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Factors associated with recently acquired hepatitis C virus infection in people who inject drugs in England, Wales and Northern Ireland: new findings from an unlinked anonymous monitoring survey

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SUMMARY

Monitoring infections and risk in people who inject drugs (PWID) is important for informing public health responses. In 2011, a novel hepatitis C antibody (anti-HCV) avidity-testing algorithm to identify samples compatible with recent primary infection was introduced into a national surveillance survey. PWID are recruited annually, through >60 needle-and-syringe programmes and prescribing services. Of the 980 individuals that could have been at risk of HCV infection, there were 20 (2%) samples that were compatible with recent primary infection. These were more common among: those imprisoned $\geqslant$5 times [8/213; adjusted odds ratio (aOR) 8·7, 95% confidence interval (CI) 2·04–37·03]; women (8/230; aOR 3·8, 95% CI 1·41–10·38); and those ever-infected with hepatitis B (5/56; aOR 6·25, 95% CI 2·12–18·43). This study is the first to apply this algorithm and to examine the risk factors associated with recently acquired HCV infection in a national sample of PWID in the UK. These findings highlight underlying risks and suggest targeted interventions are needed.

Key words: Hepatitis C, recent infection, people who inject drugs (PWID).

INTRODUCTION

The incidence of hepatitis C virus (HCV) infection, unlike prevalence, is rarely assessed [1]. In developed countries, the main risk factor for HCV infection is injecting drug use [1–3]. In the UK, about 90% of diagnosed HCV infections have been acquired through unsafe injections using contaminated equipment [4], with about half of the estimated 215 000 individuals chronically infected with HCV remaining undiagnosed [5, 6]. Globally, incidence of HCV in people who inject drugs (PWID) in high-income countries has been reported to range from <10 infections/100 person-years of exposure (100 pyr) (e.g. 7/100 pyr in Amsterdam [7]) to over 50/100 pyr (e.g. 66/100 pyr in Dublin, Ireland [8]).

Understanding incidence rates, and changes in the number of new infections over time, is important for assessing the impact of interventions to prevent and control HCV. Due to the difficulties in directly obtaining estimates, incidence is rarely studied in PWID [1]. Cohort studies are difficult in this population; follow-up is problematic due to the illicit nature of drug use and the marginalization of PWID. An alternative approach for measuring primary infection is the detection of HCV RNA in HCV antibody (anti-HCV) negative participants in cross-sectional studies.

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However, the short 'window period' for this state (<2 months) means very large sample sizes are needed unless incidence is very high, restricting the utility of this approach. A number of studies have directly assessed HCV incidence in PWID in the UK [9–15] using these two approaches. The incidence reported in these studies ranged greatly from 3/100 pyr [10] to 42/100 pyr [11]. These studies were undertaken at different times and in different, usually small, geographical areas making the data difficult to generalize. The overall extent of recent HCV transmission in the UK thus remains unclear.

An alternative approach to measuring the incidence of primary HCV is to use antibody avidity, an approach that has been used with some success for estimating recent HIV infection [16]. Antibody avidity testing provides an indication of the strength of binding of an antibody to its complementary antigen [17–19]. The binding strength of these antibodies increases with time as the host immune response matures, thus those samples with low avidity are typically indicative of recent primary infection [17, 18]. While there remains much uncertainty about the duration of the anti-HCV avidity 'window period', the available evidence suggests that this is probably longer than that during which HCV RNA is detectable before anti-HCV antibodies develop [18]. The longer duration of the window period (of between 2 and 6 months) [17–19] means that this approach may have greater utility for monitoring the extent of recent HCV infection in cross-sectional surveys, than the detection of HCV RNA in those individuals who are anti-HCV negative.

An anti-HCV avidity-testing algorithm has been developed to identify samples having markers compatible with recent primary HCV infection in the samples collected in the UK's annual Unlinked Anonymous Monitoring (UAM) Survey of PWID. In this paper, we report on the application of the avidity-testing algorithm to a national surveillance sample of PWID and the associated factors with having markers compatible with recent primary infection in 2011, the first year this novel testing algorithm was used in the survey.

