular social and physical space is referred to as a 'risk environment' (Rhodes, 2002). The risk environment framework posits that environmental factors, like social, economic, policy, and physical context, interact at different levels of influence (micro, macro) to increase the chances of harm occurring (Rhodes, 2002). Place is particularly important because it is an 'assemblage of personal networks and environmental characteristics which work together to enhance or impede the experience of health and well-being' (Frohlich, Corin, & Potvin, 2001).

Among fishermen in this study, previous analyses suggest that injection drug use plays a significant role in HIV transmission: while 12.4% of study participants tested positive for HIV at the time of interview, most fishermen (77.1%) reported no sexually activity (with men or women) in the past 3 months, and having a history of injection drug use was significantly associated with HIV seroprevalence. While fishermen's high mobility is often cited as a key factor driving HIV transmission (Entz, Prachuabmoh, van Griensven, & Soskolne, 2001; Kissling et al., 2005), less attention has been paid to the places where fishermen interact and drug use occurs, like boats, and how occupational characteristics may shape networks to create a unique risk environment. This paper utilizes qualitative and survey data to examine the intersection of place and social networks among fishermen in Kuantan, Malaysia. Specifically, we investigate how network relationships with crewmembers and captains and occupational characteristics associated with fishing intersect to shape unsafe injection practices and access to clean needles/syringes. The overall goal is to inform policy by providing important insight into HIV risk behaviour through the elucidation of the social context of drug use, network relationships, and risk navigation opportunities.

Background

The risk environment approach emphasizes how experiences of and responses to HIV risk are socially and locally situated, driven by external environmental and social conditions that shape everyday practices and increase harm among people who inject drugs (PWID) (Rhodes, 2009). Specifically, risk environment research has demonstrated the connection between environmental conditions and needle/syringe sharing (Rhodes et al., 2003; Strathdee et al., 2008). A key component of risk environment research is the role of 'place' in creating the spatial context, whether physical, social, economic, or political, where HIV risk occurs (Tempalski & McQuie, 2009). Research on place demonstrates that local characteristics of place, like geographic residence, social disorder, police tactics, levels of isolation, and policies toward drug users, create risk environments associated with HIV infection and injection risk behaviour (Bluthenthal, Kral, Erringer, & Edlin, 1999; Bourgois, Lettiere, & Quesada, 1997; Cooper, Moore, Gruskin, & Krieger, 2005; Latkin & Knowlton, 2005; Maas et al., 2007; Tempalski, 2007). Research also highlights how local social networks are instrumental in navigating the structural constraints that drive HIV risk behaviour and increase harm among PWID (Duff, 2009).

The linkage between social networks and health warrants particular attention when attempting to understand fishermen's risk environments. Social connections can constrain or enable actors by blocking or encouraging possibilities for action, by constructing identities and goals, by providing social support, and by establishing and enforcing collective norms (Emirbayer & Goodwin, 1994; Szreter & Woolcock, 2004). Social networks can also contribute to HIV-related risk behaviours and health outcomes among drug users (Curtis et al., 1995; Friedman et al., 1998, 1997; Friedman, Curtis, Neaigus, Jose, & Des Jarlais, 1999; Koram et al., 2011; Neaigus et al., 1996; Suh, Mandell, Latkin, & Kim, 1997; Weeks, Clair, Borgatti, Radda, & Schensul, 2002). According to a recent review, network size, density position and turnover; network member characteristics, role and the quality of relationships; and injecting norms, patterns of drug use, and severity of drug addiction can all contribute to drug-related HIV risk behaviour (De, Cox, Boivin, Platt, & Jolly, 2007).

Assessing the local environment becomes particularly important to understanding how environments can both contribute to HIV risk behaviour and to the development of community resilience through social networks, which generate social capital, informal support, solidarity and belonging (Duff, 2009; Friedman et al., 2007; Rhodes, 2009). These studies highlight how 'place' can be a mediator of health outcomes as it encompasses the intersection of personal networks and environmental characteristics (Duff, 2009). In the Malaysian fishing context, we posit that boats act as key places where networks intersect and where HIV risk behaviour occurs.

