Prevalence of, and risk factors for, HIV, hepatitis B and C infections among men who inject image and performance enhancing drugs.

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Prevalence of, and risk factors for, HIV, hepatitis B and C infections among men who inject image and performance enhancing drugs.

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Abstract

Background/Objective: People who inject drugs' vulnerability to infection is widely recognised; however, studies have rarely focused on users of image and performance enhancing drugs (IPEDs). IPEDs can be used to change appearance for aesthetic reasons, as well as to improve performance. Needle and syringe programme (NSP) use by IPED injectors has grown substantially in the United Kingdom. In response, this study assessed IPED injectors risk of blood-borne virus infection.

Design/Setting/Participants: A voluntary unlinked-anonymous survey recruited male IPED injectors through 19 NSPs. Participants completed a questionnaire and provided an oral-fluid sample.

Results: Of the 395 participants (median age 28 years), 36% had used IPEDs for <5 years. Anabolic steroids (86%), growth hormone (32%) and human chorionic gonadotropin (16%) were most frequently injected, with 88% injecting intramuscularly and 39% subcutaneously. Two-thirds also used IPEDs orally. Recent psychoactive drug use was common (46% cocaine, 12% amphetamine), 5% had ever injected a psychoactive drug, and 9% had shared injecting equipment. "Viagra/Cialis" was used by 7%; with 89% reporting anal/vaginal sex in the preceding year (20% had 5+ female-partners, 3% male-partners) with 13% always using condoms. Only 23% reported hepatitis B vaccine uptake, and diagnostic testing uptake was poor (31% HIV, 22% hepatitis C). Overall, 1.5% had HIV, 9% had antibodies to the hepatitis B core antigen (anti-HBc) and 5% to hepatitis C (anti-HCV). In multivariate analysis, having HIV was associated with: seeking advice from a sexual health clinic; having had an injection site abscess/wound, and having male-partners. After excluding those reporting male-partners or injecting psychoactive drugs, 0.8% had HIV, 8% anti-HBc, and 5% anti-HCV.

Conclusions: Previous prevalence studies had not found HIV among IPED injectors. HIV prevalence in this, the largest study of blood-borne viruses among IPED injectors, was

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similar to that among injectors of psychoactive drugs. Findings indicate a need for targeted interventions.

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Article summary

Article focus:

- Over the last decade the number of men using needle and syringe programmes who report injecting image and performance enhancing drugs has risen in England and Wales; as a result there has been increased concern about the levels of blood-borne viral infections in this group. This study assessed the prevalence of HIV, hepatitis B and C, and the levels of related risk behaviours in this population.

Key messages:

- The overall prevalence of HIV among men injecting image and performance enhancing drugs was similar to that among those injecting psychoactive drugs in England & Wales. Previous prevalence studies of people who inject image and performance enhancing drugs had not detected HIV.
- When the results of this study are compared to those of a previous study undertaken in England & Wales in the mid-1990s, they suggest that the prevalence of hepatitis B infection among injectors of image and performance enhancing drugs *might* have increased over time.
- Sexual risk behaviours and psychoactive drug use were common among injectors of image and performance enhancing drugs, and the sharing of injecting equipment was also reported. The uptake of diagnostic testing for blood borne-viral infections and the vaccine against hepatitis B were low.

Strengths and limitations of this study:

- This study recruited image and performance enhancing drugs users through needle and syringe programmes. Injectors of these drugs not in contact with these services may have a different risk profile and levels of infection.
- Oral-fluid testing was used to detect antibodies to HIV, hepatitis B and C; however, tests on these samples for both anti-HCV and anti-HBc have reduced sensitivity.

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- This study is the largest of blood-borne viruses among men who inject image and performance enhancing drugs, however, the sample size still restricts its power. Consequently, caution is needed when attempting to generalise these findings.

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INTRODUCTION

The vulnerability of people who inject drugs (PWID) to HIV and other infections is widely recognised; however, studies have focused on individuals who inject psychoactive drugs (such as opiates and stimulants) rather than those who inject drugs to enhance image and performance.[1,2,3,4] The number of injectors of image and performance enhancing drugs (IPEDs) in contact with needle and syringe programmes (NSPs) has grown substantially in the United Kingdom (UK);[5] and there has been increasing concern about the use of IPEDs and the associated harms in the UK and elsewhere.[3,5,6,7,8,9,10,11]

A range of illicit drugs can be injected with the aim of changing image and performance. These drugs range from tanning drugs, such as 'Melanotan-II',[12] to those used in body-building, such as human growth hormone.[3,13] The most commonly injected and studied IPEDs are anabolic steroids (AS).[3,5] IPEDs are taken both orally and by injection, with some predominantly injected and others taken only orally. Many users of these substances also take an array of different drugs.[3,5,14] The use, and particularly the injection of IPEDs has been associated with a range of harms including infections caused by bacteria[15,16,17,18,19] and blood borne viruses (BBVs).[6,20,21,22,23,24,25]

In England and Wales (E&W) surveillance of HIV and viral hepatitis among PWID is undertaken through an annual unlinked-anonymous survey[26,27] targeted at injectors of psychoactive drugs. A very small number of IPED injectors participated in this survey;[20] among the 149 sampled during the 1990s, 2% had antibodies to the hepatitis B core antigen (anti-HBc, a marker of having ever been infected with hepatitis B virus [HBV]) and none had antibodies to HIV (anti-HIV).[20] In a surveillance study of NSP clients in Australia, 1.6% (n=318) of those participating over a 10-year period reported steroid injection, with 10% having antibodies to hepatitis C virus (anti-HCV) and none

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anti-HIV.[21] Only one other survey of IPED injectors has collected biological samples; this study purposively recruited 63 AS injectors in Victoria, Australia, and found 12% had anti-HBc, 9.5% anti-HCV, and none anti-HIV.[6] A second Australian study found that half of IPED users sampled had ever experienced an injection-related health problem, with 6% having ever had an abscess.[8]

A number of other UK studies have recruited IPED injectors – principally AS injectors – however, none of these collected biological samples. These studies were mostly small (N<100), and typically recruited through gyms,[28,29,30,31,32,33] with two recruiting gay men.[34,35] The prevalence of ever sharing injecting equipment in these studies ranged from 0.3% to 6%,[20,28,29,30,32] but in one it was 20%.[33] The sharing of drug vials was more common (2.4%[35]; 9.9%[34]; 23%[32]). Studies elsewhere have found similar levels of equipment sharing.[6,8] IPED users also report using psychoactive drugs, particularly stimulants, though the reported injection of psychoactive drugs is rare.[6,8,28,35,36] IPED users also tend to have more sexual partners than their comparison groups,[20,28] report risky sexual behaviours,[20,32] and low levels of condom use;[28,34] suggesting an elevated risk for HIV infection through sexual activity.

During 2010 and 2011, in response to the increasing concerns about IPED use, a targeted survey was undertaken as part of the on-going unlinked-anonymous survey of PWID. The aim of this sub-survey was to assess the current levels of infection and risk among IPED injectors. As far as we are aware this is the largest, and the first study outside of Australia, to purposively recruit IPED injectors to measure the prevalence of anti-HIV, anti-HBc and anti-HCV.

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METHODS

Recruitment. In E&W, PWID have been recruited into a voluntary unlinked-anonymous monitoring survey since 1990, methodological details of which have been published previously.[26,27,37] Briefly, agencies providing services to PWID (e.g. NSPs and addiction treatment) at sentinel locations throughout E&W invite clients who have ever injected to participate. Sentinel sites are selected so as to reflect both the geographic distribution and range of services offered to PWID. Those who agree (overall refusal rate during 2010/11, 4.7%) provide a biological sample and self-complete a brief questionnaire focused on psychoactive drug use.[26,27,37] This study purposively recruited IPED injectors through 19 NSP. Participants were recruited either when attending a NSP site or through outreach provision, they provided an oral-fluid sample and self-completed a short, specially developed, questionnaire focused on IPED use (types of drug used and routes of administration), related behaviours (injecting practices and sexual behaviours) and health service use.

Laboratory methods. Oral-fluid specimens were collected using the OraSure™ device (OraSure Technologies Inc, Pennsylvania, USA). These were tested for anti-HIV using an in-house GACELISA with similar performance to GACELISA HIV 1+2 (Abbott Murex Diagnostics Ltd, Dartford, UK). Reactive specimens underwent further testing according to a proven algorithm that included a second ELISA and Western Blot (sensitivity and specificity approaches 100%[38]). Anti-HCV testing employed a previously validated commercial enzyme-immunoassay (Ortho HCV 3.0 SAVe, Ortho Diagnostics) with 92% sensitivity and 99% specificity,[39] and for anti-HBc an in-house IgG class-specific antibody capture EIA procedure was used, estimated sensitivity 75% and specificity 99% (JV Parry & A Judd, personal communication). Oral-fluid sample quality was verified by testing each one for the presence of a pre-determined minimum quantity of total IgG (1mg/litre) employing an in-house ELISA method.

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Analyses. Descriptive analyses were undertaken first, then bivariate associations ($p<0.05$) between outcomes variables (anti-HIV, anti-HBc and anti-HCV positivity, equipment sharing and condom use) and co-variates (age, drug use, sexual practice, and health services use; table 1) were examined using Fisher's exact (when expected cell frequencies <5) and Pearson's Chi-square tests. Where possible associations were found ($p<0.10$) these were further examined via logistic regression models using forward stepwise procedures to select variables, with selection based on the likelihood ratio test ($p<0.05$). All analyses were undertaken using SPSS 19.

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RESULTS

Between May 2010 and May 2011, 400 IPED injectors participated in this study; five (1.25%) women were excluded from the analyses (due to the small number). Of those reporting their age (88%, n=347), a quarter (27%) were aged <25 years (table 1). Overall, 1.5% (95%CI 0.7%-3.3%; n=6) had anti-HIV, 8.8% (95%CI 6.4%-12%) had ever been infected with hepatitis B (26 anti-HBc positive, adjusted for test sensitivity of 0.75) and 5.5% (95%CI 3.7%-8.2%) exposed to hepatitis C (20 anti-HCV positive, adjusted for test sensitivity of 0.92).

IPED Use. During the preceding year, 86% reported injecting AS and over half also reported consuming these orally (57%); a third reported injecting growth hormone (32%), almost a quarter using oral anti-estrogens (23%), and a fifth (20%) taking ephedrine orally (table 1). Overall 65% (n=252) had taken an IPED orally during the preceding year, with 58 (23%) of these having taken two types orally, and 85 (34%) ≥3 types. Most had injected only one type of IPED during the preceding year; however, 87 (22%) had injected two types and 58 (15%) ≥3 types. Considering both injecting and oral use, 71 (18%) had taken two types of IPED and 133 (34%) ≥3 during the preceding year. Those who injected human growth hormone were more like to be older (aged >35 years) than those who had not (37% [47/128] vs. 22% [60/267], p<0.001); there were no other significant differences in the IPEDs used by age.

Most participants reported injecting themselves during the preceding year; 17% reported being injected by someone-else (table 1). The majority (88%) had injected intramuscularly during the preceding year, with 39% reporting subcutaneous injection (table 1). Overall, 8.9% (95%CI 6.4%-12%) reported having ever shared a needle/syringe or drugs vial (table 1); 27 (6.8%) had just shared a vial, six (1.5%) had just shared a needle/syringe and two (0.51%) had shared both.

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Table 1: Characteristics of male injectors of image and performance drugs (IPED).

Characteristics			n	***IPED use, last year***			n	***Use of other illicit drugs***			n
Age, years	Under 25	27%	106	Years since first used a IPED	0 to 4	36%	141	Ever injected illicit drug other than an IPED		4.8%	19
	25 to 34	34%	134		5 or more	32%	128	Snorted cocaine, last year		46%	181
	35 and over	27%	107		*Median (IQR)*	*4 (8)*		Snorted, drunk or swallowed amphetamine, last year		12%	47
	Median (IQR)	*28 (13)*			Not reported	32%	126	***Injecting practice***			
	Not reported	12%	48	*IPED injected*				Usually injected by, last year	Someone else	17%	68
Had ever been in prison		16%	63	Anabolic steroids		86%	340		Myself	74%	294
Health service use				Growth hormone		32%	128		Not reported	8.4%	33
Ever used a Needle and Syringe Programme		75%	298	Human chorionic gonadotropin (hCG)		16%	62	Intramuscular injection, last year		88%	346
Seen a General Practitioner about their health, last year		45%	178	Insulin		5.6%	22	Subcutaneous injection, last year		39%	154
Sought advice at an Emergency / Minor injuries clinic, last year		16%	64	Melanotan I /II		8.6%	34	Ever shared needle, syringe or vial		8.9%	35
Taken / used prescribed medication, last year		28%	111	Others (incl. EPO, IGF–1 and Nubain)		5.1%	20	***Sexual Behaviour, last year***			
Sought advice from a sexual health / STI clinic, last year		17%	68	*IPED taken orally*				Number of sexual partners	One	38%	152
Taken up offer of the vaccine against hepatitis B		23%	90	Anabolic steroids		57%	226		Two or more	47%	187
Ever had a blood test for hepatitis C		22%	85	Anti–oestrogens		23%	92		No sex / Not reported	14%	56
Ever had a blood test for HIV		31%	122	Clenbuterol		15%	60	Gender of sexual partners	Male partner(s)	3.3%	13
Symptom of injury or infection at injection site				Ephedrine		20%	78		No male partners	82%	323
Ever had redness at an injection site		43%	168	Thyroid hormones		9%	37		No sex / Not reported	15%	59
Ever had an injection site abscess/sore/open wound		6.8%	27	Phosphodiesterase type 5 inhibitors ("Viagra /Cialis")		6.6%	26	Always condom (anal / vaginal sex) or no sex		20%	78
				Other (incl. diuretics, DNP, prohormones/designer supplements)		12%	46				

Key. STI: sexually transmitted infection; EPO: ethryopoetin; IGF–1: insulin–like growth factor 1; Nubain: nalbuphine hydrochloride; DNP: 2,4–dinitrophenol.