MATERIALS AND METHODS

PWID across England, Wales and Northern Ireland have been recruited into an annual cross-sectional, unlinked anonymous seroprevalence survey since 1990; the methodological details of which have previously been reported [20, 21]. In brief, people who have ever injected drugs are recruited through specialist drug services [providers of advice, needle-and-syringe programmes (NSPs), opiate substitution therapy (OST) or addiction treatment]. Those who agree to participate self-complete a short questionnaire and, since 2011, have provided a dried blood spot (DBS) sample (prior to then, oral fluid samples had been collected). DBS collection involves obtaining a few drops of blood, drawn by a lancet from the finger, onto absorbent filter paper. Drug service selection is reviewed regularly and reflects the range of services provided for PWID, as well as what is known about geographical variations in injecting drug use. The survey received multi-site approval from the London Research Ethics Committee.

In addition to core demographics (age and gender), the questionnaire collects self-reported data from those who had injected during the previous 12 months on: prior imprisonment and homelessness; their psychoactive drug use [such as types of drug(s) used] in the previous 12 months; uptake of health services (such as OST and vaccination); and sexual behaviours (such as condom use) in the previous 12 months.

The DBS samples were tested for antibodies to HIV (anti-HIV), hepatitis C (anti-HCV), and hepatitis B core antigen (anti-HBc). All laboratory testing was performed at the Virus Reference Department at PHE Colindale. A 6-mm diameter disk was punched from each DBS card, placed in a designated well of a 96-well microplate and eluted overnight by immersion in 200 μl of PBS/Tween buffer. For anti-HIV testing, an in-house version of the GACELISA HIV 1 + 2 enzyme immunoassay was employed as the commercial kit is no longer manufactured [22]. Specimens that were borderline anti-HIV reactive [optical density/cut-off (OD/CO 0·8–3·0)] on initial testing were re-tested in duplicate using the GACELISA, the mean of the duplicates taken as the final result. All reactive (OD/CO $\geqslant$1) samples were examined by a modified Western blot procedure (HIV Blot 2·2, MP Biomedicals, Singapore) to confirm the presence of anti-HIV antibodies. Testing for anti-HBc was performed using a modified protocol for the Bio-Rad Monolisa Anti-HBc PLUS ELISA kit (product code 72316, Bio-Rad, France). Anti-HCV testing was performed using a modified protocol for the Ortho HCV 3·0 SAVe ELISA (product number 940982, Ortho Diagnostics, UK) [23]. The method employs a cut-off OD of 0·090, and any DBS sample giving an

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OD value between 0·080 and 2·500 is re-eluted from a new punch and re-tested in duplicate using the same assay, the mean of the duplicates taken as the final result. All reactive (OD $\geqslant$0·090) samples are considered to be anti-HCV positive.

In 2011, a novel-testing algorithm to assess anti-HCV avidity, in order to identify samples having markers compatible with recent primary infection, was introduced. This employed a further modification of the anti-HCV DBS assay above, to include an incubation step with urea, which causes low-avidity (weakly bound) antibodies to dissociate from the HCV antigens attached to the surface of the microplate. The method is similar to that described by Shepherd *et al.* [18] (who reported an observed sensitivity of 100% and a specificity of 98·3%). In brief, a 20 µl aliquot of each anti-HCV positive DBS eluate was added to 100 µl of specimen diluent in each of two microplate wells. Anti-HCV positive and negative controls, as well as low- and high-avidity controls were included in each test run. The DBS anti-HCV assay protocol described in Judd *et al.* [23] was followed, except that, following the initial overnight incubation step with the eluate an additional stage was incorporated. Each well was washed once with the kit wash buffer, following which, one of each duplicate had 300 µl of 7 M urea added to it and to the other 300 µl of kit wash buffer. Following 15 min static incubation at room temperature (22 ± 5 °C) all the wells were washed five times with kit wash buffer and the assay was completed according to the previously described DBS protocol [23]. Analysis of results began with an assessment of the control values to determine that they had met previously determined acceptable ranges and then, the avidity index (AI) of each specimen was determined. The AI is expressed by the equation:

$$(\text{OD urea treated}/\text{OD untreated}) \times 100\%.$$

A low AI is considered to be $\leqslant$40%. Low-avidity antibody is also frequently found in individuals who have cleared HCV RNA. Klimashevskaya *et al.* concluded that, for this reason, AI cannot be used alone to identify a recent HCV infection [19] and this was also our experience. Therefore, specimens with low AI are subsequently tested for HCV RNA employing a PCR targeting the NS5B region of the genome [24]. Only those individuals with DBS containing both low-avidity anti-HCV antibody and HCV RNA are considered to have recently acquired their HCV infection (i.e. to have markers compatible with recent primary infection).

