An Investigation into Predictors of Risk-Associated Injecting Behaviours in a Sample of Injecting Drug Users

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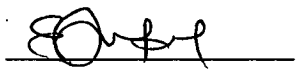
I declare that this thesis is my own work and that, to the best of my knowledge and belief, it does not contain material from published sources without proper acknowledgement, nor does it contain material which has been accepted for the award of any other higher degree or graduate diploma in any university.

Signature:  Date: 20·01·10

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Literature Review Abstract

The sharing and lending of injecting equipment amongst the injecting drug user (IDU) population has been identified as a leading cause of the transmission of blood-borne viruses such as hepatitis B (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV). A large body of research exists which has attempted to identify those IDU who are at elevated risk for engaging in behaviours known to be associated with BBV transmission. Primary amongst these identified factors are those relating to impulsivity traits, psychological distress including anxiety and depression, and pharmacological effects of drug use. Also, a number of demographic and drug use variables also are routinely investigated in the literatures as possible risk factors, and typically include factors of sex, age, duration of injecting history, frequency of injecting, preferred drug of choice, sexual orientation, drug treatment status, accommodation status, education level, ethnicity, and the presence or absence of prison history.

The following literature review describes the existing research into each of these key variables, elucidating those which present as the clear risk factors for BBV transmission risk behaviours, and those which are somewhat ambivalent in the prediction of risk behaviours and BBV transmission rates. Further, the review discusses the need for comprehensive research to be conducted, identifying the variables that are most predictive of BBV risk behaviours amongst this population.

Blood-borne viruses

The term 'blood-borne virus'(BBV) refers to a virus which is spread by inoculation of contaminated blood through a breach in the skin or mucosal lining (Farrell, 2002). Some of the most common BBVs include the hepatitis B virus (HBV), hepatitis C virus (HCV), and the human immunodeficiency virus (HIV). Cases of each of these viruses have been noted worldwide, and in some locations the prevalence of these viruses has become particularly problematic.

Hepatitis B is a virus which may cause such symptoms as fatigue, rashes, joint pain, and fever (Kumar & Clark, 2005). These symptoms are usually only present for a few weeks, and some people who are infected with the virus report no symptoms. While most people recover completely from hepatitis B infection, a minority will go on to develop conditions such as chronic hepatitis or liver cancer (hepatocellular carcinoma) as a result of the initial infection, or become asymptomatic carriers of the virus (Kumar & Clark, 2005). A vaccine is now available to protect against the hepatitis B virus.

The human immunodeficiency virus (HIV) has received much public attention in Australia since the early 1980s when prevention campaigns were introduced in a bid to limit the spread of the virus. Like HBV, many people infected with this virus may be asymptomatic for some time before signs of infection become apparent, however others exhibit symptoms shortly after becoming infected. Infection with this virus may lead to the development of acquired immunodeficiency syndrome (AIDS), with subsequent high risk of mortality as a result of a lowered immune system. While rates of HIV infection initially decreased in response to prevention efforts, recent research reveals that there has been a substantial increase in new HIV diagnoses in Australia whereby rates increased by 41% in the period 2000

to 2005 (National Centre in HIV Epidemiology and Clinical Research, 2006b). At the end of 2005, there were estimated to be 15,310 people living with HIV/AIDS in Australia. The notable recent increase in new HIV cases indicates that the provision of prevention campaigns and education is vitally important to ensure that transmission rates are curbed.

The hepatitis C virus was first identified in 1988 and is now estimated to affect millions of people worldwide. At the end of 2005, there were approximately 264,000 people living with HCV antibodies in Australia alone (Ministerial Advisory Committee on AIDS, 2006) and it is now the most common communicable disease in Australia (Dore, Law, MacDonald, & Kaldor, 2003). Epidemiological studies of hepatitis C reveal that there was a 45 per cent increase in new hepatitis C infections in Australia between 1997 and 2001, from 11,000 per annum in 1997 to 16,000 per annum in 2001, and the prevalence of hepatitis C is expected to more than triple by 2020 unless changes are implemented (Law et al., 2003).