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Psychoactive drug use. During the preceding year, 46% reported snorting cocaine and 12% reported snorting, drinking or swallowing amphetamine. Ever having injected a psychoactive drug (including heroin and cocaine) was reported by 4.8% (table 1). Those who had injected a psychoactive drug were more likely to report injecting insulin as an IPED than those who had not (21% [4/19] vs. 4.8% [18/376], p=0.016); there were no other significant differences in the IPEDs used between those who injected psychoactive drugs and those who had not. Those who had injected psychoactive drugs were more likely to report having ever shared a needle/syringe or vial than those who had not (37% [7/19] vs. 7.4% [28/376], p=0.001).

Sexual behaviour. Nine-tenths (89%, 350/395) reported having anal or vaginal sex in the preceding year, with 47% of these reporting ≥2 sexual partners and 9.1% (36/395) ≥10 partners (table 1). Considering just female partners, 20% (80/395) of respondents had ≥5. Thirteen (3.3%) reported ≥1 male sexual partners during the preceding year (table 1). Overall, 20% (95%CI 16%-24%) had either always used condoms or not had sex during the preceding year (table 1); among those who reported sex during the preceding year 14% (95%CI 11%-18%, 48/350) had always used condoms.

Those reporting male sexual partners were older than those who did not (median age 38 years, IQR 12; and 28 years, IQR 11, respectively). Those reporting male sexual partners were also more likely to have ever injected a psychoactive drug (23% [3/13] vs. 4.2% [16/382], p=0.020), more likely to report snorting, drinking, or swallowing amphetamine during the last year (46% [6/13] vs. 11% [41/382], p=0.002), and a higher proportion reported snorting cocaine, but this difference was not significant (62% [8/13] vs. 45% [173/382], p=0.248). Those reporting male sexual partners were also more likely to report having ever shared a needle/syringe or vial (25% [4/13] vs. 8.1% [31/382], p=0.021). A higher proportion of those reporting male sexual partners reported always

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using condoms during the last year, but this difference was not significant (38% [5/13] vs. 19% [73/382], p=0.146). There were no differences in the types of IPED used, nor in their routes of administration, between those reporting male partners and those not.

Health service use. The participants had used a range of health services (table 1), with 75% having used an NSP (though participants were recruited via NSP, some were recruited during targeted outreach and so may not have seen this as NSP use). During the preceding year, 45% had seen a General Practitioner, 17% sought advice from a Sexual Health (SH)/Sexually Transmitted Infection (STI) clinic, 16% used an Emergency/Minor injuries clinic, and 28% had taken prescribed medication. Overall, 23% reported HBV vaccine uptake, 31% ever having a diagnostic HIV test and 22% a HCV test (table 1).

Factors associated with infection. Covariates associated with anti-HIV, anti-HBc or anti-HCV positivity in bivariate and multivariate analyses are summarised in table 2. In the multivariable analysis, anti-HIV positivity was associated with having male sexual partners in preceding year, ever having an abscess/sore/open wound at injection site, and having sought advice from a SH/STI clinic in the preceding year (table 2). Having anti-HBc was associated in the multivariable analysis with having obtained advice from SH/STI clinic and having not injected subcutaneously in the preceding year (table 2). Anti-HCV positivity was associated with having ever injected a psychoactive drug and having taken a phosphodiesterase type 5 inhibitor (PDE5i) in the preceding year in the multivariable analysis (table 2).

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Table 2: Factors associated with HIV, hepatitis B and C infection among male injectors of image and performance drugs (IPED).

		Total	Positive		Unadjusted odds Ratio with 95% CI			Adjusted odds Ratio with 95% CI			
HIV		395	6	1.5%							
Age, years*	Aged<35 or age unknown	287	1	0.3%	1.0						
	Aged 35 or over	102	5	4.9%	14	1.62	- 122				
	Fisher's Exact Test	*p=*	*0.006*					*			
Gender of sexual partners last year*	Male sexual partner	13	3	23%	38	6.79	- 211				
	No male partner reported/No sex	382	3	0.8%	1.0						
	Fisher's Exact Test	*p=*	*0.001*								
Gender of sexual partners last year and Age (in years)	Male sexual partner	13	3	23%	85	8.13	- 893	79	4.29	-	1,450
	No male partners, aged<35 or age not reported	285	1	0.4%	1.0			1.0			
	No male partners, aged 35 or over	97	2	2.1%	6	0.54	- 67	9	0.59	-	135
	Pearson Chi-Square	*p<*	*0.001*								
Injected illicit other than PIED	Yes	19	2	11%	11	1.87	- 64				
	No / Not reported	376	4	1.1%	1.0			†			
	Fisher's Exact Test	*p=*	*0.029*								
Ever had an abscess/sore/open wound at injection site	Yes	27	2	7.4%	7.3	1.27	- 42	77	3.27	-	1,795
	No / Not sure	368	4	1.1%	1.0			1.0			
	Fisher's Exact Test	*p=*	*0.057*								
Taken or used any prescribed medication in last year	Yes	111	5	4.5%	13	1.54	- 116				
	No / Not sure	284	1	0.4%	1.0			†			
	Fisher's Exact Test	*p=*	*0.008*								
Sought advice from a sexual health /STI clinic, last year?	Yes	68	4	5.9%	10	1.82	- 57	24	1.03	-	542
	No / Not sure	327	2	0.6%	1.0			1.0			
	Fisher's Exact Test	*p=*	*0.009*								
Have you ever been vaccinated against hepatitis B	Yes	90	4	4.4%	7.0	1.27	- 39				
	No / Not sure	305	2	0.7%	1.0			†			
	Fisher's Exact Test	*p=*	*0.026*								
Have you ever had a blood test for hepatitis C	Yes	81	4	4.7%	7.6	1.37	- 42				
	No / Not sure	308	2	0.9%	1.0			†			
	Fisher's Exact Test	*p=*	*0.021*								
Have you ever had a blood test for HIV?	Yes	122	4	3.3%	4.6	0.83	- 25				
	No / Not sure	273	2	0.7%	1.0			†			
	Fisher's Exact Test	*p=*	*0.076*								
Ever shared needle, syringe or vial	Yes	35	2	5.7%	5.4	0.95	- 31				
	No / Not sure	360	4	1.1%	1.0			†			
	Fisher's Exact Test	*p=*	*0.091*								

* Combined variable was entered into the final multivariate model due to an interaction between age and reporting male sexual partners: with 77% of those with male sexual partners aged over 35 years compared with 25% of those not reporting male sexual partners.

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Table 2 cont: Factors associated with HIV, hepatitis B and C infection among male injectors of image and performance drugs (IPED).

		Total	Positive		Unadjusted odds ratio with 95% CI		Adjusted odds ratio with 95% CI	
Anti-HBc		395	26	6.6%				
Sought advice from a sexual health /STI clinic, last year?	Yes	68	10	14.7%	3.4	1.4 – 7.7	3.8	1.6 – 8.9
	No / Not sure	327	16	4.9%	1.0		1.0	
	Fisher's Exact Test	p=	0.006					
Subcutaneous injection, last year	Yes	154	6	3.9%	1.0		1.0	
	No / Not sure	241	20	8.3%	2.2	0.88 – 5.7	2.6	0.99 – 6.7
	Pearson Chi-Square	p=	0.085					
Anti-HCV		395	20	5.1%				
Age, years	Under25	106	4	3.8%	1.0			
	25–34	134	3	2.2%	0.58	0.13 – 2.7		
	35 and over	107	10	9.3%	2.6	0.80 – 8.7		†
	Not reported	48	3	6.3%	1.7	0.37 – 7.9		
	Pearson Chi-Square	p=	0.078					
Injected illicit other than IPED	Yes	19	3	15.8%	4.0	1.1 – 15	4.4	1.1 – 17.2
	No / Not reported	376	17	4.5%	1.0		1.0	
	Fisher's Exact Test	p=	0.064					
Taken or used any prescribed medication, last year	Yes	111	10	9.0%	2.7	1.1 – 7		
	No / Not sure	284	10	3.5%	1.0			†
	Pearson Chi-Square	p=	0.025					
Ever had a blood test for hepatitis C	Yes	85	8	9.4%	1.7	0.55 – 5.6		
	No	221	7	3.2%	0.5	0.17 – 1.8		†
	Not sure	89	5	5.6%	1.0			
	Pearson Chi-Square	p=	0.080					
Taken Phosphodiesterase type 5 inhibitors ("Viagra / Cialis")	Yes	26	5	19%	5.6	1.9 – 17	6.0	1.9 – 18
	No	369	15	4.1%	1.0		1.0	
	Fisher's Exact Test	p=	0.007					
Injected insulin (as IPED)	Yes	22	4	18%	5.0	1.5 – 16		
	No	373	16	4.3%	1.0			†
	Fisher's Exact Test	p=	0.019					
Other injected IPED (incl. EPO, IGF–1 and Nubain)	Yes	20	3	15%	3.7	0.99 – 14		
	No	375	17	4.5%	1.0			†
	Fisher's Exact Test	p=	0.073					
Ever shared needle, syringe or drug vial	Yes	35	4	11%	2.8	0.87 – 8.8		
	No / Not sure	360	16	4%	1.0			†
	Fisher's Exact Test	p=	0.090					

† Not in final model.

Key. STI: sexually transmitted infection; EPO: ethryopoetin; IGF–1: insulin–like growth factor 1; Nubain: nalbuphine hydrochloride.

After excluding those who reported *either* sex with men *or* ever injected a psychoactive drug, 0.8% had anti-HIV (95%CI 0.28%-2.4%, 3/366), 8.0% anti-HBc (95%CI 5.6%-11%, adjusted for test sensitivity, 22/366), and 4.7% anti-HCV (95%CI 2.9%-7.3%, adjusted for test sensitivity, 16/366); with 10% (95%CI 7.7%-14%, 38/366) having one or more of these three markers. In this group, having anti-HIV was found to be associated only with ever having had an abscess/wound at an injection site (8% [2/25] vs. 0.29% [1/341] for

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those who had not, p=0.013), and having anti-HBc was only associated with having sought advice from a SH/STI clinic in the preceding year (16% [9/56] vs. 4.2% [13/310] for those who had not, p=0.002). The use of three types IPEDs was associated with having anti-HCV: having taken a PDE5i (21% [5/24] vs. 3.2% [11/342] for those who had not, p=0.002); having injected insulin as IPED (18% [3/17] vs. 3.7% [13/349] for those who had not, p=0.032); and having injected a less commonly used IPED (17% [3/18] vs. 3.7% [13/348] for those who had not, p=0.037).

Co-infection. In total, 47 (12%, 95%CI 9.1%-15%;) were positive for one or more of anti-HIV, anti-HBc and anti-HCV, with 43 having just one of these markers and four having two or more of these markers. Two had both anti-HBc and anti-HCV, one of these reported injected psychoactive drugs, neither reported having had sex with men. One, who reported both sex with men and injecting psychoactive drugs, had both anti-HIV and anti-HBc; the remaining participant had all three markers and did not report with either sex with men or injecting psychoactive drugs.

Factors associated with risk behaviours. Factors associated with sharing of injecting equipment and condom use in the bivariate and multivariate analyses are summarised in table 2. In the multivariable analysis ever having shared a needle/syringe or drug vial was associated with having ever injected a psychoactive drug, having sought advice from a SH/STI clinic, subcutaneous injection, and having snorted, drunk or swallowed amphetamine (table 3). Always using condom among those who had had anal/vaginal sex during the preceding year was associated in the multivariable analysis with having had a male sexual partner and having not snorted cocaine (table 3).

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Table 3: Factors associated with risk behaviours among male injectors of image and performance drugs (IPED).