Anti-HIV-negative individuals who took part during 2011 and who reported injecting during the preceding year were included in the analyses. Anti-HIV positives were excluded as the effects of HIV on the immune system may impact on the anti-HCV avidity [25]. For analysis, participants were first divided into two groups: first, those with 'previous HCV infections', i.e. those participants anti-HCV positive who were *not* classed as having markers compatible with recent primary infection [due to high AI or the absence of HCV RNA (median AI 89, interquartile range (IQR) 56–97)]; and second, those who had been 'at risk of infection', i.e. those anti-HCV negative and those anti-HCV positive who were classed as having markers compatible with recent primary infection [due to low AI in the presence of HCV RNA (median AI 32, IQR 14–38)].

The second group, 'those at risk of infection', was then further divided into two subgroups: (*a*) those anti-HCV negative; and (*b*) those having markers compatible with recent primary infection. Associations with the following variables were examined using bivariate analyses (Pearson χ^2): demographic characteristics, having anti-HBc, prior imprisonment and homelessness, intervention uptake, drug use and sexual behaviours. Number of years since first injected – derived from age at last injection minus age at first injection – was not included in the analyses as it was correlated with age (Pearson correlation coefficient $r = 0{\cdot}56$, $P < 0{\cdot}001$) and could not always be derived due to parameters needed to calculate it occasionally not being reported. Those showing univariate associations were then entered using the forward stepwise method into a logistic regression model with inclusion assessed using the likelihood ratio (with stepwise probability for inclusion of 0·05 and exclusion of 0·1). All analyses were conducted in SPSS v. 19 (IBM Corp., USA).

Differences between the recent HCV infections and long-standing HCV infections were then explored by examining bivariate associations with demographic characteristics, having anti-HBc, prior imprisonment and homelessness, health service uptake, drug use and sexual behaviours.

The survey questionnaire only enquired about injecting risk behaviours – specifically the reported sharing of injecting equipment – among those who reported injecting during the 28 days preceding their participation in the survey. Therefore, the sharing of injecting equipment could only be examined in the

subgroup that reported injecting in the 28 days preceding participation in the survey. This was done by comparing the sharing levels in three groups: those anti-HCV negative; those having markers compatible with recent primary infection and those classed as previously infected. It should be noted that this data relates to a time after the recent infections identified here would have been acquired and so may not reflect risk levels at time of infection.

Estimating HCV incidence

To allow comparison of the extent of possible recent infection found here with the results of previous studies, primary incidence was simply estimated using the following formula:

$$I = ((n_r/T) * 365)/(n_r + n_n) * 100,$$

where I = incidence, n_r = number of participants with recent primary HCV infection, n_n = number of anti-HCV negative participants, and T = estimated window period for anti-HCV avidity.

The length of the window period for anti-HCV avidity is poorly understood; however, it was estimated to be between 60 and 180 days, based on the limited data available [17–19]. Conventional 95% confidence intervals (CI) around the estimates are not given, as these would be smaller than the difference generated by the uncertainty in the window period range.

RESULTS

There were 1718 participants during 2011 who reported injecting during the preceding year and who were anti-HIV negative [35 (1·2%) anti-HIV positives were excluded]. Of these, 23% (388) were women, and 27% (471) were aged <30 years (mean age 35 years, median 34 years; Table 1). The majority of participants reported currently receiving prescribed medication for their drug use (such as OST or a detox regimen; 1244, 72%), had ever been in prison (1211, 70%), had reported receiving at least one dose of HBV vaccine (1316, 77%) and had sex in the preceding 12 months (1257, 73%) (Table 1). Almost all (1589, 92%) had injected opiates in the preceding 12 months, with just over half (924, 54%) reporting they had injected a stimulant in the preceding 12 months (Table 1).