Methods

The data for this analysis were pulled from Project WAVES, which is a collaboration between the Centre of Excellence for Research in AIDS (CERiA) at the University of Malaya and the Social Intervention Group at Columbia University. The study was conducted in Pahang state around the Kuantan jetty, one of the busiest fishing jetties in the country and the centre of the commercial fishing industry on the east coast of peninsular Malaysia. Fishermen were eligible if they were 18 years or older and reported fishing as their primary occupation during the past year. This analysis pulled from both qualitative and quantitative data. The qualitative data were used to provide context for the interpretation of key constructs and to inform quantitative findings. The use of mixed methods allowed for the triangulation of data from multiple sources and methods, thus counterbalancing possible deficiencies of a single approach.

Data collection

From December 2009 to February 2010, semi-structured in-depth interviews were conducted with 28 fishermen reporting recent drug use. They were recruited at two fishing ports and from a neighbouring fishing village. To be eligible, fishermen had to report doing drugs either on their last trip to sea or upon returning to shore. Participants were recruited with the assistance of two male facilitators who worked locally as needle/syringe exchange outreach workers. Interviewees were paid 50 Malaysian Ringgit (RM) for participation in the study (50RM = $15). Interviews were conducted in Bahasa Melayu, by trained local interviewers, were transcribed in Bahasa Melayu, and then translated into English.

Fishermen are a highly mobile population and drug users are often 'hidden' because of criminalization and stigma, making sampling a challenge. Respondent-driven sampling (RDS), a coupon-based chain-referral method, has shown promise in overcoming some of these obstacles (Heckathorn, 1997, 2002; Salganik & Heckathorn, 2004) and is an economical and time-efficient recruitment method, which has been successful for recruiting PWID (Abdul-Quader et al., 2006; McKnight et al., 2006; Robinson et al., 2006). Other forms of chain-referral sampling are criticized for over-reliance on the characteristics of the initial sample and bias towards more cooperative subjects; however, RDS uses a statistical technique that mathematically corrects for these tendencies

(Heckathorn, 2002), using social network data to estimate the prevalence of specific traits in the target population (Salganik, 2006).

In RDS, a small number of initial participants, or 'seeds' who represent the characteristics of the population of interest and are socially well connected, are recruited from the target population. Upon completing the survey each seed is provided a fixed number of coupons (usually 3–5) to distribute to social network members who meet inclusion criteria. Coupons are required for screening into the study. Each subsequent participant is then provided the same number of coupons. Data are collected on the social networks of each participant and anonymous identification numbers are created to link recruitment chains throughout the study. New recruits become more independent of index participants with each successive wave of recruitment, and bias is thus progressively weakened, eventually reaching equilibrium (Heckathorn, 1997, 2002).

In this study, eight seeds were selected with the assistance of local facilitators who worked closely with PWID. Seeds were selected based on their motivation to participate and their social ties within the fishing community. Three initial seeds were drug-using fishermen (determined by self-report) and three were non-drug users; two drug-using seeds were added due to lack of recruitment by two initial seeds. Each seed was given three recruitment coupons and paid RM50 per successful recruitment. Recruited participants who completed the survey received RM50 in reimbursement for their time. After the survey, each participant was given three coupons to recruit other fishermen. For each successful recruit, the recruiting participant received RM25 as a secondary incentive.

Surveys were conducted with fishermen between July and December of 2011. Participants provided informed consent and interviews lasted about two hours. They were conducted using audio computer-assisted self-interview with Questionnaire Development System (QDS) software (Nova Research Company, Maryland, USA). The IRBs of Columbia University and University of Malaya approved this research.

Measures

Unsafe injection practices in the past month and access to clean needles/syringes were the primary outcomes of interest. Multivariate analyses were conducted for PWID only (yes/no). Ever-PWID was constructed from a series of questions covering 10 distinct substances, which asked each respondent whether they had ever injected the drug. The respondent was coded as '1' if they reported injecting ANY drug and '0' if they had never injected any of the substances.