		Total	Yes		Unadjusted odds ratio with 95% CI		Adjusted odds ratio with 95% CI	
Ever shared needle, syringe or vial		395	35	8.9%				
Number of sexual partners, last year	One	152	8	5.3%	0.3	0.12 – 0.94		
	Two or more	187	19	10%	0.7	0.28 – 1.6		
	Not reported / No sex	56	8	14%	1.0		†	
	Pearson Chi-Square	*p=*	*0.088*					
Gender of sexual partners, last year	Male partner(s)	13	4	31%	5.5	1.6 – 19		
	No male partners	323	24	7.4%	1.0		†	
	Not reported / No sex	59	7	12%	1.7	0.69 – 4.1		
	Pearson Chi-Square	*p=*	*0.010*					
Injected illicit other than IPED	Yes	19	7	37%	7.2	2.6 – 20	6.3	2.1 – 19
	No / Not reported	376	28	7.4%	1.0		1.0	
	Fisher's Exact Test	*p=*	*0.001*					
Sought advice from a sexual health /STI clinic, last year	Yes	68	11	16%	2.4	1.1 – 5.2	2.2	1.0 – 5.1
	No / Not sure	327	24	7.3%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.020*					
Injected growth hormone (as IPED)	Yes	128	18	14%	2.4	1.2 – 4.8		
	No	267	17	6.4%	1.0		†	
	Pearson Chi-Square	*p=*	*0.012*					
Injected insulin (as IPED)	Yes	22	5	23%	3.4	1.2 – 9.8		
	No	373	30	8.0%	1.0		†	
	Fisher's Exact Test	*p=*	*0.035*					
Subcutaneous injection, last year	Yes	154	21	14%	2.6	1.3 – 5.2	3.0	1.4 – 6.5
	No / Not sure	241	14	6%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.008*					
Snorted cocaine, last year	Yes	181	22	12%	2.1	1.0 – 4.4		
	No	214	13	6.1%	1.0		†	
	Pearson Chi-Square	*p=*	*0.034*					
Snorted, drunk or swallowed amphetamine, last year	Yes	47	11	23%	4.1	1.9 – 9.1	4.1	1.7 – 9.8
	No	348	24	6.9%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.0002*					

Always used condom for anal / vaginal sex		350	48	14%				
Gender of sexual partners, last year	Male partner(s)	13	5	38%	8.1	0.8 - 83	14	1.3 - 155
	No male partners	323	42	13%	1.9	0.25 - 15	2.8	0.35 - 22
	Not reported	14	1	7.1%	1.0		1.0	
Pearson Chi-Square		p=	0.025					
Ever had a blood test for hepatitis C	Yes	82	17	21%	3.2	1.1 - 9		
	No	201	26	13%	1.8	0.68 - 5.0	†	
	Not sure	67	5	7.5%	1.0			
	Pearson Chi-Square	p=	0.057					
Injected anabolic steroids	Yes	304	46	15%	3.9	0.92 - 17	4.2	0.96 - 18
	No	46	2	4.3%	1.0		1.0	
	Pearson Chi-Square	p=	0.048					
Intramuscular injection, last year	Yes	310	46	15%	3.3	0.77 - 14		
	No / No sure	40	2	5.0%	1.0		†	
	Pearson Chi-Square	p=	0.089					
Snorted cocaine, last year	Yes	162	11	7%	0.3	0.1 - 0.6	0.2	0.12- 0.52
	No	188	37	20%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.0005*					

† Not in final model.

Key. STI: sexually transmitted infection.

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DISCUSSION

IPED injectors are at risk of infection with HIV as well as other BBVs. This is the first prevalence study to have found HIV among IPED injectors, with the prevalence at 1.5%, similar to that found among injectors of psychoactive drugs in England and Wales (1.2%, 2011[40]). However, anti-HBc and anti-HCV – at 8.8% and 5.5% respectively – are lower than among psychoactive drug injectors (16% and 43% respectively, 2011 [40]). The prevalence of all three BBVs in this sample would appear to be higher than that found in the general UK population.[41,42] Once those who reported either sex with men or injecting psychoactive drugs were excluded, 10% had been infected with one or more of HIV, hepatitis B and hepatitis C.

It is important to consider the limitations of this study. The comparative rarity, marginalisation and illicit nature of injecting drug use impede the construction of a sampling frame, making the representativeness of our sample impossible to measure. This study used an established methodology for recruiting PWID through specialist services;[26,27] however, the robustness of this approach for IPED injectors is unknown and cannot currently be assessed due to the very limited knowledge on the size and nature of this group.[3,5] The use of NSP to access this group was a pragmatic approach; community based recruitment approaches, such as Respondent Driven Sampling and Time-Location Sampling, that are often advocated for hard to reach populations[43] are possible alternatives. However, these are likely to be difficult to implement with this group due to the diversity of the drugs used, the clandestine and close-knit nature of this group and because use usually takes place in private settings (such as homes or gyms).[3,5] The findings here also rely on self-reported behaviours – though their reliability has not been assessed among IPED users, these have been found to be reliable for psychoactive drug injectors[44,45] - and infection with BBVs has been determined by laboratory-based biological data from the testing of oral-fluid samples.

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Whilst oral-fluid testing is highly sensitive for anti-HIV, the sensitivity is reduced for anti-HCV and anti-HBc.[39] Whilst this study is the largest of BBVs in this population, the sample size still restricts its power, and consequently caution is needed when attempting to generalise these findings to the wider population of IPED injectors.

The levels of HIV and anti-HBc are both higher than in the only previous UK study to measure these in IPED injectors. Undertaken >10 years ago using a similar methodology, this found no HIV and an anti-HBc prevalence of 2%;[20] suggesting that the prevalence of these infections among IPED injectors *might* have increased over time. Exposure to BBVs among IPED injectors appears to be associated with sexual risks and the injection of psychoactive drugs; although *injecting* psychoactive drugs is rare among IPED injectors, unprotected sex with multiple partners is common. The sharing of injecting equipment or drug vials among IPED injectors at 8.9% is much less common than among injectors of psychoactive drugs (in 2011, 37% of psychoactive drug injectors reported recently sharing injecting equipment[40]). Though exposure was not associated with sharing in the multivariate analyses in this study, BBV transmission through IPED injection cannot be excluded as this study may have lacked sufficient power to detect this.

The association between having HIV and the use of SH/STI clinics, and the association with having male sexual partners, suggest that HIV transmission among IPED injectors might be related to sexual activity. This association may reflect AS use by some HIV positive gay and bisexual men to mask the longer-term effects of HIV infection.[35] The association with having an abscess/wound at the injection site probably reflects the greater vulnerability of PWID with HIV to injection related bacterial infections.[46,47] The association between exposure to HBV and having obtained advice from a SH/STI clinic is again suggestive of a role for sexual risk in infection, particularly as sexual transmission is

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the main route by which the HBV is now acquired within the UK.[48] The association between having anti-HBc and not injecting subcutaneously suggests that certain patterns of IPED use might be related to increased risk; as some IPED are only injected subcutaneously and others only intramuscularly, and many users take several types.[3,8,12,13,14] Exposure to HCV, however, would appear to be associated with the injection of psychoactive drugs – an association that has been previously noted[6] - this finding might reflect more frequent injecting in this sub-group. Sexual activity may also play a role, assuming that the use of PDE5i is related to improving or maintaining sexual performance. These associations all require further investigation.

The level sharing found here was in-line with previous studies of injecting risk among IPED users.[20,28,29,30,32,33,35] The association between sharing and subcutaneous injection, suggests that sharing – like HBV exposure – may be associated with certain patterns of IPED use. As in previous studies of IPED injectors, sexual activity was common, and condom use was poor.[20,28,34] Condom use was higher among those with male sexual partners, and lower among those who reported snorting cocaine. The more frequent use of condoms by gay and bisexual men probably reflects awareness of their increased HIV risk.[42] The association with cocaine use might possibly be related to its use as a sexual stimulant, with this possibly related to attempts to counteract the reduced libido experienced on discontinuation of AS use or in the periods between courses of AS use ('off-cycles').[14] In part, this effect may be as a result of the decrease in endogenous testosterone production,[49] and is why IPEDs users self-treat with human chorionic gonadotrophin in an attempt to stimulate endogenous production, with PDE5i used to symptomatically treat erectile dysfunction.[5,14,50] Increased libido following AS administration is also reported by users[14,33,34,51] with similar effects being reported following the use of drugs such as melanotan-II.[12]

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Associations were found between psychoactive drug use and both sharing and poor condom use. IPED users who also use psychoactive drugs may be a higher risk – or perhaps less risk averse - sub-group. Whilst this needs further investigation, it suggests – considering the substantial levels of psychoactive drug use found here and in previous studies[6,8,28,35,36] – that those using both IPED and psychoactive drugs should be an important target group for harm reduction interventions.

Our findings suggest that sexual risk and the use, and particularly the injection, of psychoactive drugs are possibly the most important factors associated with BBV transmission among IPED injectors. The transmission of HIV and other BBV through the injecting of IPED cannot be excluded, and this is certainly possible as equipment sharing does occur. However, this study largely recruited through NSP providing injecting equipment and advice. IPED injectors not in contact with NSP may have a different risk profile and so infection risk. Even so, our findings suggest the need for targeted interventions to address sexual health needs, psychoactive drug use, and the injection practices among IPED injectors. Considering the limitations of this study, a larger study recruiting from a wider range of settings and collecting dried-blood samples is needed to more fully examine prevalence and, in particular, the associated risk factors, and so the role of IPED injection in transmission of HIV and other BBVs.

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Manuscripts

Prevalence of, and risk factors for, HIV, hepatitis B and C infections among men who inject image and performance enhancing drugs.

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Abstract

Background: People who inject drugs' vulnerability to infection is widely recognised; however, studies have rarely focused on users of image and performance enhancing drugs (IPEDs). IPEDs can be used to change appearance for aesthetic reasons, as well as to improve performance. Needle and syringe programme (NSP) use by IPED injectors has grown substantially in the United Kingdom.

Objective: to describe drug use, sexual risks, and the prevalence of blood-borne viral infections among IPED injectors.

Design/Setting/Participants: A voluntary unlinked-anonymous cross-sectional bio-behavioural survey of male IPED injectors using 19 NSPs.

Results: Of the 395 participants (median age 28 years), 36% had used IPEDs for <5 years. Anabolic steroids (86%), growth hormone (32%) and human chorionic gonadotropin (16%) were most frequently injected, with 88% injecting intramuscularly and 39% subcutaneously. Two-thirds also used IPEDs orally. Recent psychoactive drug use was common (46% cocaine, 12% amphetamine), 5% had ever injected a psychoactive drug, and 9% had shared injecting equipment. "Viagra/Cialis" was used by 7%; with 89% reporting anal/vaginal sex in the preceding year (20% had 5+ female-partners, 3% male-partners) with 13% always using condoms. Overall, 1.5% had HIV, 9% had antibodies to the hepatitis B core antigen (anti-HBc) and 5% to hepatitis C (anti-HCV). In multivariate analysis, having HIV was associated with: seeking advice from a sexual health clinic; having had an injection site abscess/wound, and having male-partners. After excluding those reporting male-partners or injecting psychoactive drugs, 0.8% had HIV, 8% anti-HBc, and 5% anti-HCV. Only 23% reported hepatitis B vaccine uptake, and diagnostic testing uptake was poor (31% HIV, 22% hepatitis C).

Conclusions: Previous prevalence studies had not found HIV among IPED injectors. HIV prevalence in this, the largest study of blood-borne viruses among IPED injectors, was

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similar to that among injectors of psychoactive drugs. Findings indicate a need for targeted interventions.

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Article summary

Article focus:

- Over the last decade the number of men using needle and syringe programmes who report injecting image and performance enhancing drugs has risen in England and Wales; as a result there has been increased concern about the levels of blood-borne viral infections in this group.
- This study describes the nature of drug use and the risk behaviours in this population, as well as the prevalence of HIV, hepatitis B and C.

Key messages:

- The overall prevalence of HIV among men injecting image and performance enhancing drugs was similar to that among those injecting psychoactive drugs in England & Wales. Previous prevalence studies of people who inject image and performance enhancing drugs had not detected HIV.
- When the results of this study are compared to those of a previous study undertaken in England & Wales in the mid-1990s, they suggest that the prevalence of hepatitis B infection among injectors of image and performance enhancing drugs *might* have increased over time.
- Sexual risk behaviours and psychoactive drug use were common among injectors of image and performance enhancing drugs, and the sharing of injecting equipment was also reported. The uptake of diagnostic testing for blood borne-viral infections and the vaccine against hepatitis B were low.

Strengths and limitations of this study:

- This study recruited image and performance enhancing drugs users through needle and syringe programmes. Injectors of these drugs who are not in contact with these services may have a different risk profile and levels of infection.
- Oral-fluid testing was used to detect antibodies to HIV, hepatitis B and C; however, tests on these samples for both anti-HCV and anti-HBc have reduced sensitivity.

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- This study is the largest of blood-borne viruses among men who inject image and performance enhancing drugs, however, the sample size still restricts its power. Consequently, caution is needed when attempting to generalise these findings.