Of those who develop HCV antibodies following exposure to the virus, around 25% are expected to clear the virus within 2 to 6 months of becoming infected (Australian Institute for Primary Care, 2001). However, the remaining 75% will develop chronic infection and remain at risk of developing long term health consequences. Indeed, around 7% of those with chronic infection will develop cirrhosis of the liver after 20 years following exposure, 2% will develop hepatocellular carcinoma, and 4% will develop liver failure (Ministerial Advisory Committee on AIDS, 2006). The economic cost of this virus is huge. For the year 1996/97, the direct cost associated with the HCV in Australia was conservatively estimated to be $75 million, while costs associated with loss of productivity resulting from premature death or absenteeism were estimated for this period to be $32.5

million (Lowe & Cotton, 1999), notwithstanding the substantial personal cost to quality of life of those affected (Southgate et al., 2003). These figures are likely to underestimate current healthcare costs associated with the virus.

During chronic HCV infection, common symptoms include lethargy and fatigue, fever, nausea, muscle aches, and poor appetite and can affect the individual so much that participation in various areas of their lives, such as family, social relationships, and work, becomes difficult to sustain (Community Affairs References Committee, 2004; Parliament of NSW, 1998). In some cases, this then may lead to the breakdown of relationships including divorce, reduced income as a result of being unable to work, and social isolation. The psychological impact that hepatitis C has on the infected individual is also well documented. Feelings of fear, apprehension, anxiety, uncertainty about the future, mood swings, loss of self-esteem, stress, and depression are commonly reported by those affected by hepatitis C (Community Affairs References Committee, 2004; Parliament of NSW, 1998). Stigmatisation and discrimination by health care professionals, friends, and the general community are also common themes recognised by those experiencing HCV (Parliament of NSW, 1998). Diagnosis with HCV clearly can have a devastating impact on the individual, both psychologically and physically.

Because blood-borne viruses are spread through blood-to-blood contact, any activity where this is likely to occur creates a risk of virus transmission. In the case of HCV, identified transmission routes include vertical (mother-to-child) transmission, occupational needle-stick injuries, tattooing, piercing, acupuncture and other forms of skin penetration when contaminated equipment is used (Australian Institute for Primary Care, 2001; Farrell, 2002). In Australia, recipients of blood products prior to 1990, when screening for HCV antibodies was not conducted, were

also at risk of becoming infected. While there is some controversy regarding transmission of the virus through sexual contact (Pancholi, 2007), it is likely that the risk of transmitting the virus by this method is low and is likely to be responsible for only a small minority of HCV transmissions where blood-to-blood contact is present during sexual contact (Australian Institute for Primary Care, 2001).

While any of the abovementioned routes can transmit the virus, it has been shown that the vast majority of new cases of HCV infection are transmitted during the process of injecting illicit drugs. In fact, estimates are that just over 80% of prevalent HCV cases are transmitted in this way (Dore, Pritchard-Jones, Fisher, & Law, 1999; Ministerial Advisory Committee on AIDS, 2006). According to the 2007 National Drug Strategy Household Survey, it is estimated that 328,100 Australians over the age of 14 had ever injected drugs (1.9%), and 82,400 people over 14 years had injected in the previous 12 months (0.5%) (Australian Institute of Health and Welfare, 2008). Amongst the injecting drug user (IDU) population, HCV prevalence falls in the range of 50% to 70% (Law et al., 2003), and incidence among this demographic has been estimated at 15% per year (Crofts, Jolley, Kaldor, Van Beek, & Wodak, 1997; Ministerial Advisory Committee on AIDS, 2006). In contrast, HCV rates within the general population are much smaller, at approximately 0.06% in 2005 (National Centre in HIV Epidemiology and Clinical Research, 2006b).