Unsafe injection practices in the past month was a dichotomous measure based on the Risk Behaviour Assessment, which asks a series of eight questions on injection-related risk, covering receptive and non-receptive needle/syringe sharing, frontloading and backloading, sharing equipment, sharing drugs from a common container, or adding blood to the drug solution before injecting (Dowling-Guyer et al., 1994). The respondent was coded as '1' if they had engaged in any of these behaviours one or more times in the past month, indicating unsafe injection practices, and '0' if they reported zero times for all behaviours. Access to clean needles/syringes was a dichotomous measure assessing whether or not the respondent reported being able to access clean needles/syringes when they needed them.

Our predictors included measures of social networks and occupational characteristics of fishing. Measures of social network structure and composition included self-reported network size of fishermen, which is based on the core RDS question that asks, "How many people do you know personally (you know their name, you know who they are and they know you, and you have seen them in the last 6 months) who are fishermen (work at least 6 months of the year as fishermen)?" The proportion of the personal network of fishermen who were PWID, was based on a follow-up question, which asked, "To the best of your knowledge how many of these fishermen you know inject drugs?" Number of close friends was assessed separately by asking respondents how many close friends they had who also worked as fishermen. Measures of occupational characteristics included: whether the respondent worked on a deep-sea vessel; amount of money earned on last fishing trip; number of boats worked on in the past 3 months; and number of nights spent out to sea in the past 3 months, which earlier analyses demonstrated was associated with HIV serostatus among fishermen in the sample.

We also included measures of risk environment characteristics that encompassed the intersection between networks, place, and drug use. These included a series of dichotomous measures assessing (yes or no) if: the respondent had ever used drugs on the boat during a fishing trip; the boat crewmembers knew about their drug use; the boat captain knew about their drug use; the respondent had used drugs with crewmembers while on the boat; the respondent had used drugs with the captain while on the boat; the captain had loaned money to the respondent to buy drugs; and if the captain had ever provided drugs to help with work.

Data analysis

The qualitative and quantitative data informed one another and served as concurrent checks on findings, thus establishing a high degree of triangulation (Sanjek, 1990; Wolcott, 2001). The qualitative data allowed us to illuminate what 'place' meant in the context of the Malaysian fishing industry, to contextualize the quantitative results, and to assess the extent to which data converged. Analysis of in-depth interviews relied largely on content analysis. Data were coded thematically and analyzed by the first author to inform key research questions around the linkages between place, networks and HIV risk. We utilized a focused coding approach to generate themes and organize the data. Data analysis was theoretically driven and informed by theories of the social determinants of health and risk environments.

Univariate analyses, except for continuous variables, were conducted using RDSAT version 7.1.38 (Volz et al., 2012), which produced estimated population proportions and confidence intervals that adjust data for personal network size and homophily in recruitment. We present results for the total sample and also compare ever-PWID to non-injectors (Table 1). Significant differences in demographic, network and occupational characteristics by injection drug use status were determined by bivariate logistic regression. All predictors were then assessed for multicollinearity before being entered into multivariate logistic models. While RDSAT generates individual sampling weights based on self-reported network data for use in multivariate analyses, they were not used in our models because regression is fairly immune to weights (Winship & Radbill, 1994) and to avoid issues of circularity as network measures served as key predictors in our models.

Model selection was informed by Akaike information criteria (AIC), which combines estimation and model selection (Akaike, 1974). We compared AIC values to a minimum AIC or 'best' model using the formula: $\Delta_i = AIC_i - AIC_{min}$; models having $\Delta_i \leq 2$ demonstrate substantial support while models with $4 \leq \Delta_i \leq 7$ have less support (Burnham & Anderson, 2004). AIC was utilized because it allowed us to compare multiple models in an exploratory way and helped us identify and avoid overfitted models, while not as heavily penalizing extra variables, like Bayes Information Criterion does (Kuha, 2004). All predictor variables were included in multivariate analysis and AIC was computed for all possible subsets of these independent variables. We evaluated all models with $\Delta_i \leq 4$

Table 1
Estimated demographic, occupational and network characteristics for ever injection drug users (ever-PWID) vs. non-injectors and total sample.