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INTRODUCTION

The vulnerability of people who inject drugs (PWID) to HIV and other infections is widely recognised; however, studies have focused on individuals who inject psychoactive drugs (such as opiates and stimulants) rather than those who inject drugs to enhance image and performance.[1,2,3,4] The number of injectors of image and performance enhancing drugs (IPEDs) in contact with needle and syringe programmes (NSPs) has grown substantially in the United Kingdom (UK);[5] and there has been increasing concern about the use of IPEDs and the associated harms in the UK and elsewhere.[3,5,6,7,8,9,10,11]

A range of illicit drugs can be injected with the aim of changing image and performance. These drugs range from tanning drugs, such as 'Melanotan-II',[12] to those used in body-building, such as human growth hormone.[3,13] The most commonly injected and studied IPEDs are anabolic steroids (AS).[3,5] IPEDs are taken both orally and by injection, with some predominantly injected and others taken only orally. Many users of these substances also take an array of different drugs.[3,5,14] The use, and particularly the injection of IPEDs has been associated with a range of harms including infections caused by bacteria[15,16,17,18,19] and blood borne viruses (BBVs).[6,20,21,22,23,24,25]

In England and Wales (E&W) surveillance of HIV and viral hepatitis among PWID is undertaken through an annual unlinked-anonymous survey[26,27] targeted at injectors of psychoactive drugs. A very small number of IPED injectors participated in this survey;[20] among the 149 sampled during the 1990s, 2% had antibodies to the hepatitis B core antigen (anti-HBc, a marker of having ever been infected with hepatitis B virus [HBV]) and none had antibodies to HIV (anti-HIV).[20] In a surveillance study of NSP clients in Australia, 1.6% (n=318) of those participating over a 10-year period reported steroid injection, with 10% having antibodies to hepatitis C virus (anti-HCV) and none

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anti-HIV.[21] Only one other survey of IPED injectors has collected biological samples; this study purposively recruited 63 AS injectors in Victoria, Australia, and found 12% had anti-HBc, 9.5% anti-HCV, and none anti-HIV.[6] A second Australian study found that half of IPED users sampled had ever experienced an injection-related health problem, with 6% having ever had an abscess.[8]

A number of other UK studies have recruited IPED injectors – principally AS injectors – however, none of these collected biological samples. These studies were mostly small (N<100), and typically recruited through gyms,[28,29,30,31,32,33] with two recruiting gay men.[34,35] The prevalence of ever sharing injecting equipment in these studies ranged from 0.3% to 6%,[20,28,29,30,32] but in one it was 20%.[33] The sharing of drug vials was more common (2.4%[35]; 9.9%[34]; 23%[32]). Studies elsewhere have found similar levels of equipment sharing.[6,8] IPED users also report using psychoactive drugs, particularly stimulants, though the reported injection of psychoactive drugs is rare.[6,8,28,35,36] IPED users also tend to have more sexual partners than their comparison groups,[20,28] report risky sexual behaviours,[20,32] and low levels of condom use;[28,34] suggesting an elevated risk for HIV infection through sexual activity.

During 2010 and 2011, in response to the increasing concerns about IPED use, a targeted survey was undertaken as part of the on-going unlinked-anonymous survey of PWID. The aim of this survey was to describe the:- a) patterns of drug use and injecting risk; b) sexual behaviours; and c) BBV prevalence among IPED injectors. As far as we are aware this is the largest, and the first study outside of Australia, to purposively recruit IPED injectors to measure the prevalence of anti-HIV, anti-HBc and anti-HCV.

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HIV and image & performance enhancing drug use. 8

METHODS

Recruitment. In E&W, PWID have been recruited into a voluntary unlinked-anonymous monitoring survey since 1990, methodological details of this cross-sectional survey have been published previously.[26,27,37] Briefly, agencies providing services to PWID (e.g. NSPs and addiction treatment) at sentinel locations throughout E&W invite clients who have ever injected to participate. Sentinel sites are selected so as to reflect both the geographic distribution and range of services offered to PWID. Those who consent to participate (overall refusal rate during 2010/11, 4.7%) provide a biological sample and self-complete a brief questionnaire focused on psychoactive drug use.[26,27,37] The survey has multi-site ethics approval. This study purposively recruited IPED injectors through 19 sites that provided NSP. Participants were recruited either when attending a NSP site or through outreach provision, they provided an oral-fluid sample and self-completed a short, specially developed, questionnaire focused on IPED use (types of drug used and routes of administration), related behaviours (injecting practices and sexual behaviours) and health service use.

Laboratory methods. Oral-fluid specimens were collected using the OraSure™ device (OraSure Technologies Inc, Pennsylvania, USA). These were tested for anti-HIV using an in-house GACELISA with similar performance to GACELISA HIV 1+2 (Abbott Murex Diagnostics Ltd, Dartford, UK). Reactive specimens underwent further testing according to a proven algorithm that included a second ELISA and Western Blot (sensitivity and specificity approaches 100%[38]). Anti-HCV testing employed a previously validated commercial enzyme-immunoassay (Ortho HCV 3.0 SAVe, Ortho Diagnostics) with 92% sensitivity and 99% specificity,[39] and for anti-HBc an in-house IgG class-specific antibody capture EIA procedure was used, estimated sensitivity 75% and specificity 99% (JV Parry & A Judd, personal communication). Oral-fluid sample quality was verified by

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testing each one for the presence of a pre-determined minimum quantity of total IgG (1mg/litre) employing an in-house ELISA method.

Analyses. Descriptive analyses were undertaken first, then bivariate associations ($p<0.05$) between outcomes variables (anti-HIV, anti-HBc and anti-HCV positivity, equipment sharing and condom use) and co-variates (age, drug use, sexual practice, and health services use; table 1) were examined using Fisher's exact (when expected cell frequencies <5) and Pearson's Chi-square tests. Where possible associations were found ($p<0.10$) these were further examined via logistic regression models using forward stepwise procedures to select variables, with selection based on the likelihood ratio test ($p<0.05$). All analyses were undertaken using SPSS 19.

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RESULTS

Between May 2010 and May 2011, 400 IPED injectors participated in this study; five (1.25%) women were excluded from the analyses (due to the small number). The participants characteristics and health service usage are summarised in table 1. Of those reporting their age (88%, n=347), a quarter (27%) were aged <25 years. During the preceding year, 45% had seen a General Practitioner and 28% had taken prescribed medication.

Drug Use. Details of the participants IPED use during the preceding year are given in table 1. AS were the mostly commonly injected IPED (86%), and over half also reported consuming these orally (57%); a third reported injecting growth hormone (32%), and almost a quarter using oral anti-oestrogens (23%). Overall 65% (n=252) had taken an IPED orally during the preceding year, with 58 (23%) of these having taken two types orally, and 85 (34%) ≥3 types. Most had injected only one type of IPED during the preceding year; however, 87 (22%) had injected two types and 58 (15%) ≥3 types. Considering both injecting and oral use, 71 (18%) had taken two types of IPED and 133 (34%) ≥3 during the preceding year.

Those who injected human growth hormone were more like to be older (aged >35 years) than those who had not (37% [47/128] vs. 22% [60/267], p<0.001); there were no other significant differences in the IPEDs used by age. During the preceding year most of the participants (74%) reported that they had usually injected themselves, and the majority (88%) had injected intramuscularly (table 1).

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Table 1: Characteristics of male injectors of image and performance drugs (IPED).

Characteristics			n	***IPED use, last year***			n	***Use of other illicit drugs***			n
Age, years	Under 25	27%	106	Years since first used a IPED	0 to 4	36%	141	Ever injected illicit drug other than an IPED		4.8%	19
	25 to 34	34%	134		5 or more	32%	128	Snorted cocaine, last year		46%	181
	35 and over	27%	107		*Median (IQR)*	*4 (8)*		Snorted, drunk or swallowed amphetamine, last year		12%	47
	Median (IQR)	*28 (13)*			Not reported	32%	126	***Injecting practice***			
	Not reported	12%	48	*IPED injected*				Usually injected by, last year	Someone else	17%	68
Had ever been in prison		16%	63	Anabolic steroids		86%	340		Myself	74%	294
Health service use				Growth hormone		32%	128		Not reported	8.4%	33
Ever used a Needle and Syringe Programme		75%	298	Human chorionic gonadotropin (hCG)		16%	62	Intramuscular injection, last year		88%	346
Seen a General Practitioner about their health, last year		45%	178	Insulin		5.6%	22	Subcutaneous injection, last year		39%	154
Sought advice at an Emergency / Minor injuries clinic, last year		16%	64	Melanotan I /II		8.6%	34	Ever shared needle, syringe or vial		8.9%	35
Taken / used prescribed medication, last year		28%	111	Others (incl. EPO, IGF–1 and Nubain)		5.1%	20	***Sexual Behaviour, last year***			
Sought advice from a sexual health / STI clinic, last year		17%	68	*IPED taken orally*				Number of sexual partners	One	38%	152
Taken up offer of the vaccine against hepatitis B		23%	90	Anabolic steroids		57%	226		Two or more	47%	187
Ever had a blood test for hepatitis C		22%	85	Anti–oestrogens		23%	92		No sex / Not reported	14%	56
Ever had a blood test for HIV		31%	122	Clenbuterol		15%	60	Gender of sexual partners	Male partner(s)	3.3%	13
Symptom of injury or infection at injection site				Ephedrine		20%	78		No male partners	82%	323
Ever had redness at an injection site		43%	168	Thyroid hormones		9%	37		No sex / Not reported	15%	59
Ever had an injection site abscess/sore/open wound		6.8%	27	Phosphodiesterase type 5 inhibitors ("Viagra /Cialis")		6.6%	26	Always condom (anal / vaginal sex) or no sex		20%	78
				Other (incl. diuretics, DNP, prohormones/designer supplements)		12%	46				

Key. STI: sexually transmitted infection; EPO: ethryopoetin; IGF–1: insulin–like growth factor 1; Nubain: nalbuphine hydrochloride; DNP: 2,4–dinitrophenol.

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The participant's also reported psychoactive drug use (table 1), with 46% snorting cocaine and 12% snorting, drinking or swallowing amphetamine during the preceding year. Ever having injected a psychoactive drug (including heroin and cocaine) was reported by 4.8% (table 1). Those who had injected a psychoactive drug were more likely to report injecting insulin as an IPED than those who had not (21% [4/19] vs. 4.8% [18/376], p=0.016); there were no other significant differences in the IPEDs used between those who injected psychoactive drugs and those who had not.

Overall, 8.9% (95%CI 6.4%-12%) reported having ever shared a needle/syringe or drugs vial (table 1); 27 (6.8%) had just shared a vial, six (1.5%) had just shared a needle/syringe and two (0.51%) had shared both. Factors associated with sharing are summarised in table 2. In the multivariable analysis ever having shared a needle/syringe or drug vial was associated with having ever injected a psychoactive drug, having sought advice from a SH/STI clinic, subcutaneous injection, and having snorted, drunk or swallowed amphetamine (table 2).

Sexual behaviour. Nine-tenths (89%, 350/395) reported having anal or vaginal sex in the preceding year, and 9.1% (36/395) had ≥10 partners (table 1). Considering just female partners, 20% (80/395) of respondents had ≥5. Thirteen (3.3%) reported ≥1 male sexual partners during the preceding year (table 1). Those reporting male sexual partners were older than those who did not (median age 38 years, IQR 12; and 28 years, IQR 11, respectively). Those reporting male sexual partners were also more likely to have ever injected a psychoactive drug (23% [3/13] vs. 4.2% [16/382], p=0.020), more likely to report snorting, drinking, or swallowing amphetamine during the last year (46% [6/13] vs. 11% [41/382], p=0.002), and a higher proportion reported snorting cocaine, but this was not significant (62% [8/13] vs. 45% [173/382], p=0.248). Those reporting male sexual partners were also more likely to report having ever shared a needle/syringe or vial (25%

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[4/13] vs. 8.1% [31/382], p=0.021). A higher proportion of those reporting male sexual partners reported always using condoms during the last year, but this difference was not significant (38% [5/13] vs. 19% [73/382], p=0.146). There were no differences in the types of IPED used, nor in their routes of administration, between those reporting male partners and those not.

Among those who reported sex during the preceding year, 14% (95%CI 11%-18%, 48/350) had always used condoms. Factors associated with condom use are given in table 2. Always using condoms among those who had had sex during the preceding year was associated in the multivariable analysis with having had a male sexual partner and having not snorted cocaine (table 2).

BBV prevalence. Overall, 1.5% (95%CI 0.7%-3.3%; n=6) had anti-HIV, 8.8% (95%CI 6.4%-12%) had ever been infected with hepatitis B (26 anti-HBc positive, adjusted for test sensitivity of 0.75) and 5.5% (95%CI 3.7%-8.2%) with hepatitis C (20 anti-HCV positive, adjusted for test sensitivity of 0.92). Covariates associated with anti-HIV, anti-HBc or anti-HCV positivity are given in table 3. In the multivariable analysis, anti-HIV positivity was associated with having male sexual partners in preceding year, ever having an abscess/sore/open wound at injection site, and having sought advice from a SH/STI clinic in the preceding year (table 3). Having anti-HBc was associated in the multivariable analysis with having obtained advice from SH/STI clinic and having not injected subcutaneously in the preceding year (table 3). Anti-HCV positivity was associated with having ever injected a psychoactive drug and having taken a phosphodiesterase type 5 inhibitor (PDE5i) in the preceding year in the multivariable analysis (table 3).

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Table 2: Factors associated with risk behaviours among male injectors of image and performance drugs (IPED).