Virus transmission through injecting drug use has long been recognised as occurring through the sharing or re-using of needles and syringes. Within the literature, the term 'sharing' refers to both donating equipment to another (lending), or using another's equipment (borrowing). However, in addition to transmission occurring through needle sharing, evidence also reveals that other injecting paraphernalia such as swabs, spoons, water vials, tourniquets, and syringe barrels as

well as contact with contaminated hands or other body parts and mixing surfaces also provide opportunities for virus transmission (Crofts, Aitken, & Kaldor, 1999; Hagan et al., 2001; MacDonald & Wodak, 2003; Maher et al., 2006; Thorpe et al., 2002). Even small volumes of blood can transmit BBVs efficiently (Gerberding, 1995), and due to this, strict hygiene needs to be adhered throughout the injection process in order to reduce the transmission of blood-borne viruses such as HBV, HCV, and HIV.

It is clear that due to the high rates of virus transmission occurring within the IDU population, intervention programs should primarily be targeted to this group. In response to the emergence of HIV, needle and syringe programs were introduced in the late 1980s to distribute sterile injecting equipment such as needles and syringes in an effort to encourage safe and clean injecting practices. As a consequence of this and other harm reduction strategies, rates of new HIV cases were shown to decline, and it is now generally recognised that Australia's speedy response to the emergence of this virus resulted in a largely successful prevention campaign (Commonwealth Department of Health and Aged Care, 2000). Several large Australian studies (eg. (Crofts & Aitken, 1997; Loxley, Carruthers, & Bevan, 1995; MacDonald et al., 1997) indicate that while there has been variation in needle sharing rates over time, there has generally been a reduction in the sharing of needles and syringes in IDU populations since significant harm reduction measures were put in place in the early 1990s. An annual survey of IDU participants attending needle and syringe program sites in Australia has provided evidence for this trend. In 1995 approximately 30% of participants reported the reuse of someone else's used syringe in the month prior to survey, while in 2007 this figure had dropped to 18% (National Centre in HIV Epidemiology and Clinical Research, 2003, 2008). It is estimated that as a result of

the introduction of needle and syringe programs alone, 25,000 cases of HIV had been avoided by the year 2000, and 4,500 deaths will have been averted by 2010 (Commonwealth Department of Health and Ageing, 2002). In terms of treatment costs, this translates to a saving of an estimated $7,025 million.

However, while the introduction of needle and syringe programs has been shown to be effective in reducing HIV incidence in IDU in both Australia and worldwide (Commonwealth Department of Health and Ageing, 2002; Hurley, Jolley, & Kaldor, 1997), the same cannot be said for the transmission of HCV. While there is some evidence of a slight reduction of HCV transmission rates during the 1980s in response to HIV prevention campaigns, incidence rates have since increased and are occurring at extremely high levels, even in primary health settings which emphasise the prevention of blood borne virus contamination (i.e. health centres which provide medical care, counselling, social welfare services, needle syringe exchange services to clients including youth, sex workers and IDU) (Crofts et al., 1997; MacDonald et al., 2000; Van Beek, Dwyer, Dore, Luo, & Kaldor, 1998).The greater difficulty in controlling the spread of HCV is generally attributed to the higher viral infectivity content that HCV has compared with HIV, meaning that even extremely small volumes of blood can transmit the virus efficiently, even amounts so small as to be invisible to the naked eye (Gerberding, 1995). In addition, transmission rates are difficult to control as the high background prevalence rate means that even an occasional risky injection episode carries with it a considerable risk of infection (Crofts et al., 1999). The high frequency of injecting also contributes to the difficulty in controlling the spread of the virus.

In Australia, transmission rates of HCV amongst IDU are even higher than previously thought. In a recent study, Maher and colleagues (Maher, Li, Jalaludin,

Chant, & Kaldor, 2007) recruited a group of new initiates into injecting drug use from needle and syringe programs, methadone clinics, and street-based outreach in south-western Sydney who were tested to be anti-HCV seronegative. Participants were followed up every 3 to 6 months until seroconversion or study completion. The results of this study revealed that seroconversion incidence rates were an alarming 45.8 per 100 person years. For those who had been injecting for less than one year, the mean time to HCV seroconversion was just 0.31 years. This leaves a very small window of opportunity for intervention efforts to be implemented. The results from this study indicate that the rate of HCV transmission in Australia has now become one of the highest in the world.