	Total sample (n = 398)		Non-injector (n = 249)		Ever PWID (n = 149)		Sig.
	Mean (SD)	Median (range)	Mean (SD)	Median (range)	Mean (SD)	Median (range)	*p*-Value
Demographics							
Age	37.76 (12.33)	35.00 (19–78)	37.78 (14.33)	34.00 (19–78)	37.73 (7.98)	37.00 (21–60)	0.976
Current marital status	% (n)	95% CI	% (n)	95% CI	% (n)	95% CI	0.001
Single/separated/divorced/widowed	70.00 (253)	63.60–76.00	65.40 (142)	57.10–74.00	78.20 (111)	70.20–85.30	
Married	30.00 (145)	24.00–36.40	34.60 (107)	26.60–42.90	21.80 (38)	14.70–29.80	
Education level	% (n)	95% CI	% (n)	95% CI	% (n)	95% CI	0.323
Some secondary or less	72.00 (274)	66.10–77.10	69.20 (167)	61.30–75.80	75.10 (107)	64.60–82.60	
Completed secondary or more	28.00 (124)	22.90–33.90	30.80 (82)	24.20–38.80	24.90 (42)	17.40–35.50	
Occupational characteristics							
Number of nights spent out to sea in past 3 months	7.05 (12.59)	3.00 (0–90)	4.48 (10.32)	2.00 (0–67)	11.29 (14.73)	7.00 (0–90)	0.000
Amount of money made on last fishing trip	337.48 (366.48)	200.00 (2–3000)	256.87 (371.61)	120.00 (2–3000)	470.55 (316.75)	500.00 (20–1500)	0.000
Number of boats worked on in last year	0.86 (1.26)	1.00 (0–12)	0.69 (1.02)	0.00 (0–9)	1.15 (1.55)	1.00 (0–12)	0.001
Type of fishing vessel	% (n)	95% CI	% (n)	95% CI	% (n)	95% CI	0.000
Inshore vessel	68.50 (282)	60.10–75.90	85.80 (213)	78.40–91.90	47.90 (69)	35.70–59.10	
Deep sea vessel	31.50 (108)	24.10–39.90	14.20 (31)	8.10–21.60	52.10 (77)	40.90–64.30	
Network characteristics							
Size of fishermen network	30.63 (56.87)	9.00 (0–400)	34.71 (61.87)	10.00 (0–400)	23.81 (46.74)	8.00 (1–300)	0.071
Number of close friends who are fishermen	2.64 (4.29)	2.00 (0–40)	2.83 (4.03)	2.00 (0–25)	2.33 (4.67)	1.00 (0–40)	0.270
Proportion of network who inject drugs	0.35 (0.39)	0.20 (0–1)	0.19 (0.29)	0.00 (0–1)	0.59 (0.33)	0.55 (0–1)	0.000

to assess independent variable patterns; the best model for each outcome was selected by assessing AIC value and parameter estimates. The final model for access to syringes had the best (lowest) AIC. For unsafe injection practices, the final model was selected because it was within $\Delta_i \leq 2$ in AIC, which still demonstrates substantial support, but also had stronger parameter estimates. Both models controlled for age, marital status ('single, divorced, widowed, separated' or 'currently married'), and education level ('less than secondary complete' or 'secondary or more complete'). All data were analyzed using SAS software version 9.2 (SAS Institute Inc.).

Results

A total of 406 fishermen (including 8 seeds) were recruited, with the longest chain in the sample having over 15 recruitment waves, well in advance of the 5 waves needed to achieve equilibrium. The sample was composed of 8 isolated recruitment chains, including two large chains that made up almost 64% of the data.