		Total	Yes		Unadjusted odds ratio with 95% CI		Adjusted odds ratio with 95% CI	
Ever shared needle, syringe or vial		395	35	8.9%				
Number of sexual partners, last year	One	152	8	5.3%	0.3	0.12 – 0.94		
	Two or more	187	19	10%	0.7	0.28 – 1.6		
	Not reported / No sex	56	8	14%	1.0		†	
	Pearson Chi-Square	*p=*	*0.088*					
Gender of sexual partners, last year	Male partner(s)	13	4	31%	5.5	1.6 – 19		
	No male partners	323	24	7.4%	1.0		†	
	Not reported / No sex	59	7	12%	1.7	0.69 – 4.1		
	Pearson Chi-Square	*p=*	*0.010*					
Injected illicit other than IPED	Yes	19	7	37%	7.2	2.6 – 20	6.3	2.1 – 19
	No / Not reported	376	28	7.4%	1.0		1.0	
	Fisher's Exact Test	*p=*	*0.001*					
Sought advice from a sexual health /STI clinic, last year	Yes	68	11	16%	2.4	1.1 – 5.2	2.2	1.0 – 5.1
	No / Not sure	327	24	7.3%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.020*					
Injected growth hormone (as IPED)	Yes	128	18	14%	2.4	1.2 – 4.8		
	No	267	17	6.4%	1.0		†	
	Pearson Chi-Square	*p=*	*0.012*					
Injected insulin (as IPED)	Yes	22	5	23%	3.4	1.2 – 9.8		
	No	373	30	8.0%	1.0		†	
	Fisher's Exact Test	*p=*	*0.035*					
Subcutaneous injection, last year	Yes	154	21	14%	2.6	1.3 – 5.2	3.0	1.4 – 6.5
	No / Not sure	241	14	6%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.008*					
Snorted cocaine, last year	Yes	181	22	12%	2.1	1.0 – 4.4		
	No	214	13	6.1%	1.0		†	
	Pearson Chi-Square	*p=*	*0.034*					
Snorted, drunk or swallowed amphetamine, last year	Yes	47	11	23%	4.1	1.9 – 9.1	4.1	1.7 – 9.8
	No	348	24	6.9%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.0002*					

Always used condom for anal / vaginal sex		350	48	14%				
Gender of sexual partners, last year	Male partner(s)	13	5	38%	8.1	0.8 - 83	14	1.3 - 155
	No male partners	323	42	13%	1.9	0.25 - 15	2.8	0.35 - 22
	Not reported	14	1	7.1%	1.0		1.0	
Pearson Chi-Square		p=	0.025					
Ever had a blood test for hepatitis C	Yes	82	17	21%	3.2	1.1 - 9		
	No	201	26	13%	1.8	0.68 - 5.0	†	
	Not sure	67	5	7.5%	1.0			
	Pearson Chi-Square	p=	0.057					
Injected anabolic steroids	Yes	304	46	15%	3.9	0.92 - 17	4.2	0.96 - 18
	No	46	2	4.3%	1.0		1.0	
	Pearson Chi-Square	p=	0.048					
Intramuscular injection, last year	Yes	310	46	15%	3.3	0.77 - 14		
	No / No sure	40	2	5.0%	1.0		†	
	Pearson Chi-Square	p=	0.089					
Snorted cocaine, last year	Yes	162	11	7%	0.3	0.1 - 0.6	0.2	0.12- 0.52
	No	188	37	20%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.0005*					

† Not in final model.

Key. STI: sexually transmitted infection.

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After excluding those who reported either sex with men or ever injected a psychoactive drug, 0.8% had anti-HIV (95%CI 0.28%-2.4%, 3/366), 8.0% anti-HBc (95%CI 5.6%-11%, adjusted for test sensitivity, 22/366), and 4.7% anti-HCV (95%CI 2.9%-7.3%, adjusted for test sensitivity, 16/366); with 10% (95%CI 7.7%-14%, 38/366) having one or more of these three markers. In this group, having anti-HIV was found to be associated only with ever having had an abscess/wound at an injection site (8% [2/25] vs. 0.29% [1/341] for those who had not, p=0.013), and having anti-HBc was only associated with having sought advice from a SH/STI clinic in the preceding year (16% [9/56] vs. 4.2% [13/310] for those who had not, p=0.002). The use of three types IPEDs was associated with having anti-HCV: having taken a PDE5i (21% [5/24] vs. 3.2% [11/342] for those who had not, p=0.002); having injected insulin as IPED (18% [3/17] vs. 3.7% [13/349] for those who had not, p=0.032); and having injected a less commonly used IPED (17% [3/18] vs. 3.7% [13/348] for those who had not, p=0.037).

In total, 47 (12%, 95%CI 9.1%-15%;) were positive for one or more of anti-HIV, anti-HBc and anti-HCV, with 43 having just one of these markers and four having two or more of these markers. Two had both anti-HBc and anti-HCV, one of these reported injected psychoactive drugs, neither reported having had sex with men. One, who reported both sex with men and injecting psychoactive drugs, had both anti-HIV and anti-HBc; the remaining participant had all three markers and did not report with either sex with men or injecting psychoactive drugs.

Uptake of interventions related to the three BBV infections was poor. Overall, only 23% reported receiving a dose of HBV vaccine, 31% ever having a diagnostic HIV test and 22% having a HCV test (table 1).

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Table 3: Factors associated with HIV, hepatitis B and C infection among male injectors of image and performance drugs (IPED).

		Total	Positive		Unadjusted odds Ratio with 95% CI			Adjusted odds Ratio with 95% CI			
HIV		395	6	1.5%							
Age, years*	Aged<35 or age unknown	287	1	0.3%	1.0						
	Aged 35 or over	102	5	4.9%	14	1.62	- 122				
	Fisher's Exact Test	*p=*	*0.006*					*			
Gender of sexual partners last year*	Male sexual partner	13	3	23%	38	6.79	- 211				
	No male partner reported/No sex	382	3	0.8%	1.0						
	Fisher's Exact Test	*p=*	*0.001*								
Gender of sexual partners last year and Age (in years)	Male sexual partner	13	3	23%	85	8.13	- 893	79	4.29	-	1,450
	No male partners, aged<35 or age not reported	285	1	0.4%	1.0			1.0			
	No male partners, aged 35 or over	97	2	2.1%	6	0.54	- 67	9	0.59	-	135
	Pearson Chi-Square	*p<*	*0.001*								
Injected illicit other than PIED	Yes	19	2	11%	11	1.87	- 64				
	No / Not reported	376	4	1.1%	1.0			†			
	Fisher's Exact Test	*p=*	*0.029*								
Ever had an abscess/sore/open wound at injection site	Yes	27	2	7.4%	7.3	1.27	- 42	77	3.27	-	1,795
	No / Not sure	368	4	1.1%	1.0			1.0			
	Fisher's Exact Test	*p=*	*0.057*								
Taken or used any prescribed medication in last year	Yes	111	5	4.5%	13	1.54	- 116				
	No / Not sure	284	1	0.4%	1.0			†			
	Fisher's Exact Test	*p=*	*0.008*								
Sought advice from a sexual health /STI clinic, last year?	Yes	68	4	5.9%	10	1.82	- 57	24	1.03	-	542
	No / Not sure	327	2	0.6%	1.0			1.0			
	Fisher's Exact Test	*p=*	*0.009*								
Have you ever been vaccinated against hepatitis B	Yes	90	4	4.4%	7.0	1.27	- 39				
	No / Not sure	305	2	0.7%	1.0			†			
	Fisher's Exact Test	*p=*	*0.026*								
Have you ever had a blood test for hepatitis C	Yes	81	4	4.7%	7.6	1.37	- 42				
	No / Not sure	308	2	0.9%	1.0			†			
	Fisher's Exact Test	*p=*	*0.021*								
Have you ever had a blood test for HIV?	Yes	122	4	3.3%	4.6	0.83	- 25				
	No / Not sure	273	2	0.7%	1.0			†			
	Fisher's Exact Test	*p=*	*0.076*								
Ever shared needle, syringe or vial	Yes	35	2	5.7%	5.4	0.95	- 31				
	No / Not sure	360	4	1.1%	1.0			†			
	Fisher's Exact Test	*p=*	*0.091*								

* Combined variable was entered into the final multivariate model due to an interaction between age and reporting male sexual partners: with 77% of those with male sexual partners aged over 35 years compared with 25% of those not reporting male sexual partners.

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Table 3 cont: Factors associated with HIV, hepatitis B and C infection among male injectors of image and performance drugs (IPED).

		Total	Positive		Unadjusted odds ratio with 95% CI		Adjusted odds ratio with 95% CI	
Anti-HBc		395	26	6.6%				
Sought advice from a sexual health /STI clinic, last year?	Yes	68	10	14.7%	3.4	1.4 – 7.7	3.8	1.6 – 8.9
	No / Not sure	327	16	4.9%	1.0		1.0	
	Fisher's Exact Test	p=	0.006					
Subcutaneous injection, last year	Yes	154	6	3.9%	1.0		1.0	
	No / Not sure	241	20	8.3%	2.2	0.88 – 5.7	2.6	0.99 – 6.7
	Pearson Chi-Square	p=	0.085					
Anti-HCV		395	20	5.1%				
Age, years	Under25	106	4	3.8%	1.0			
	25–34	134	3	2.2%	0.58	0.13 – 2.7		
	35 and over	107	10	9.3%	2.6	0.80 – 8.7	†	
	Not reported	48	3	6.3%	1.7	0.37 – 7.9		
	Pearson Chi-Square	p=	0.078					
Injected illicit other than IPED	Yes	19	3	15.8%	4.0	1.1 – 15	4.4	1.1 – 17.2
	No / Not reported	376	17	4.5%	1.0		1.0	
	Fisher's Exact Test	p=	0.064					
Taken or used any prescribed medication, last year	Yes	111	10	9.0%	2.7	1.1 – 7		
	No / Not sure	284	10	3.5%	1.0		†	
	Pearson Chi-Square	p=	0.025					
Ever had a blood test for hepatitis C	Yes	85	8	9.4%	1.7	0.55 – 5.6		
	No	221	7	3.2%	0.5	0.17 – 1.8		
	Not sure	89	5	5.6%	1.0		†	
	Pearson Chi-Square	p=	0.080					
Taken Phosphodiesterase type 5 inhibitors ("Viagra / Cialis")	Yes	26	5	19%	5.6	1.9 – 17	6.0	1.9 – 18
	No	369	15	4.1%	1.0		1.0	
	Fisher's Exact Test	p=	0.007					
Injected insulin (as IPED)	Yes	22	4	18%	5.0	1.5 – 16		
	No	373	16	4.3%	1.0		†	
	Fisher's Exact Test	p=	0.019					
Other injected IPED (incl. EPO, IGF–1 and Nubain)	Yes	20	3	15%	3.7	0.99 – 14		
	No	375	17	4.5%	1.0		†	
	Fisher's Exact Test	p=	0.073					
Ever shared needle, syringe or drug vial	Yes	35	4	11%	2.8	0.87 – 8.8		
	No / Not sure	360	16	4%	1.0		†	
	Fisher's Exact Test	p=	0.090					

† Not in final model.

Key. STI: sexually transmitted infection; EPO: ethryopoetin; IGF–1: insulin–like growth factor 1; Nubain: nalbuphine hydrochloride.

DISCUSSION

IPED injectors are at risk of infection with HIV as well as other BBVs. This is the first prevalence study to have found HIV among IPED injectors, with the prevalence at 1.5%, similar to that found among injectors of psychoactive drugs in England and Wales (1.2%,

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2011[40]). However, anti-HBc and anti-HCV – at 8.8% and 5.5% respectively – are lower than among psychoactive drug injectors (16% and 43% respectively, 2011 [40]). The prevalence of all three BBVs in this sample would appear to be higher than that found in the general UK population.[41,42] Once those who reported either sex with men or injecting psychoactive drugs were excluded, 10% had been infected with one or more of HIV, hepatitis B and hepatitis C.

It is important to consider the limitations of this study. The comparative rarity, marginalisation and illicit nature of injecting drug use impede the construction of a sampling frame, making the representativeness of our sample impossible to measure. This study used an established methodology for recruiting PWID through specialist services;[26,27] however, the robustness of this approach for IPED injectors is unknown and cannot currently be assessed due to the very limited knowledge on the size and nature of this group.[3,5] The use of NSP to access this group was a pragmatic approach; community based recruitment approaches, such as Respondent Driven Sampling and Time-Location Sampling, that are often advocated for hard to reach populations[43] are possible alternatives. However, these are likely to be difficult to implement with this group due to the diversity of the drugs used, the clandestine and close-knit nature of this group and because use usually takes place in private settings (such as homes or gyms).[3,5] The findings here also rely on self-reported behaviours – though their reliability has not been assessed among IPED users, these have been found to be reliable for psychoactive drug injectors[44,45] - and infection with BBVs has been determined by laboratory-based biological data from the testing of oral-fluid samples. Whilst oral-fluid testing is highly sensitive for anti-HIV, the sensitivity is reduced for anti-HCV and anti-HBc.[39] Whilst this study is the largest of BBVs in this population, the sample size still restricts its power, and consequently caution is needed when attempting to generalise these findings to the wider population of IPED injectors.