The above study highlights the severity of the issue of blood-borne virus transmission in Australia, and also the urgent need for implementation of effective interventions to curb these soaring transmission rates. It is clear that while current interventions have helped to reduce transmission, there is still great room for improvement in the delivery of intervention techniques. Currently, these interventions are generally delivered to all accessible IDU, regardless of their propensity to take risks in relation to the sharing of injecting equipment. Ideally, what is needed is the ability to distinguish those IDU who are likely to engage in risk behaviours from those who are unlikely to take these risks. By doing so, this allows additional high cost interventions to be more specifically targeted to those who are found to be most at risk of sharing or using unsterile injecting equipment, and hence be at risk of transmitting or spreading blood-borne viruses. The lack of an available vaccine for HCV also adds to the impetus to carry out this research.

Risk Factors

Many studies have been conducted investigating the potential risk factors which differentiate those who are likely to share needles and other injecting paraphernalia from those who choose not to share equipment. Similarly, studies also indirectly examine the propensity to share by studying the seroepidemiology of the virus, and determining which factors are associated with seroconversion in cohort studies or prevalence of the virus in cross-sectional studies. With the current high rates of HCV transmission, recent studies tend to focus on this blood-borne virus as opposed to HIV. Presumably, this is because campaigns to reduce the rates of HIV transmission have been somewhat successful, however rates of HCV transmission remain high. As such, the risk factors associated with HCV transmission will be the primary topic of examination here. While the results of studies to date appear to show some clear trends in which certain factors contribute significantly to the sharing of needles and equipment and to the transmission of blood-borne viruses, there still remain some factors which do not lend to easy interpretation as distinct risk variables. This may indicate that there are some shared associations with latent variables. For example, the literature may indicate that females are at a greater risk for BBV transmission, however in reality this may be due to the fact that it is more common for female IDU to be injected by others. The issue as to what factors contribute significantly to the transmission of viruses such as HCV is certainly a complex one.

Sex

One factor most commonly investigated in these studies is whether males or females are most at risk for HCV acquisition. Australian studies examining needle sharing risk yield differing results, with some studies reporting a significant sex difference (Dwyer et al., 1994; Larson, Shannon, & Eldridge, 1999; Lucas & Easthope, 1996), while others note no such difference in needle sharing propensity between the genders (Darke, Hall, & Carless, 1990; Dwyer et al., 2002; Loxley et al., 1995; MacDonald et al., 1997; Treloar et al., 2003). Others again report gender differences in some aspect of sharing, but not others. For example, Breen, Roxburgh, and Degenhardt (2005) found that female participants were more likely to lend needles, however there was no difference between males and females in their tendency to borrow needles or to share any injecting paraphernalia such as spoons, water, or filters. Overseas studies of gender differences in needle sharing tend to report higher rates of sharing amongst female participants (Booth, 1995; Evans et al., 2003; Montgomery et al., 2002; Valente & Vlahov, 2001). A similar pattern of results is found amongst seroepidemiological studies both in Australia and overseas, where some report sex differences while others do not find any such difference. While the majority of studies show that females are more likely to participate in some aspect of sharing (either lending or borrowing), there are a minority of studies which found that males are significantly more likely to engage in this behaviour. For details of studies examining sex as a risk factor, please refer to Table 1.

It appears then that there is considerable discrepancy in the literature regarding whether a sex difference exists in the sharing of injecting equipment and the seroepidemiology of HCV, particularly amongst Australian studies. Of the literature examined however, the results of these studies suggest a trend towards females being at higher risk for BBV acquisition than males. Indeed, Southgate et al.

(2003) concurs that the literature suggests that females are more likely to share injecting equipment when compared with males.