Overall, 15% had ever been infected with HBV (anti-HBc positive, $n = 257$) and 44% of participants had been infected with HCV (738 previously infected and 20 who had markers compatible with recent primary infection).

Those previously infected with HCV ($n = 738$), compared to those not previously infected ($n = 980$, including the 20 who had markers compatible with recent primary infection and the 960 anti-HCV negative) were: older, more likely to report receiving at least one dose of HBV vaccine, more likely to have ever been imprisoned, more likely to have used a NSP during the preceding year, more likely to be currently receiving prescribed medication for their drug use, more likely to have injected opiates during the preceding year, more likely to have injected stimulants during the preceding year, more likely to have injected during the preceding month, and were more likely to have had sex during the preceding year (Table 1). They also had a higher prevalence of anti-HBc (Table 1).

The 20 (2%) with markers compatible with recent primary infection among the 980 who had been at risk of infection suggests a HCV incidence of between four and 12 infections/100 pyr of exposure (based on 161 pyr and 483 pyr of exposure, derived from the lower and upper limits of the window period). In bivariate analyses, the factors associated with having markers compatible with recent primary HCV infections in those who had been at risk, ($P < 0·1$) were age, gender, imprisonment and having anti-HBc (Table 2). In multivariable analysis, those with markers compatible with recent primary HCV infection were more common in: those with anti-HBc [8·9%, 5/56, adjusted odds ratio (aOR) 6·25, 95% CI 2·12–18·43] compared to those with no HBV exposure (1·6%, 15/924); women (3·5%, 8/230, aOR 3·8, 95% CI 1·41–10·38) compared to men (1·6%, 12/750); those who had been imprisoned on $\geqslant 5$ occasions (3·8%, 8/213, aOR 8·7, 95% CI 2·04–37·03) compared to those who had never been imprisoned (0·83%, 3/362; and those imprisoned $\leqslant 4$ times, 2·2%, 9/405). No associations were found with homelessness, sexual behaviour, injection site infection, drug treatment uptake, NSP use, HBV vaccination, or HCV testing.

In bivariate analysis, those with markers compatible with recent primary infection were more likely to be female (40%, 8/20 *vs.* 21·4%, 158/738; $P = 0·047$) compared to those previously infected. They were also younger than those previously infected [median age 36 years (IQR 29–42, mean 35·5 years) *vs.* median age 37 years (IQR 32–43, mean 36·9 years)], although this difference was not significant (Mann–Whitney

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Table 1. *Descriptive analysis of demographics, injecting and sexual risk behaviours and infections associated with anti-HCV status in PWID*