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The levels of HIV and anti-HBc are both higher than in the only previous UK study to measure these in IPED injectors. Undertaken >10 years ago using a similar methodology, this found no HIV and an anti-HBc prevalence of 2%;[20] suggesting that the prevalence of these infections among IPED injectors *might* have increased over time. Exposure to BBVs among IPED injectors appears to be associated with sexual risks and the injection of psychoactive drugs; although *injecting* psychoactive drugs is rare among IPED injectors, unprotected sex with multiple partners is common. The sharing of injecting equipment or drug vials among IPED injectors at 8.9% is much less common than among injectors of psychoactive drugs (in 2011, 37% of psychoactive drug injectors reported recently sharing injecting equipment[40]). Though exposure was not associated with sharing in the multivariate analyses in this study, BBV transmission through IPED injection cannot be excluded as this study may have lacked sufficient power to detect this.

The associations between having HIV and the use of SH/STI clinics and having male sexual partners, suggest that HIV transmission among IPED injectors might be related to sexual activity. This association may reflect AS use by some HIV positive gay and bisexual men to mask the longer-term effects of HIV infection.[35] The association with having an abscess/wound at the injection site probably reflects the greater vulnerability of PWID with HIV to injection related bacterial infections.[46,47] The association between exposure to HBV and having obtained advice from a SH/STI clinic is again suggestive of a role for sexual risk in infection, particularly as sexual transmission is the main route by which the HBV is now acquired within the UK.[48] The association between having anti-HBc and not injecting subcutaneously suggests that certain patterns of IPED use might be related to increased risk; as some IPED are only injected subcutaneously and others only intramuscularly, and many users take several types.[3,8,12,13,14] Exposure to

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HCV, however, would appear to be associated with the injection of psychoactive drugs – an association that has been previously noted[6] - this finding might reflect more frequent injecting in this sub-group. Sexual activity may also play a role, assuming that the use of PDE5i is related to improving or maintaining sexual performance. These associations all require further investigation.

The level sharing found here was in-line with previous studies of injecting risk among IPED users.[20,28,29,30,32,33,35] The association between sharing and subcutaneous injection, suggests that sharing – like HBV exposure – may be associated with certain patterns of IPED use. As in previous studies of IPED injectors, sexual activity was common, and condom use was poor.[20,28,34] Condom use was higher among those with male sexual partners, and lower among those who reported snorting cocaine. The more frequent use of condoms by gay and bisexual men probably reflects awareness of their increased HIV risk.[42] The association with cocaine use might possibly be related to its use as a sexual stimulant, with this possibly related to attempts to counteract the reduced libido experienced on discontinuation of AS use or in the periods between courses of AS use ('off-cycles').[14] In part, this effect may be as a result of the decrease in endogenous testosterone production,[49] and is why IPEDs users self-treat with human chorionic gonadotrophin in an attempt to stimulate endogenous production, with PDE5i used to symptomatically treat erectile dysfunction.[5,14,50] Increased libido following AS administration is also reported by users[14,33,34,51] with similar effects being reported following the use of drugs such as melanotan-II.[12]

Associations were found between psychoactive drug use and both sharing and poor condom use. IPED users who also use psychoactive drugs may be a higher risk – or perhaps less risk averse - sub-group. Whilst this needs further investigation, it suggests – considering the substantial levels of psychoactive drug use found here and in previous

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studies[6,8,28,35,36] – that those using both IPED and psychoactive drugs should be an important target group for harm reduction interventions.

This study indicates that those providing services to PWID – particularly NSPs, outreach services and General Practitioners - should be alert to the needs of those who use IPEDs. In particular, they need to be aware of the range drugs that may be used by this group and of the associated injecting practices as these differ from those of psychoactive drug injectors. Considering the BBV prevalence and levels risk found specialist services for PWID need to both engage with IPED users and ensure that they have access to appropriate injecting equipment and targeted harm reduction advice. They should also ensure that this group has access to testing for BBVs, hepatitis B vaccinations, sexual health services, and condoms.

Our findings suggest that sexual risk and the use, and particularly the injection, of psychoactive drugs are possibly the most important factors associated with BBV transmission among IPED injectors. The transmission of HIV and other BBV through the injecting of IPED cannot be excluded, and this is certainly possible as equipment sharing does occur. However, this study largely recruited through NSP providing injecting equipment and advice. IPED injectors not in contact with NSP may have a different risk profile and so infection risk. Even so, our findings suggest the need for targeted interventions to address sexual health needs, psychoactive drug use, and the injection practices among IPED injectors. Considering the limitations of this study, a larger study recruiting from a wider range of settings and collecting dried-blood samples is needed to more fully examine prevalence and, in particular, the associated risk factors, and so the role of IPED injection in transmission of HIV and other BBVs.

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Prevalence of, and risk factors for, HIV, hepatitis B and C infections among men who inject image and performance enhancing drugs.

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Abstract

Background: People who inject drugs' vulnerability to infection is widely recognised; however, studies have rarely focused on users of image and performance enhancing drugs (IPEDs). IPEDs can be used to change appearance for aesthetic reasons, as well as to improve performance. Needle and syringe programme (NSP) use by IPED injectors has grown substantially in the United Kingdom.

Objective: to describe drug use, sexual risks, and the prevalence of blood-borne viral infections among IPED injectors.

Design/Setting/Participants: A voluntary unlinked-anonymous cross-sectional bio-behavioural survey of male IPED injectors using 19 NSPs.

Results: Of the 395 participants (median age 28 years), 36% had used IPEDs for <5 years. Anabolic steroids (86%), growth hormone (32%) and human chorionic gonadotropin (16%) were most frequently injected, with 88% injecting intramuscularly and 39% subcutaneously. Two-thirds also used IPEDs orally. Recent psychoactive drug use was common (46% cocaine, 12% amphetamine), 5% had ever injected a psychoactive drug, and 9% had shared injecting equipment. "Viagra/Cialis" was used by 7%; with 89% reporting anal/vaginal sex in the preceding year (20% had 5+ female-partners, 3% male-partners) with 13% always using condoms. Overall, 1.5% had HIV, 9% had antibodies to the hepatitis B core antigen (anti-HBc) and 5% to hepatitis C (anti-HCV). In multivariate analysis, having HIV was associated with: seeking advice from a sexual health clinic; having had an injection site abscess/wound, and having male-partners. After excluding those reporting male-partners or injecting psychoactive drugs, 0.8% had HIV, 8% anti-HBc, and 5% anti-HCV. Only 23% reported hepatitis B vaccine uptake, and diagnostic testing uptake was poor (31% HIV, 22% hepatitis C).

Conclusions: Previous prevalence studies had not found HIV among IPED injectors. HIV prevalence in this, the largest study of blood-borne viruses among IPED injectors, was

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similar to that among injectors of psychoactive drugs. Findings indicate a need for targeted interventions.

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Article summary

Article focus:

- Over the last decade the number of men using needle and syringe programmes who report injecting image and performance enhancing drugs has risen in England and Wales; as a result there has been increased concern about the levels of blood-borne viral infections in this group.
- This study describes the nature of drug use and the risk behaviours in this population, as well as the prevalence of HIV, hepatitis B and C.

Key messages:

- The overall prevalence of HIV among men injecting image and performance enhancing drugs was similar to that among those injecting psychoactive drugs in England & Wales. Previous prevalence studies of people who inject image and performance enhancing drugs had not detected HIV.
- When the results of this study are compared to those of a previous study undertaken in England & Wales in the mid-1990s, they suggest that the prevalence of hepatitis B infection among injectors of image and performance enhancing drugs *might* have increased over time.
- Sexual risk behaviours and psychoactive drug use were common among injectors of image and performance enhancing drugs, and the sharing of injecting equipment was also reported. The uptake of diagnostic testing for blood borne-viral infections and the vaccine against hepatitis B were low.

Strengths and limitations of this study:

- This study recruited image and performance enhancing drugs users through needle and syringe programmes. Injectors of these drugs who are not in contact with these services may have a different risk profile and levels of infection.
- Oral-fluid testing was used to detect antibodies to HIV, hepatitis B and C; however, tests on these samples for both anti-HCV and anti-HBc have reduced sensitivity.

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- This study is the largest of blood-borne viruses among men who inject image and performance enhancing drugs, however, the sample size still restricts its power. Consequently, caution is needed when attempting to generalise these findings.

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INTRODUCTION

The vulnerability of people who inject drugs (PWID) to HIV and other infections is widely recognised; however, studies have focused on individuals who inject psychoactive drugs (such as opiates and stimulants) rather than those who inject drugs to enhance image and performance.[1,2,3,4] The number of injectors of image and performance enhancing drugs (IPEDs) in contact with needle and syringe programmes (NSPs) has grown substantially in the United Kingdom (UK);[5] and there has been increasing concern about the use of IPEDs and the associated harms in the UK and elsewhere.[3,5,6,7,8,9,10,11]

A range of illicit drugs can be injected with the aim of changing image and performance. These drugs range from tanning drugs, such as 'Melanotan-II',[12] to those used in body-building, such as human growth hormone.[3,13] The most commonly injected and studied IPEDs are anabolic steroids (AS).[3,5] IPEDs are taken both orally and by injection, with some predominantly injected and others taken only orally. Many users of these substances also take an array of different drugs.[3,5,14] The use, and particularly the injection of IPEDs has been associated with a range of harms including infections caused by bacteria[15,16,17,18,19] and blood borne viruses (BBVs).[6,20,21,22,23,24,25]

In England and Wales (E&W) surveillance of HIV and viral hepatitis among PWID is undertaken through an annual unlinked-anonymous survey[26,27] targeted at injectors of psychoactive drugs. A very small number of IPED injectors participated in this survey;[20] among the 149 sampled during the 1990s, 2% had antibodies to the hepatitis B core antigen (anti-HBc, a marker of having ever been infected with hepatitis B virus [HBV]) and none had antibodies to HIV (anti-HIV).[20] In a surveillance study of NSP clients in Australia, 1.6% (n=318) of those participating over a 10-year period reported steroid injection, with 10% having antibodies to hepatitis C virus (anti-HCV) and none

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anti-HIV.[21] Only one other survey of IPED injectors has collected biological samples; this study purposively recruited 63 AS injectors in Victoria, Australia, and found 12% had anti-HBc, 9.5% anti-HCV, and none anti-HIV.[6] A second Australian study found that half of IPED users sampled had ever experienced an injection-related health problem, with 6% having ever had an abscess.[8]

A number of other UK studies have recruited IPED injectors – principally AS injectors – however, none of these collected biological samples. These studies were mostly small (N<100), and typically recruited through gyms,[28,29,30,31,32,33] with two recruiting gay men.[34,35] The prevalence of ever sharing injecting equipment in these studies ranged from 0.3% to 6%,[20,28,29,30,32] but in one it was 20%.[33] The sharing of drug vials was more common (2.4%[35]; 9.9%[34]; 23%[32]). Studies elsewhere have found similar levels of equipment sharing.[6,8] IPED users also report using psychoactive drugs, particularly stimulants, though the reported injection of psychoactive drugs is rare.[6,8,28,35,36] IPED users also tend to have more sexual partners than their comparison groups,[20,28] report risky sexual behaviours,[20,32] and low levels of condom use;[28,34] suggesting an elevated risk for HIV infection through sexual activity.

During 2010 and 2011, in response to the increasing concerns about IPED use, a targeted survey was undertaken as part of the on-going unlinked-anonymous survey of PWID. The aim of this survey was to describe the:- a) patterns of drug use and injecting risk; b) sexual behaviours; and c) BBV prevalence among IPED injectors. As far as we are aware this is the largest, and the first study outside of Australia, to purposively recruit IPED injectors to measure the prevalence of anti-HIV, anti-HBc and anti-HCV.

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METHODS

Recruitment. In E&W, PWID have been recruited into a voluntary unlinked-anonymous monitoring survey since 1990, methodological details of this cross-sectional survey have been published previously.[26,27,37] Briefly, agencies providing services to PWID (e.g. NSPs and addiction treatment) at sentinel locations throughout E&W invite clients who have ever injected to participate. Sentinel sites are selected so as to reflect both the geographic distribution and range of services offered to PWID. Those who consent to participate (overall refusal rate during 2010/11, 4.7%) provide a biological sample and self-complete a brief questionnaire focused on psychoactive drug use.[26,27,37] The survey has multi-site ethics approval. This study purposively recruited IPED injectors through 19 sites that provided NSP. Participants were recruited either when attending a NSP site or through outreach provision, they provided an oral-fluid sample and self-completed a short, specially developed, questionnaire focused on IPED use (types of drug used and routes of administration), related behaviours (injecting practices and sexual behaviours) and health service use.

Laboratory methods. Oral-fluid specimens were collected using the OraSure™ device (OraSure Technologies Inc, Pennsylvania, USA). These were tested for anti-HIV using an in-house GACELISA with similar performance to GACELISA HIV 1+2 (Abbott Murex Diagnostics Ltd, Dartford, UK). Reactive specimens underwent further testing according to a proven algorithm that included a second ELISA and Western Blot (sensitivity and specificity approaches 100%[38]). Anti-HCV testing employed a previously validated commercial enzyme-immunoassay (Ortho HCV 3.0 SAVe, Ortho Diagnostics) with 92% sensitivity and 99% specificity,[39] and for anti-HBc an in-house IgG class-specific antibody capture EIA procedure was used, estimated sensitivity 75% and specificity 99% (JV Parry & A Judd, personal communication). Oral-fluid sample quality was verified by

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testing each one for the presence of a pre-determined minimum quantity of total IgG (1mg/litre) employing an in-house ELISA method.