Table 1

Findings of Studies Investigating Sex as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Group at Greater Risk	Study Characteristics	Origin
Bennett (2000)		↑↓	Males more likely to lend injecting equipment, females more likely to borrow injecting equipment	n = 181. IDU recruited through NSP and 'snowballing'. Must have injected drugs in month preceding interview and speak English. Cross-sectional design.	UK
Booth (1995)		↓	Female	n = 593. Recruited using street-based outreach. Eligible if injected drugs in the past 30 days and /or smoked crack cocaine in past 2 days, not in drug treatment in the past 30 days, and over 18 years. Cross-sectional design.	US
Breen (2005)		↓ = =	Females more likely to lend needles No difference between genders in borrowing needles No difference between genders in sharing ancillary injecting equipment	n = 154. Recruited through NSP and snowballing. Eligible if at least monthly injecting in past 6 months and resided in Sydney over the past 12 months. Cross-sectional design.	Aus
Crofts (1993)*	↑		Male	n = 303. IDU recruited by peer workers through social networks, community agencies, and prisons. Prospective cohort study.	Aus
Crofts (1994)*	=			n = 315. IDU recruited through social networks, community agencies and prisons. Cohort design.	Aus
Darke (1990)		=		n = 100. Opiate users in and out of treatment. Recruited through advertisements in waiting rooms of methadone clinics and health centres. Cross-sectional design.	Aus
Darke (1998)		↓ =	Females more likely to borrow injecting equipment No difference between genders in lending of equipment	n = 283. Incarcerated and community methadone maintenance patients who have been in treatment for more than 6 months. Cross-sectional design.	Aus
Dwyer (1994)		↓	Female	n = 1,245. IDU from Sydney recruited by flyers around sites such as NSPs and social security offices. Cross-sectional design.	Aus
Dwyer (2002)		=		n = 416. Participants who had injected monthly for past 6 months. Recruited via snowballing, posted advertisements, and NSP sites. Cross-sectional design.	Aus
Evans (2003)		↓	Female	n = 844. Recruited by street outreach, eligible if injected drugs in the past month, under 30 years old, and spoke English. Cross-sectional design.	US

Loxley (1995)		=		n = 872. IDU from Adelaide, Melbourne, Sydney, and Perth recruited by advertisements with agencies (e.g. NSPs, health centres) and snowballing. Cross-sectional design.	Aus
Larson (1999)		↓	Female	n = 77. Aboriginal and Torres Strait Islander IDU who had injected in past 12 months. Cross-sectional design.	Aus
Lucas (1996)		↓	Female	n = 215. IDU from Hobart, Tasmania. Cohort study over 4 years.	Aus
MacDonald (2000)	↓		Female	n = 4,141. IDU who had attended selected NSP sites around Australia 1995 – 1997. Repeated cross-sectional surveys.	Aus
MacDonald (1997)		=		n = 1,005. All IDUs who had attended 21 NSPs across Australia in one week in March 1995. Cross-sectional survey.	Aus
Maher (2004)	↑		Male	n = 372. IDU in South-West Sydney with history of IDU in last 6 months and HCV serostatus not known to be positive. Recruited using word-of-mouth and snowballing methods. Cross-sectional design.	Aus
Maher (2006)*	↓		Female	n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus
Maher (2007)*	↓		Female	n = 215. IDU who had injected drugs in the past 6 months and were seronegative or had unknown HCV serostatus. Recruited through outreach, methadone clinics, and NSPs. Prospective cohort study.	Aus
Montgomery (2002)		↓	Female	n = 320. IDU and referred members of their social networks. Cross-sectional design.	US
Treloar (2003)		=		n = 336. IDU aged between 16 – 25 years who had been injecting for 4 years or less from urban Sydney, urban Brisbane, or rural NSW. Recruited by advertisements in NSPs, treatment centres, health clinics, local press etc. Cross-sectional design.	Aus
Valente (2001)*		↓	Female	n = 1,184. IDU who had attended a Baltimore NSP. Cohort study.	US
Van Beek (1994)	=			n = 201. All IDU who had attended a primary health care facility in central Sydney and had undertaken HCV testing. Retrospective cross-sectional study.	Aus