				At risk of HCV infection*		Previously infected with HCV†	
Risk factors		*N*	(%)	*N*	(%)	*N*	(%)
		1718		980		738	
Gender	Male	1330	(77·4)	750	(76·5)	580	(78·6)
	Female	388	(22·6)	230	(23·5)	158	(21·4)
	Pearson χ^2			$P = 0{\cdot}312$			
Age, years	<30	471	(27·4)	340	(34·7)	131	(17·8)
	30–39	776	(45·2)	459	(46·8)	317	(43·0)
	⩾40	471	(27·4)	181	(18·5)	290	(39·3)
	Mean/median	34·75/34		32·81/32		36·98/37	
	Pearson χ^2			***P* < 0·001**			
Anti-HBc	Detected	257	(44·0)	56	(5·7)	201	(27·2)
	Not detected	1461	(56·0)	924	(94·3)	537	(72·8)
	Pearson χ^2			***P* < 0·001**			
Had at least one hepatitis B vaccination	Yes	1316	(77·0)	729	(74·4)	587	(79·5)
	No	402	(23·0)	251	(25·6)	151	(20·5)
	Pearson χ^2			***P* = 0·013**			
Had blood test for hepatitis C	Yes	1326	(77·0)	718	(73·3)	608	(82·4)
	No	392	(23·0)	262	(26·7)	130	(17·6)
	Pearson χ^2			***P* < 0·001**			
Had ever been to prison	No	507	(29·5)	362	(36·9)	145	(19·6)
	Yes, 1–4 times	697	(40·6)	405	(41·3)	292	(39·6)
	Yes, ⩾5 times	514	(29·9)	213	(21·7)	301	(40·8)
	Pearson χ^2			***P* < 0·001**			
Had been homeless in last 12 months	Yes	566	(32·9)	310	(31·6)	256	(34·7)
	No	1152	(67·1)	670	(68·4)	482	(65·3)
	Pearson χ^2			$P = 0{\cdot}182$			
Used a needle exchange in last 12 months	Yes	1495	(87·0)	835	(85·2)	660	(89·4)
	No	223	(13·0)	145	(14·8)	78	(10·6)
	Pearson χ^2			***P* = 0·010**			
Ever been prescribed a detox or maintenance programme	Never prescribed	234	(13·6)	158	(16·1)	76	(10·3)
	Previously prescribed	240	(14·0)	139	(14·2)	101	(13·7)
	Currently prescribed, 0–5 months	318	(18·5)	204	(20·8)	114	(15·4)
	Currently prescribed, ⩾6 months	926	(53·9)	479	(48·9)	447	(60·6)
	Pearson χ^2			***P* < 0·001**			
Had an injection site infection in last 12 months	Yes	430	(25·0)	241	(24·6)	189	(25·6)
	No	1288	(75·0)	739	(75·4)	549	(74·4)
	Pearson χ^2			$P = 0{\cdot}630$			
Had sex in last 12 months	Yes	1257	(73·2)	765	(78·1)	492	(66·7)
	No	461	(26·8)	215	(21·9)	246	(33·3)
	Pearson χ^2			***P* < 0·001**			
Used condom in last 12 months‡	Always used	175	(15·2)	116	(11·8)	59	(8·0)
	Sometimes used	362	(31·5)	218	(22·2)	144	(19·5)
	Never used	613	(53·3)	362	(36·9)	251	(34·0)
	Pearson χ^2			$P = 0{\cdot}223$			
Injected opiates in last 12 months	Yes	1589	(92·5)	895	(91·3)	694	(94·0)
	No	129	(7·5)	85	(8·7)	44	(6·0)
	Pearson χ^2			***P* = 0·035**			

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Table 1 (*cont.*)

Risk factors		*N*	(%)	At risk of HCV infection* *N*	(%)	Previously infected with HCV† *N*	(%)
Injected stimulants in last 12 months	Yes	924	(53·8)	473	(48·3)	451	(61·1)
	No	794	(46·2)	507	(51·7)	287	(38·9)
	Pearson χ^2			***P* < 0·001**			
Injected drug other than opiates or stimulants in last 12 months	Have injected other drugs	245	(14·3)	145	(14·8)	100	(13·6)
	Haven't injected other drugs	1473	(85·7)	835	(85·2)	638	(86·4)
	Pearson χ^2			*P* = 0·465			
Sharing of injection equipment§	Injected in last 4 weeks and reported sharing any injecting equipment	514	(29·9)	283	(28·9)	231	(31·3)
	Injected in last 4 weeks and did not report sharing any injecting equipment	782	(45·5)	429	(43·8)	353	(47·8)
	Pearson χ^2			***P* = 0·019**			

* Anti-HCV negative and those recently infected (anti-HCV avidity <40% with HCV RNA).
† Anti-HCV positive, excluding recent infections.
‡ Among those who had sex in the previous 12 months (missing for 568 cases).
§ Missing for 32 cases.

U test, *P* = 0·566). There were no differences in the patterns of drug use, sexual behaviours, levels of imprisonment and homelessness, or the uptake of health service use between these two groups.

The reported levels of injecting equipment sharing in the subgroup that reported injecting during the 28 days preceding participation (*n* = 1254, 75% of the participations) varied by infection status. Reported sharing was more common in those with markers compatible with recent primary infection (71%, 10/17), than in those previously infected (40%, 231/584) and those anti-HCV negative (39%, 273/695) (*P* = 0·263).

DISCUSSION

This study provides one of the first reports of risk factors associated with recently acquired primary HCV infection in PWID in England, Wales and Northern Ireland. Markers compatible with recent HCV infection were more common in women, those ever-infected with HBc, or those who had been imprisoned on ⩾5 occasions.