Analyses. Descriptive analyses were undertaken first, then bivariate associations ($p<0.05$) between outcomes variables (anti-HIV, anti-HBc and anti-HCV positivity, equipment sharing and condom use) and co-variates (age, drug use, sexual practice, and health services use; table 1) were examined using Fisher's exact (when expected cell frequencies <5) and Pearson's Chi-square tests. Where possible associations were found ($p<0.10$) these were further examined via logistic regression models using forward stepwise procedures to select variables, with selection based on the likelihood ratio test ($p<0.05$). All analyses were undertaken using SPSS 19.

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RESULTS

Between May 2010 and May 2011, 400 IPED injectors participated in this study; five (1.25%) women were excluded from the analyses (due to the small number). The participants characteristics and health service usage are summarised in table 1. Of those reporting their age (88%, n=347), a quarter (27%) were aged <25 years. During the preceding year, 45% had seen a General Practitioner and 28% had taken prescribed medication.

Drug Use. Details of the participants IPED use during the preceding year are given in table 1. AS were the mostly commonly injected IPED (86%), and over half also reported consuming these orally (57%); a third reported injecting growth hormone (32%), and almost a quarter using oral anti-oestrogens (23%). Overall 65% (n=252) had taken an IPED orally during the preceding year, with 58 (23%) of these having taken two types orally, and 85 (34%) ≥3 types. Most had injected only one type of IPED during the preceding year; however, 87 (22%) had injected two types and 58 (15%) ≥3 types. Considering both injecting and oral use, 71 (18%) had taken two types of IPED and 133 (34%) ≥3 during the preceding year.

Those who injected human growth hormone were more like to be older (aged >35 years) than those who had not (37% [47/128] vs. 22% [60/267], p<0.001); there were no other significant differences in the IPEDs used by age. During the preceding year most of the participants (74%) reported that they had usually injected themselves, and the majority (88%) had injected intramuscularly (table 1).

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Table 1: Characteristics of male injectors of image and performance drugs (IPED).

Characteristics			n	***IPED use, last year***			n	***Use of other illicit drugs***			n
Age, years	Under 25	27%	106	Years since first used a IPED	0 to 4	36%	141	Ever injected illicit drug other than an IPED		4.8%	19
	25 to 34	34%	134		5 or more	32%	128	Snorted cocaine, last year		46%	181
	35 and over	27%	107		*Median (IQR)*	*4 (8)*		Snorted, drunk or swallowed amphetamine, last year		12%	47
	Median (IQR)	*28 (13)*			Not reported	32%	126	***Injecting practice***			
	Not reported	12%	48	*IPED injected*				Usually injected by, last year	Someone else	17%	68
Had ever been in prison		16%	63	Anabolic steroids		86%	340		Myself	74%	294
Health service use				Growth hormone		32%	128		Not reported	8.4%	33
Ever used a Needle and Syringe Programme		75%	298	Human chorionic gonadotropin (hCG)		16%	62	Intramuscular injection, last year		88%	346
Seen a General Practitioner about their health, last year		45%	178	Insulin		5.6%	22	Subcutaneous injection, last year		39%	154
Sought advice at an Emergency / Minor injuries clinic, last year		16%	64	Melanotan I /II		8.6%	34	Ever shared needle, syringe or vial		8.9%	35
Taken / used prescribed medication, last year		28%	111	Others (incl. EPO, IGF–1 and Nubain)		5.1%	20	***Sexual Behaviour, last year***			
Sought advice from a sexual health / STI clinic, last year		17%	68	*IPED taken orally*				Number of sexual partners	One	38%	152
Taken up offer of the vaccine against hepatitis B		23%	90	Anabolic steroids		57%	226		Two or more	47%	187
Ever had a blood test for hepatitis C		22%	85	Anti–oestrogens		23%	92		No sex / Not reported	14%	56
Ever had a blood test for HIV		31%	122	Clenbuterol		15%	60	Gender of sexual partners	Male partner(s)	3.3%	13
Symptom of injury or infection at injection site				Ephedrine		20%	78		No male partners	82%	323
Ever had redness at an injection site		43%	168	Thyroid hormones		9%	37		No sex / Not reported	15%	59
Ever had an injection site abscess/sore/open wound		6.8%	27	Phosphodiesterase type 5 inhibitors ("Viagra /Cialis")		6.6%	26	Always condom (anal / vaginal sex) or no sex		20%	78
				Other (incl. diuretics, DNP, prohormones/designer supplements)		12%	46				

Key. STI: sexually transmitted infection; EPO: ethryopoetin; IGF–1: insulin–like growth factor 1; Nubain: nalbuphine hydrochloride; DNP: 2,4–dinitrophenol.

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The participant's also reported psychoactive drug use (table 1), with 46% snorting cocaine and 12% snorting, drinking or swallowing amphetamine during the preceding year. Ever having injected a psychoactive drug (including heroin and cocaine) was reported by 4.8% (table 1). Those who had injected a psychoactive drug were more likely to report injecting insulin as an IPED than those who had not (21% [4/19] vs. 4.8% [18/376], p=0.016); there were no other significant differences in the IPEDs used between those who injected psychoactive drugs and those who had not.

Overall, 8.9% (95%CI 6.4%-12%) reported having ever shared a needle/syringe or drugs vial (table 1); 27 (6.8%) had just shared a vial, six (1.5%) had just shared a needle/syringe and two (0.51%) had shared both. Factors associated with sharing are summarised in table 2. In the multivariable analysis ever having shared a needle/syringe or drug vial was associated with having ever injected a psychoactive drug, having sought advice from a SH/STI clinic, subcutaneous injection, and having snorted, drunk or swallowed amphetamine (table 2).

Sexual behaviour. Nine-tenths (89%, 350/395) reported having anal or vaginal sex in the preceding year, and 9.1% (36/395) had ≥10 partners (table 1). Considering just female partners, 20% (80/395) of respondents had ≥5. Thirteen (3.3%) reported ≥1 male sexual partners during the preceding year (table 1). Those reporting male sexual partners were older than those who did not (median age 38 years, IQR 12; and 28 years, IQR 11, respectively). Those reporting male sexual partners were also more likely to have ever injected a psychoactive drug (23% [3/13] vs. 4.2% [16/382], p=0.020), more likely to report snorting, drinking, or swallowing amphetamine during the last year (46% [6/13] vs. 11% [41/382], p=0.002), and a higher proportion reported snorting cocaine, but this was not significant (62% [8/13] vs. 45% [173/382], p=0.248). Those reporting male sexual partners were also more likely to report having ever shared a needle/syringe or vial (25%

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[4/13] vs. 8.1% [31/382], p=0.021). A higher proportion of those reporting male sexual partners reported always using condoms during the last year, but this difference was not significant (38% [5/13] vs. 19% [73/382], p=0.146). There were no differences in the types of IPED used, nor in their routes of administration, between those reporting male partners and those not.

Among those who reported sex during the preceding year, 14% (95%CI 11%-18%, 48/350) had always used condoms. Factors associated with condom use are given in table 2. Always using condoms among those who had had sex during the preceding year was associated in the multivariable analysis with having had a male sexual partner and having not snorted cocaine (table 2).

BBV prevalence. Overall, 1.5% (95%CI 0.7%-3.3%; n=6) had anti-HIV, 8.8% (95%CI 6.4%-12%) had ever been infected with hepatitis B (26 anti-HBc positive, adjusted for test sensitivity of 0.75) and 5.5% (95%CI 3.7%-8.2%) with hepatitis C (20 anti-HCV positive, adjusted for test sensitivity of 0.92). Covariates associated with anti-HIV, anti-HBc or anti-HCV positivity are given in table 3. In the multivariable analysis, anti-HIV positivity was associated with having male sexual partners in preceding year, ever having an abscess/sore/open wound at injection site, and having sought advice from a SH/STI clinic in the preceding year (table 3). Having anti-HBc was associated in the multivariable analysis with having obtained advice from SH/STI clinic and having not injected subcutaneously in the preceding year (table 3). Anti-HCV positivity was associated with having ever injected a psychoactive drug and having taken a phosphodiesterase type 5 inhibitor (PDE5i) in the preceding year in the multivariable analysis (table 3).

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Table 2: Factors associated with risk behaviours among male injectors of image and performance drugs (IPED).

		Total	Yes		Unadjusted odds ratio with 95% CI		Adjusted odds ratio with 95% CI	
Ever shared needle, syringe or vial		395	35	8.9%				
Number of sexual partners, last year	One	152	8	5.3%	0.3	0.12 – 0.94		
	Two or more	187	19	10%	0.7	0.28 – 1.6		
	Not reported / No sex	56	8	14%	1.0		†	
	Pearson Chi-Square	*p=*	*0.088*					
Gender of sexual partners, last year	Male partner(s)	13	4	31%	5.5	1.6 – 19		
	No male partners	323	24	7.4%	1.0		†	
	Not reported / No sex	59	7	12%	1.7	0.69 – 4.1		
	Pearson Chi-Square	*p=*	*0.010*					
Injected illicit other than IPED	Yes	19	7	37%	7.2	2.6 – 20	6.3	2.1 – 19
	No / Not reported	376	28	7.4%	1.0		1.0	
	Fisher's Exact Test	*p=*	*0.001*					
Sought advice from a sexual health /STI clinic, last year	Yes	68	11	16%	2.4	1.1 – 5.2	2.2	1.0 – 5.1
	No / Not sure	327	24	7.3%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.020*					
Injected growth hormone (as IPED)	Yes	128	18	14%	2.4	1.2 – 4.8		
	No	267	17	6.4%	1.0		†	
	Pearson Chi-Square	*p=*	*0.012*					
Injected insulin (as IPED)	Yes	22	5	23%	3.4	1.2 – 9.8		
	No	373	30	8.0%	1.0		†	
	Fisher's Exact Test	*p=*	*0.035*					
Subcutaneous injection, last year	Yes	154	21	14%	2.6	1.3 – 5.2	3.0	1.4 – 6.5
	No / Not sure	241	14	6%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.008*					
Snorted cocaine, last year	Yes	181	22	12%	2.1	1.0 – 4.4		
	No	214	13	6.1%	1.0		†	
	Pearson Chi-Square	*p=*	*0.034*					
Snorted, drunk or swallowed amphetamine, last year	Yes	47	11	23%	4.1	1.9 – 9.1	4.1	1.7 – 9.8
	No	348	24	6.9%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.0002*					

Always used condom for anal / vaginal sex		350	48	14%				
Gender of sexual partners, last year	Male partner(s)	13	5	38%	8.1	0.8 - 83	14	1.3 - 155
	No male partners	323	42	13%	1.9	0.25 - 15	2.8	0.35 - 22
	Not reported	14	1	7.1%	1.0		1.0	
Pearson Chi-Square		p=	0.025					
Ever had a blood test for hepatitis C	Yes	82	17	21%	3.2	1.1 - 9		
	No	201	26	13%	1.8	0.68 - 5.0	†	
	Not sure	67	5	7.5%	1.0			
	Pearson Chi-Square	p=	0.057					
Injected anabolic steroids	Yes	304	46	15%	3.9	0.92 - 17	4.2	0.96 - 18
	No	46	2	4.3%	1.0		1.0	
	Pearson Chi-Square	p=	0.048					
Intramuscular injection, last year	Yes	310	46	15%	3.3	0.77 - 14		
	No / No sure	40	2	5.0%	1.0		†	
	Pearson Chi-Square	p=	0.089					
Snorted cocaine, last year	Yes	162	11	7%	0.3	0.1 - 0.6	0.2	0.12- 0.52
	No	188	37	20%	1.0		1.0	
	Pearson Chi-Square	*p=*	*0.0005*					

† Not in final model.

Key. STI: sexually transmitted infection.

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After excluding those who reported either sex with men or ever injected a psychoactive drug, 0.8% had anti-HIV (95%CI 0.28%-2.4%, 3/366), 8.0% anti-HBc (95%CI 5.6%-11%, adjusted for test sensitivity, 22/366), and 4.7% anti-HCV (95%CI 2.9%-7.3%, adjusted for test sensitivity, 16/366); with 10% (95%CI 7.7%-14%, 38/366) having one or more of these three markers. In this group, having anti-HIV was found to be associated only with ever having had an abscess/wound at an injection site (8% [2/25] vs. 0.29% [1/341] for those who had not, p=0.013), and having anti-HBc was only associated with having sought advice from a SH/STI clinic in the preceding year (16% [9/56] vs. 4.2% [13/310] for those who had not, p=0.002). The use of three types IPEDs was associated with having anti-HCV: having taken a PDE5i (21% [5/24] vs. 3.2% [11/342] for those who had not, p=0.002); having injected insulin as IPED (18% [3/17] vs. 3.7% [13/349] for those who had not, p=0.032); and having injected a less commonly used IPED (17% [3/18] vs. 3.7% [13/348] for those who had not, p=0.037).