Key:
↑ denotes male sex is a significant positive predictor of risk
↓ denotes female sex is a significant positive predictor of risk
= denotes sex is a non-significant factor
*indicates studies of particularly high quality due to design or power

Studies examining this gender difference assert that this tendency can at least in part be explained due to status factors and norms amongst IDU circles. That is, within the culture of injecting drug use, it has been reported that, within some subgroups, it is normal injecting etiquette for women to borrow used needles from their sexual partner if there is insufficient clean injecting equipment available at a group injecting session (Klee, Faugier, Hayes, Boulton, & Morris, 1990b). In accordance with this, Bennett, Velleman, Barter and Bradbury (2000) found in their study that men generally were more likely to pass on equipment, and women were more likely to receive. Other studies (Booth, 1995; Dwyer et al., 1994; Evans et al., 2003; Lenton & Tan-Quigley, 1997; Loxley et al., 1995) also find that females are more likely to share injecting equipment with sex partners more so than men. Miller and Neaigus (2001) report that male sex partners are often older than the female, and are more likely to have been exposed to BBV such as HCV, HIV, and HBV, further adding to transmission risk. It has also been reported that sharing needles and injecting paraphernalia with one's partner is also viewed as a sign of trust, solidarity, and intimacy within that partnership (Dwyer et al., 1994; Klee et al., 1990b) so the tendency to decline an offer of used needles carries with it connotations of distrust and therefore would not be a preferable course of action to take. In their study of gender differences in sexual and injection risk behaviours amongst IDU in San Francisco, Evans et al. (2003) found that a further factor explaining females' greater risk for contracting BBV is that they were more likely to be injected by someone else, thereby increasing the opportunities for BBV transmission. Bruno (2006) found similar trends in a sample of Tasmanian IDU, such that females were more likely than males to be injected by others.

Age

A further demographic variable that has received considerable attention in the BBV risk literature is the age of the IDU and the impact this has on the sharing of injecting equipment and on HCV seroprevalence. Studies specifically examining needle sharing reveal a clear trend that those IDU who are younger in age are more likely to share needles than those who are older (Dwyer et al., 2002; Larson et al., 1999; Lenton & Tan-Quigley, 1997; Southgate et al., 2003; Valente & Vlahov, 2001). This trend is apparent both in Australian studies and in international research. Most of these studies label younger IDU as those who are under the age of 25, while older IDU are categorised as those older than 25 years. Naturally, there remains some discrepancy in these findings which should be noted, with a few studies reporting no effect of age on needle sharing (Darke et al., 1990; Evans et al., 2003; Treloar et al., 2003) and one study reporting that older study participants were more likely to share equipment (Loxley et al., 1995); however the overall trend is clearly that younger IDU are more likely to engage in risky injection practices in terms of the sharing of needles and related injecting equipment (see Table 2 for a summary of research findings).

When examining the seroepidemiological studies, these can be divided into those which examine HCV prevalence rates and those which examine HCV incidence rates. The benefit of incidence studies is that information can be obtained regarding at what age and when IDU are becoming infected with the virus, whereas prevalence studies can only provide information as to the cumulative impact of HCV infection. By looking at these two groups of studies separately, the literature clearly reveals that prevalence among IDU is high and that prevalence rates increase the older the person is. For example, Crofts et al. (1994) found that the prevalence of