Sample characteristics, including information on occupation and networks, are shown in Table 1.

About 37% of survey respondents reported that they had ever injected drugs. PWID were significantly more likely than non-injectors to be unmarried, but were similar in age and education level. Occupational characteristics varied by injection drug use status: PWID spent more nights out to sea in the past 3 months (mean = 11.29, SD = 14.73) relative to non-injectors (mean = 4.48, SD = 10.32); made more money on their last fishing trip, around RM471 (SD = 316.75) compared to an average of about RM257 (SD = 371.61) for non-injectors; and, on average, worked on a greater number of boats in the last year, 1.15 (SD = 1.55) compared to 0.69 (SD = 1.02). PWID were also significantly more likely to work on a deep-sea, rather than an inshore, vessel: about one-half (52%) of PWID worked on deep-sea vessels compared to about 14% of non-injectors. Both PWID and non-injectors had an average of 2 close friends (SD = 4.03, SD = 4.67, respectively). PWID had an average network size of 23.81 (SD = 46.74) people, while non-injectors had a network size of 34.71. The proportion of a respondent's personal network who injected drugs was significantly greater for PWID: 0.59 for PWID compared to 0.19 for non-injectors. While not part of this analysis, almost 25% of PWID tested positive for HIV.

Place, networks, and risk

The qualitative data revealed a connection between place, networks and drug use. In our 28 in-depth interviews with drug-using fishermen, most of the men interviewed reported that they injected drugs. PWID reported injecting 3 to 5 times per day, if money allowed, and some reported sharing needles/syringes with crewmembers and friends. Heroin was the most frequently used drug and was preferred, but buprenorphine, *pil kuda* (an amphetamine), methamphetamine, methadone, benzodiazepines, cannabis, glue, and ecstasy, were also used. Many men reported that they brought a drug supply with them when they went out to sea, but they also reported they could usually only afford to bring enough drugs for a day or two. Before going to sea, fishermen often asked their captain for a loan so they could purchase drugs and then this money was deducted from their salary at the end of the trip. Some fishermen used methadone to help them through the rest of the trip when drug supplies ran out. Other men said that they only used drugs right before they left and then immediately when they returned to shore.

Drug use, though highly stigmatized in Malaysian society, was not hidden from crewmembers. In our interviews, almost all reported that other crewmembers, both drug users and non-drug users, were aware of their drug habits and either 'don't mind' or

'say nothing'. According to a 40-year-old fisherman, his crewmembers 'know [about his drug use]. . .When I use, I don't do it in hiding. I use in front of them'. Other men reported that even though crewmembers were aware of their drug use, they were discreet when injecting or using drugs. One man, aged 22, said that he 'sit[s] on the boat near the engine [so other crewmembers] won't see me'. Another man, age 45, had different concerns. He pointed out that he avoids being seen taking drugs to protect his supply: 'If they saw it, sure they'd ask for it, agree? They'd also want some, so if they see that I take drug and I don't share with them, they'll say what a stingy friend. They'd say all kinds of things'. Boat captains, or skippers, were also aware of drug use on boats and some were users themselves. When talking about sharing drugs on boats and the role of skippers, a 34-year-old fishermen said, 'If the skipper is a drug buddy, then everyone is a drug buddy too'. Skippers knew about drug use because fishermen told them and because fishermen got loans to buy drugs before going out to sea. In at least one case, it was reported that the boat captain was the one who was selling drugs to crewmembers.