In total, 47 (12%, 95%CI 9.1%-15%;) were positive for one or more of anti-HIV, anti-HBc and anti-HCV, with 43 having just one of these markers and four having two or more of these markers. Two had both anti-HBc and anti-HCV, one of these reported injected psychoactive drugs, neither reported having had sex with men. One, who reported both sex with men and injecting psychoactive drugs, had both anti-HIV and anti-HBc; the remaining participant had all three markers and did not report with either sex with men or injecting psychoactive drugs.

Uptake of interventions related to the three BBV infections was poor. Overall, only 23% reported receiving a dose of HBV vaccine, 31% ever having a diagnostic HIV test and 22% having a HCV test (table 1).

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Table 3: Factors associated with HIV, hepatitis B and C infection among male injectors of image and performance drugs (IPED).

		Total	Positive		Unadjusted odds Ratio with 95% CI			Adjusted odds Ratio with 95% CI			
HIV		395	6	1.5%							
Age, years*	Aged<35 or age unknown	287	1	0.3%	1.0						
	Aged 35 or over	102	5	4.9%	14	1.62	- 122				
	Fisher's Exact Test	*p=*	*0.006*					*			
Gender of sexual partners last year*	Male sexual partner	13	3	23%	38	6.79	- 211				
	No male partner reported/No sex	382	3	0.8%	1.0						
	Fisher's Exact Test	*p=*	*0.001*								
Gender of sexual partners last year and Age (in years)	Male sexual partner	13	3	23%	85	8.13	- 893	79	4.29	-	1,450
	No male partners, aged<35 or age not reported	285	1	0.4%	1.0			1.0			
	No male partners, aged 35 or over	97	2	2.1%	6	0.54	- 67	9	0.59	-	135
	Pearson Chi-Square	*p<*	*0.001*								
Injected illicit other than PIED	Yes	19	2	11%	11	1.87	- 64				
	No / Not reported	376	4	1.1%	1.0			†			
	Fisher's Exact Test	*p=*	*0.029*								
Ever had an abscess/sore/open wound at injection site	Yes	27	2	7.4%	7.3	1.27	- 42	77	3.27	-	1,795
	No / Not sure	368	4	1.1%	1.0			1.0			
	Fisher's Exact Test	*p=*	*0.057*								
Taken or used any prescribed medication in last year	Yes	111	5	4.5%	13	1.54	- 116				
	No / Not sure	284	1	0.4%	1.0			†			
	Fisher's Exact Test	*p=*	*0.008*								
Sought advice from a sexual health /STI clinic, last year?	Yes	68	4	5.9%	10	1.82	- 57	24	1.03	-	542
	No / Not sure	327	2	0.6%	1.0			1.0			
	Fisher's Exact Test	*p=*	*0.009*								
Have you ever been vaccinated against hepatitis B	Yes	90	4	4.4%	7.0	1.27	- 39				
	No / Not sure	305	2	0.7%	1.0			†			
	Fisher's Exact Test	*p=*	*0.026*								
Have you ever had a blood test for hepatitis C	Yes	81	4	4.7%	7.6	1.37	- 42				
	No / Not sure	308	2	0.9%	1.0			†			
	Fisher's Exact Test	*p=*	*0.021*								
Have you ever had a blood test for HIV?	Yes	122	4	3.3%	4.6	0.83	- 25				
	No / Not sure	273	2	0.7%	1.0			†			
	Fisher's Exact Test	*p=*	*0.076*								
Ever shared needle, syringe or vial	Yes	35	2	5.7%	5.4	0.95	- 31				
	No / Not sure	360	4	1.1%	1.0			†			
	Fisher's Exact Test	*p=*	*0.091*								

* Combined variable was entered into the final multivariate model due to an interaction between age and reporting male sexual partners: with 77% of those with male sexual partners aged over 35 years compared with 25% of those not reporting male sexual partners.

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Table 3 cont: Factors associated with HIV, hepatitis B and C infection among male injectors of image and performance drugs (IPED).

		Total	Positive		Unadjusted odds ratio with 95% CI		Adjusted odds ratio with 95% CI	
Anti-HBc		395	26	6.6%				
Sought advice from a sexual health /STI clinic, last year?	Yes	68	10	14.7%	3.4	1.4 – 7.7	3.8	1.6 – 8.9
	No / Not sure	327	16	4.9%	1.0		1.0	
	Fisher's Exact Test	p=	0.006					
Subcutaneous injection, last year	Yes	154	6	3.9%	1.0		1.0	
	No / Not sure	241	20	8.3%	2.2	0.88 – 5.7	2.6	0.99 – 6.7
	Pearson Chi-Square	p=	0.085					
Anti-HCV		395	20	5.1%				
Age, years	Under25	106	4	3.8%	1.0			
	25–34	134	3	2.2%	0.58	0.13 – 2.7		
	35 and over	107	10	9.3%	2.6	0.80 – 8.7	†	
	Not reported	48	3	6.3%	1.7	0.37 – 7.9		
	Pearson Chi-Square	p=	0.078					
Injected illicit other than IPED	Yes	19	3	15.8%	4.0	1.1 – 15	4.4	1.1 – 17.2
	No / Not reported	376	17	4.5%	1.0		1.0	
	Fisher's Exact Test	p=	0.064					
Taken or used any prescribed medication, last year	Yes	111	10	9.0%	2.7	1.1 – 7		
	No / Not sure	284	10	3.5%	1.0		†	
	Pearson Chi-Square	p=	0.025					
Ever had a blood test for hepatitis C	Yes	85	8	9.4%	1.7	0.55 – 5.6		
	No	221	7	3.2%	0.5	0.17 – 1.8		
	Not sure	89	5	5.6%	1.0		†	
	Pearson Chi-Square	p=	0.080					
Taken Phosphodiesterase type 5 inhibitors ("Viagra / Cialis")	Yes	26	5	19%	5.6	1.9 – 17	6.0	1.9 – 18
	No	369	15	4.1%	1.0		1.0	
	Fisher's Exact Test	p=	0.007					
Injected insulin (as IPED)	Yes	22	4	18%	5.0	1.5 – 16		
	No	373	16	4.3%	1.0		†	
	Fisher's Exact Test	p=	0.019					
Other injected IPED (incl. EPO, IGF–1 and Nubain)	Yes	20	3	15%	3.7	0.99 – 14		
	No	375	17	4.5%	1.0		†	
	Fisher's Exact Test	p=	0.073					
Ever shared needle, syringe or drug vial	Yes	35	4	11%	2.8	0.87 – 8.8		
	No / Not sure	360	16	4%	1.0		†	
	Fisher's Exact Test	p=	0.090					

† Not in final model.

Key. STI: sexually transmitted infection; EPO: ethryopoetin; IGF–1: insulin–like growth factor 1; Nubain: nalbuphine hydrochloride.

DISCUSSION

IPED injectors are at risk of infection with HIV as well as other BBVs. This is the first prevalence study to have found HIV among IPED injectors, with the prevalence at 1.5%, similar to that found among injectors of psychoactive drugs in England and Wales (1.2%,

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2011[40]). However, anti-HBc and anti-HCV – at 8.8% and 5.5% respectively – are lower than among psychoactive drug injectors (16% and 43% respectively, 2011 [40]). The prevalence of all three BBVs in this sample would appear to be higher than that found in the general UK population.[41,42] Once those who reported either sex with men or injecting psychoactive drugs were excluded, 10% had been infected with one or more of HIV, hepatitis B and hepatitis C.

It is important to consider the limitations of this study. The comparative rarity, marginalisation and illicit nature of injecting drug use impede the construction of a sampling frame, making the representativeness of our sample impossible to measure. This study used an established methodology for recruiting PWID through specialist services;[26,27] however, the robustness of this approach for IPED injectors is unknown and cannot currently be assessed due to the very limited knowledge on the size and nature of this group.[3,5] The use of NSP to access this group was a pragmatic approach; community based recruitment approaches, such as Respondent Driven Sampling and Time-Location Sampling, that are often advocated for hard to reach populations[43] are possible alternatives. However, these are likely to be difficult to implement with this group due to the diversity of the drugs used, the clandestine and close-knit nature of this group and because use usually takes place in private settings (such as homes or gyms).[3,5] The findings here also rely on self-reported behaviours – though their reliability has not been assessed among IPED users, these have been found to be reliable for psychoactive drug injectors[44,45] - and infection with BBVs has been determined by laboratory-based biological data from the testing of oral-fluid samples. Whilst oral-fluid testing is highly sensitive for anti-HIV, the sensitivity is reduced for anti-HCV and anti-HBc.[39] Whilst this study is the largest of BBVs in this population, the sample size still restricts its power, and consequently caution is needed when attempting to generalise these findings to the wider population of IPED injectors.

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The levels of HIV and anti-HBc are both higher than in the only previous UK study to measure these in IPED injectors. Undertaken >10 years ago using a similar methodology, this found no HIV and an anti-HBc prevalence of 2%;[20] suggesting that the prevalence of these infections among IPED injectors *might* have increased over time. Exposure to BBVs among IPED injectors appears to be associated with sexual risks and the injection of psychoactive drugs; although *injecting* psychoactive drugs is rare among IPED injectors, unprotected sex with multiple partners is common. The sharing of injecting equipment or drug vials among IPED injectors at 8.9% is much less common than among injectors of psychoactive drugs (in 2011, 37% of psychoactive drug injectors reported recently sharing injecting equipment[40]). Though exposure was not associated with sharing in the multivariate analyses in this study, BBV transmission through IPED injection cannot be excluded as this study may have lacked sufficient power to detect this.

The associations between having HIV and the use of SH/STI clinics and having male sexual partners, suggest that HIV transmission among IPED injectors might be related to sexual activity. This association may reflect AS use by some HIV positive gay and bisexual men to mask the longer-term effects of HIV infection.[35] The association with having an abscess/wound at the injection site probably reflects the greater vulnerability of PWID with HIV to injection related bacterial infections.[46,47] The association between exposure to HBV and having obtained advice from a SH/STI clinic is again suggestive of a role for sexual risk in infection, particularly as sexual transmission is the main route by which the HBV is now acquired within the UK.[48] The association between having anti-HBc and not injecting subcutaneously suggests that certain patterns of IPED use might be related to increased risk; as some IPED are only injected subcutaneously and others only intramuscularly, and many users take several types.[3,8,12,13,14] Exposure to

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HCV, however, would appear to be associated with the injection of psychoactive drugs – an association that has been previously noted[6] - this finding might reflect more frequent injecting in this sub-group. Sexual activity may also play a role, assuming that the use of PDE5i is related to improving or maintaining sexual performance. These associations all require further investigation.

The level sharing found here was in-line with previous studies of injecting risk among IPED users.[20,28,29,30,32,33,35] The association between sharing and subcutaneous injection, suggests that sharing – like HBV exposure – may be associated with certain patterns of IPED use. As in previous studies of IPED injectors, sexual activity was common, and condom use was poor.[20,28,34] Condom use was higher among those with male sexual partners, and lower among those who reported snorting cocaine. The more frequent use of condoms by gay and bisexual men probably reflects awareness of their increased HIV risk.[42] The association with cocaine use might possibly be related to its use as a sexual stimulant, with this possibly related to attempts to counteract the reduced libido experienced on discontinuation of AS use or in the periods between courses of AS use ('off-cycles').[14] In part, this effect may be as a result of the decrease in endogenous testosterone production,[49] and is why IPEDs users self-treat with human chorionic gonadotrophin in an attempt to stimulate endogenous production, with PDE5i used to symptomatically treat erectile dysfunction.[5,14,50] Increased libido following AS administration is also reported by users[14,33,34,51] with similar effects being reported following the use of drugs such as melanotan-II.[12]

Associations were found between psychoactive drug use and both sharing and poor condom use. IPED users who also use psychoactive drugs may be a higher risk – or perhaps less risk averse - sub-group. Whilst this needs further investigation, it suggests – considering the substantial levels of psychoactive drug use found here and in previous

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studies[6,8,28,35,36] – that those using both IPED and psychoactive drugs should be an important target group for harm reduction interventions.

This study indicates that those providing services to PWID – particularly NSPs, outreach services and General Practitioners - should be alert to the needs of those who use IPEDs. In particular, they need to be aware of the range drugs that may be used by this group and of the associated injecting practices as these differ from those of psychoactive drug injectors. Considering the BBV prevalence and levels risk found specialist services for PWID need to both engage with IPED users and ensure that they have access to appropriate injecting equipment and targeted harm reduction advice. They should also ensure that this group has access to testing for BBVs, hepatitis B vaccinations, sexual health services, and condoms.

Our findings suggest that sexual risk and the use, and particularly the injection, of psychoactive drugs are possibly the most important factors associated with BBV transmission among IPED injectors. The transmission of HIV and other BBV through the injecting of IPED cannot be excluded, and this is certainly possible as equipment sharing does occur. However, this study largely recruited through NSP providing injecting equipment and advice. IPED injectors not in contact with NSP may have a different risk profile and so infection risk. Even so, our findings suggest the need for targeted interventions to address sexual health needs, psychoactive drug use, and the injection practices among IPED injectors. Considering the limitations of this study, a larger study recruiting from a wider range of settings and collecting dried-blood samples is needed to more fully examine prevalence and, in particular, the associated risk factors, and so the role of IPED injection in transmission of HIV and other BBVs.

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