It is important to consider the limitations and generalizability of these findings. The marginalization and illicit nature of injecting drug use make the recruitment of a representative sample of injectors problematic. To minimize potential sampling bias and maximize representativeness, this long-established survey uses the extensive provision of services for PWID in the UK as a sampling frame. Uptake and use of such services in the UK are high; with community-recruited studies finding very few PWID who are not in contact with services [23]. Even so, individuals who have recently started to inject drugs may be under-represented as they will have had limited time to start making use of services and, as these individuals may be at greatest risk [26, 27], this could result in an underestimation of recent HCV infection. Furthermore, behavioural data is based on self-report, the accuracy of which may be subject to recall bias. However, the reliability of self-report risk behaviours in PWID has been shown in other studies [28, 29]. A final consideration relates to the identification of those with possible recent infections. Although a conservative approach was used here, there is relatively limited evidence on the length of the avidity window period. Furthermore, it is known that a minority of individuals clear HCV infection rapidly [30], therefore the inclusion in our algorithm of the need for HCV RNA positivity may lead to such cases being excluded, thus leading to a small underestimation of the number of recent primary infections. Therefore, the incidence estimate in particular should be viewed with caution.

It has been well established that gender [31], prior infection with HBV [32, 33], and incarceration

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Table 2. *Logistic regression analysis for risk factors associated with recent HCV infection in PWID*

Risk factors		*N*	Recent infection No. HCV+	Recent infection % HCV	Unadjusted odds ratios OR	Unadjusted odds ratios 95% CI	Unadjusted odds ratios *P* value*	Adjusted odds ratios OR	Adjusted odds ratios 95% CI
Gender	Male	750	12	1·6%	1·00		0·086	1·00	
	Female	230	8	3·5%	2·22	0·90–5·49		3·83	1·41–10·38
Age, years	<30	340	5	1·5%				‡	
	30–39	459	8	1·7%					
	⩾40	181	7	3·9%					
	Per year increase in age				1·05	1·0–1·11	0·069		
Anti-HBc	Detected	56	5	8·9%	5·94	2·08–16·99	0·001	6·25	2·12–18·44
	Not detected	924	15	1·6%	1·00			1·00	
Had ever been to prison	No	362	3	0·8%	1·00		0·076	1·00	
	Yes, 1–4 times	405	9	2·2%	2·72	0·73–10·12		3·60	0·95–14·13
	Yes, ⩾5 times	213	8	3·8%	4·67	1·23–17·80		8·70	2·04–37·03
Had at least one hepatitis B vaccination	Yes	729	16	2·2%	1·39	0·46–4·18	0·563	§	
	No	251	4	1·6%	1·00				
Had blood test for hepatitis C	Yes	718	16	2·2%	1·47	0·49–4·44	0·494		
	No	262	4	1·5%	1·00				
Had been homeless in last 12 months	Yes	310	8	2·6%	1·45	0·59–3·59	0·419		
	No	670	12	1·8%	1·00				
Used a needle exchange in last 12 months	Yes	835	19	2·3%	1·00		0·240		
	No	145	1	0·7%	0·30	0·04–2·25			
Ever prescribed a detox or maintenance programme	Never prescribed	158	3	1·9%	1·00		0·503		
	Previously prescribed	139	2	1·4%	0·75	0·12–4·58			
	Currently prescribed, 0–5 months	204	2	1·0%	0·51	0·08–3·10			
	Currently prescribed, ⩾6 months	479	13	2·7%	1·44	0·41–5·13			
Had an injection site infection in last 12 months†	Yes	241	7	2·9%	1·67	0·66–4·24	0·280		
	No	739	13	1·8%	1·00				
Had sex in last 12 months	Yes	765	14	1·8%	0·62	0·24–1·63	0·623		
	No	205	6	2·9%	1·00				
Injected opiates in last 12 months	Yes	895	19	2·1%	1·82	0·24–13·78	0·561		
	No	85	1	1·2%	1·00				
Injected stimulants in last 12 months	Yes	473	10	2·1%	1·07	0·44–2·60	0·875		
	No	507	10	2·0%	1·00				
Injected drug other than opiates or stimulants in last 12 months	Have injected other drugs	145	5	3·4%	1·00		0·202		
	Haven't injected other drugs	835	15	1·8%	0·51	0·18–1·43			