The frequent use of drugs on boats, when supported by networks of both crewmembers and boat captains, appears to have created a culture of drug use tied to the occupation of fishing and the boats where work occurs. The overwhelming sentiment of fishermen interviewed was that as long as they did their work, the boat captain ignored drug use. A 41-year-old fisherman noted that, 'the skipper, he doesn't bother. He goes to the sea, he gives money, he. . .he doesn't bother. He says nothing. He only wants us to work'. Another fisherman, 45 years old, said about the skipper: 'He doesn't care much, as long as you can work. Don't be lazy and not finish the work given by him'. Beyond this, fishermen reported that some boat captains actually prefer to hire drug users. According to a 32-year-old fisherman, 'these skippers, sometimes they like it more when the crew members use because it makes us work faster'. Another fisherman, 36 years old, indicated something similar, saying: 'he'll watch us when we work, how I work. Like, like, even if I'm an addict, but I'm ok with my work, there's no problem. . .the skipper likes it'. When asked why, he said: 'Because when an addict works, he beats the normal people. Two normal persons equal an addict, that's the amount of hard work put in'. He goes on to say, 'addicts do their work seriously when it's time to work. But if there're no drugs, they can't work. That's the only problem'. This sentiment may explain why some men reported that captains provided drugs to crew for the purpose of work.

While we did not conduct in-depth interviews with captains, skippers' preference for hiring drug-using crew was corroborated during an informal interview with a retired boat captain and former head of a village fishing association. He indicated that while boat captains say they do not approve of drug use, they actually prefer to hire drug users because they are less afraid and will go out to sea during monsoon season when the sea is dangerous. Overall, crewmembers and boat captains did not seem to care about drug use, providing PWID a place where they could both earn money and use drugs without facing recrimination, which was not an option in most other occupations.

The quantitative analyses echoed the findings of the qualitative data and further suggested that the occupational culture of drug use and the social relationships among fishermen, crewmembers and captains may be driving HIV risk. As shown in Table 2, drug use on boats and with crewmembers was common, creating a unique risk environment. The large majority (83%) of PWID reported that boat crewmembers knew about their drug use and about four-fifths (78%) said the boat captain was aware of drug use. Drug use occurred on the boat during a fishing trip for about 76% of PWID: 69% had used drugs with other crewmembers on the boat and 3.20% had used drugs with the boat captain. Moreover, 14% of respondents reported that the captain of the boat had provided them with drugs to help them work and 55% said that the captain of the boat had ever loaned them money to buy drugs. Almost 44% reported engaging in one or more unsafe injection practices in the past month and the large majority of PWID (94.70%) said they could obtain new, unused needles and syringes when they needed them (see Table 3).

Table 2
Estimated prevalence of risk environment characteristics among ever-PWID.

	% (*n*)	95% CI
Has ever used drugs while on the boat during a fishing trip		
No	23.70 (37)	15.30–32.80
Yes	76.30 (112)	67.20–84.70
Crewmembers on the boat know respondent uses drugs		
No	17.10 (25)	10.10–24.80
Yes	82.90 (124)	75.20–89.90
Captain of boat knows respondent uses drugs		
No	21.60 (33)	14.00–29.90
Yes	78.40 (116)	70.10–86.00
Has ever used drugs with other crewmembers while on the boat		
No	30.90 (47)	21.70–40.60
Yes	69.10 (102)	59.40–78.30
Has ever used drugs with the captain while on the boat		
No	96.80 (142)	94.00–99.40
Yes	3.20 (7)	0.60–6.00
The captain of the boat has ever loaned respondent money to buy drugs		
No	45.00 (64)	34.50–55.10
Yes	55.00 (85)	44.90–65.50
The captain of the boat has ever provided drugs to help with work		
No	85.10 (125)	80.00–92.50
Yes	13.90 (24)	7.50–20.00

Table 3
Estimated prevalence of unsafe injection practices and access to clean needles/syringes among ever PWID.

	% (*n*)	95% CI
Unsafe injection practices		
Any unsafe injecting practice in past month		
No	56.20 (85)	44.80–65.90
Yes	43.80 (64)	34.10–55.20
Unsafe injection practices in past month		
Injected with used needle	14.70 (26)	8.10–21.30
Injected with used syringe	17.10 (29)	9.20–26.50
Syringe backloaded with drugs from someone else's syringe	15.30 (28)	9.00–22.10
Used injection equipment used by someone else	26.90 (35)	17.80–37.80
Fixed drugs and split drug solution with another person	32.60 (47)	24.00–43.80
Pulled drugs from common cooker (frontloading)	23.60 (38)	15.40–34.00
Added blood to drug solution before injecting	9.70 (12)	3.90–15.70
Gave used needle/syringe to someone else	20.20 (30)	12.50–29.60
Access to clean needles		
Can obtain new, unused needles and syringes when needed		
No	5.30 (13)	1.50–10.00
Yes	94.70 (136)	90.00–98.50

Network and risk environment characteristics were significantly associated with unsafe injection practices in the past month (see Table 4). The proportion of PWID in one's personal network was associated with unsafe injection practices (OR = 3.52, CI = 1.05–11.70); however, network size of close friends was not a significant predictor. If the boat captain had knowledge of the respondent's drug use, they were 2.4 times more likely (CI = 0.86–6.64) to have engaged in unsafe injection practices, though this relationship was only marginally significant (p-value = 0.095). Respondents were 2.8 times more likely (CI = 1.02–7.58) to engage in unsafe injection practices

Table 4
Logistic regression results for relationship between occupational, network and risk environment characteristics and unsafe injection practice and access to clean needles/syringes.[a]

	OR	95% CI
Any unsafe injection practice in past 30 days (n = 149)		
Nights out to sea in past 3 months	1.018	0.993–1.045
Number of boats worked in past 3 months	1.198	0.920–1.558
Number of close friends who are fishermen	0.970	0.893–1.055
Network composition: proportion of network who inject drugs	3.510**	1.053–11.700
Boat captain knows about drug use	2.389*	0.859–6.643
Captain has provided drugs to help with work	2.777**	1.018–7.576
Can access clean needles/syringes when needed (n = 149)		
Size of fishermen network	0.987***	0.977–0.996
Network composition: proportion of network who inject drugs	4.743	0.561–40.122
Boat crewmembers know about drug use	7.234**	1.430–36.604
Has used drugs with captain while on boat	0.182	0.021–1.560
Captain has provided drugs to help with work	0.134**	0.025–0.720

[a] Models control for age, marital status, and education level.
* $p < .10$.
** $p < .05$.
*** $p < .01$.

when the captain had provided drugs to help with work. Network and risk environment factors also predicted access to clean needles/syringes. PWID with larger overall networks were slightly less likely to have access to needles/syringes (OR = 0.99, CI = 0.98–0.996), while respondents whose crewmembers knew about their drug use were 7.234 times more likely (CI = 1.43–36.60) to be able to access clean injection equipment. Respondents were significantly less likely to be able to access clean equipment if their boat captain had provided drugs to help them work (OR = 0.13, CI = 0.03–0.72).

Discussion

A connection between seafaring and substance use, especially alcohol and cannabis, has been found throughout the world (Carruthers, Boots, & Midford, 2002; Evans, Tait, Harvey, & Newbury, 2005; Kissling et al., 2005; Seeley et al., 2012; Tumwesigye et al., 2012). Our results suggest that drug use, especially the injection of heroin, is prevalent in this Malaysian fishing community and that boats, as both a physical and social space, played a key role in the drug scene of fishermen.

The relationships among PWID, crewmembers, and captains on boats served as both drivers of HIV risk behaviour and resources for risk reduction. The qualitative and quantitative data indicated that most crewmembers and captains were aware of drug use on boats and some were also involved in drug use. On the one hand, network relationships drove risk: having a larger proportion of PWID in their network was associated with a greater likelihood of unsafe injection practices. This may be the result of social pressure, norms around sharing, or increased drug availability (Curtis et al., 1995; Friedman et al., 2000, 1997; Hawkins, Latkin, Mandel, & Oziemkowska, 1999; Latkin, Mandell, Vlahov, Oziemkowska, & Celentano, 1996). On the other hand, crewmembers' knowledge of the respondent's drug use increased the likelihood of having access to clean needles/syringes, indicating that PWID networks may also be playing a protective role, perhaps by elevating levels of social trust and capital (Kirst, 2009). Additional research is needed to determine how network characteristics operate in this population and the mechanisms through which they may be driving or reducing injection-related risk practices.