HCV, Hepatitis C virus; PWID, people who inject drugs; OR, Odds ratio; CI, confidence interval.
* Pearson χ^2 test
† Symptoms of an injection site infection included reports of abscess, sore, or open wound at an injection site.
‡ Entered into stepwise regression model but not significant in final model
§ Not entered into final model

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multiple times [34–37] are associated with HCV prevalence in PWID in developed countries. Studies in Australia and Canada have also found that female PWID had increased odds of primary HCV infection [26, 38]. Associations with imprisonment and anti-HBc positivity have not previously been reported in studies looking at HCV transmission in PWID.

The indication of a higher level of HCV transmission in women found in this, and previous studies, may reflect a heightened risk of infection in female drug injectors through sexual and injecting risks from their intimate partners [3], especially as female injectors are also more likely to have a sexual partner who also injects drugs [31]. The association found with ever having a HBV infection probably reflects similar overall patterns of risk for these two infections in PWID. The elevated incidence in those more frequently imprisoned might reflect a number of factors: multiple imprisonment could be a marker for a higher risk subgroup; high-risk behaviours in prison; or, as is the case for overdoses, elevated level of risk in the period immediately after release from prison [34, 39]. This association needs further investigation, particularly as this study did not ask how long ago they had last been imprisoned – so it is not possible to explore if this risk relates to recent imprisonment, i.e. infection in prison or on release.

Of those sampled, 2% were found to have markers compatible with recent primary infection during 2011, with a crudely estimated incidence of 4–12 infections/100 pyr. This incidence estimate needs to be viewed very cautiously considering the limited understanding of the length of the low-avidity window associated with recent HCV acquisition. However, it is similar to that reported in the majority of other published studies from the UK [9–15], with most studies reporting estimated incidences of between 2·6 [10] and 14·3 [9] infections/100 pyr of exposure in PWID. However, three studies from the UK have described higher incidence, reporting 28 (in 1993–1998) [15], 40 (in 2006) [12] and 42 (in 2001) [11] infections/100 pyr of exposure. Several factors are probably responsible for the variation in rates between studies, as incidence is likely to differ over time, between areas, by setting, and with recruitment methods used. The previous studies that reported higher incidences than that found here were: focused in high-prevalence areas such as London and Glasgow [11, 15], may have potentially over-recruited higher risk individuals [12], reported very high rates of injecting paraphernalia sharing and/or were undertaken some time ago [11, 15], so they are probably not representative of the current overall level of HCV incidence in the UK.

The results presented in this paper indicate that initiatives to prevent HCV transmission among PWID should be targeted at women and those repeatedly imprisoned. Interventions that address the specific needs of women who inject drugs need to be considered. Multidisciplinary initiatives that address relationship dynamics, housing, employment and the needs of children, over those that focus solely on injecting practices and condom use, have been shown to have more success in reducing the risk of bloodborne infections in women who inject drugs, and thus require further development and implementation into harm reduction services [40]. Prisons would appear to be an important environment for delivering prevention messages to those who inject, or who are at risk of injecting drugs, and for engaging people injecting drugs into interventions, such as OST, that can prevent the harm associated with injecting drugs. In addition, measures to prevent HCV transmission in UK prison settings, for example through the provision of bleach tablets [41], need to be maintained and further developed.

These findings indicate that in PWID, there is on-going transmission of HCV, with between one in eight and one in 24 probably becoming infected each year. In previously published studies, incidence rates varied; however, the extent of recent primary infection found in this first national study to cover the whole of England, Wales and Northern Ireland is comparable to the incidence reported in most of the previously published studies from across the UK. The routine monitoring of markers compatible with recent primary HCV infection through the UAM Survey, using the novel avidity-testing algorithm applied here, will permit changes in incidence over time to be assessed and so allow examination of the impact of interventions. Further work is needed to understand the risks for HCV infection, and to better ascertain the duration of the recent infection window for the anti-HCV avidity assay.

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DECLARATION OF INTEREST

None.

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