Boat captains, in particular, played a primary role in driving HIV risk behaviour and limiting opportunities to reduce harm among fishermen who inject drugs: they loaned crewmembers money to buy drugs and supplied drugs for the purpose of work, which was associated with unsafe injection practices and more limited access to clean needles/syringes. Given the relative power position between captains and crew, PWID may have had limited ability to refuse to share needles/syringes or equipment, or to refuse drugs at all, indicating that social influence may be of great importance to drug-related risk behaviour for these fishermen (French & Raven, 1959; Pettigrew, 1972; Raven, 1965). In these ways, boats and captains may be a crucial point of intervention for future harm reduction efforts.

Collectively, network and occupational characteristics combined to create a social and physical space that constituted a unique risk environment specific to fishing (Latkin et al., 1996; Singer et al., 2000). The qualitative and quantitative data revealed an overwhelming acceptance of drug use within the fishing community and on boats, especially. The passive acceptance by non-drug using crewmembers and the sometimes active encouragement of drug use by captains contributed to an occupational culture of drug use that operated on the principle that if you are able to work, then drug use was not a problem. This may have made fishing an attractive environment for some PWID, providing access to drugs, cash, and the formal wage economy, which was not an option in most other occupations. As a result, PWID, though highly stigmatized in broader society, experienced greater acceptance within the fishing community.

Overall, the findings of this study suggest that injection-related HIV risk behaviour in this Malaysian fishing community is tied to occupational and social network characteristics that combine to form a risk environment that revolves around fishing boats. While the occupation of fishing was a safe harbour for many PWID who would struggle to be employed elsewhere, it also placed many men at greater risk for HIV transmission by shaping social networks, increasing opportunities for unsafe injection and limiting opportunities for risk reduction.

These findings are subject to several limitations. While a random sample is preferable, there was no sampling frame from which to pull, so given the hidden nature of the population, RDS provided a good alternative. However, recent studies highlight that RDS estimation procedures may not produce unbiased estimates and may result in confidence intervals that are too narrow (Goel & Salganik, 2010; McCreesh et al., 2012). RDS also relies on self-report of network size, which can introduce bias, though RDS estimation procedures take into account network size. In these ways, this study is limited in its ability to make generalizations to the larger fishermen population of Malaysia and care must be taken when interpreting estimates; however given that this is the first study of its kind in the region, its findings provide an important contribution to the empirical literature.

Conclusions

Understanding the social and structural factors that drive risk environments is a first step towards creating 'enabling environments' where risk for HIV infection is reduced (Rhodes, 2002). Our results indicate that occupational, network, and risk environment factors intersected to drive HIV risk behaviour. In this study, boats were a key place where risk occurred, so the creation of safe injection spaces, which have been shown to reduce injection-related comorbidities and increase utilization of other health services (Broadhead, Kerr, Grund, & Altice, 2002; Wood et al., 2004; Wood, Tyndall, Zhang, Montaner, & Kerr, 2007), may be crucial to risk reduction if made accessible to fishermen at jetties.

The cultivation of social networks that promote protective norms and practices may also act as a buffer against HIV risk behaviour (Duff, 2009); specifically, PWID's relationships with crewmembers and captains often increased risk, so working with captains, especially, may be a key point of intervention. Further, PWID were socially marginalized and had limited occupational opportunities; however, while fishing provided PWID access to the formal wage economy, it also entailed risks to health. Reducing stigma and integrating PWID more fully into society and the economy could reduce the creation of occupational silos of HIV risk, like that which exists in the fishing industry, and could have important implications for the health of PWID.

Acknowledgements

The Malaysian Ministry of Higher Education High Impact Research Grant on Mitigating the Malaysian HIV Epidemic through a Comprehensive Research Programme (E-000001-20001) and the World Bank provided funding for the study. *Conflict of interest statement*: We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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