HCV in IDU under the age of 25 was 46%, while in those participants aged over 25, this figure jumps to 80%. Similarly, Van Beek, Buckley, Stewart, MacDonald, and Kaldor (1994) found that in IDU aged under 20 years, the prevalence rate was 17%, while in those over 35 years of age the rate was an alarming 93%. Similar findings are found in international studies (Chang, Ko, & Liu, 1998; Diaz et al., 2001; Guadagnino et al., 1995; Lamden et al., 1998; Patti et al., 1993; Stark et al., 1995; Thomas et al., 1995). When looking more specifically at incidence studies, this research reveals that those IDU who are younger in age are contracting the virus at a faster rate than those IDU who are older (Crofts et al., 1995; Hagan et al., 1999; Van Beek et al., 1998). In a study by Van Beek and colleagues, (Van Beek et al., 1998) incidence rates were found to be 75.6 per 100 person years for those IDU under 20 years of age, however in those 30 years and older the rate was only 6.6 per 100 person years. Together, these studies reveal that the greatest risk period for contracting HCV is in younger IDU, but the likelihood of having contracted the disease rises with age, most likely due to the cumulative risk that each injection episode brings. However, it should also be noted that some studies no not detect an effect of age on HCV incidence or prevalence (e.g. Garfein et al., 1998; Hagan et al., 2001; Maher et al., 2006; Maher et al., 2007). Despite this, the clear majority of studies indicate a significant effect of age.

Table 2

Findings of Studies Investigating Age as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Group at Greater Risk	Study Characteristics	Origin
Chang (1998)	↑		>30 years greater risk than those 29 and under	n = 934. Participants were drug users (injecting and non-injecting) recruited from a drug treatment centre and a prison. Cross-sectional design.	Taiwan
Crofts (1993)*	↑		>25 years at greater risk compared with those <25 years	n = 303. IDU recruited by peer workers through social networks, community agencies, and prisons. Prospective cohort study.	Aus
Crofts (1994)*	↑		>25 years at greater risk compared with those <25 years	n = 315. IDU recruited through social networks, community agencies and prisons. Cohort design.	Aus
Crofts (1995)	↓		Those who seroconverted were younger (mean 22.2 years) than those who did not seroconvert (mean 26.2 years)	n = 3,629. Victorian prison entrants (not all IDU). Cross-sectional design.	Aus
Darke (1990)		=		n = 100. Opiate users in and out of treatment. Recruited by advertising in waiting rooms of methadone clinics and health centres. Cross-sectional design.	Aus
Diaz (2001)	↑		25 – 29 years at greater risk compared with those 18 – 24 years	n = 557. IDU aged 18 – 29 who had injected in last 6 months and been injecting for less than 3 years. Street recruited. Cross-sectional design.	US
Dwyer (2002)	↑	↑	< 25 years at greater risk compared with those > 25 years	n = 416. Participants must have injected monthly for past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Evans (2003)		=		n = 844. Recruited by street outreach, eligible if injected drugs in the past month, under 30 years old, and spoke English. Cross-sectional design.	US
Garfein (1998)	=			n = 229. IDU aged 18 – 29 years. Recruited through community outreach. Prospective cohort study.	US
Guadagnino (1995)	↑		Those > 27 years old at greater risk than those 26 years and younger	n = 146. Male heterosexual IDU (injected in the past 12 months) who had attended a methadone maintenance clinic. Cross-sectional design.	Italy
Hagan (1995)	↓		< 25 years at greater risk than those 25 – 34 years old	n = 28 (case patients), n = 38 (control patients). Participants were IDU who had attended a health department. Case-control design.	US
Hagan (1999)*	↓		Age groups < 24 years and 25 – 34 higher rates of HCV than those > 35	n = 647. IDU recruited from drug treatment, corrections, and social service agencies. Eligible if had injected in previous year, were over 14 years old, and were English or Spanish speaking. Prospective cohort study.	US

Hagan (2001)*	=			n = 317. Clients who had injected in the past year, were over 14 years old, and English or Spanish speaking were eligible. Recruited from drug treatment and correction centres. Follow up 1 year later. Prospective cohort study.	US
Lamden (1998)	↑		> 25 years at greater risk compared with those < 25 years	n = 773. Drug users (injecting & non-injecting) who had hepatitis serology testing between 1992 and 1996 at public health facilities. Retrospective cross-sectional design.	UK
Larson (1999)		↓	< 20 years at greater risk compared with those > 20 years	n = 77. Aboriginal and Torres Strait Islander IDU (injected in past 12 months). Cross-sectional design.	Aus
Lenton (1997)		↓	< 26 years at greater risk compared with those > 26 years	n = 511. Questionnaires were included in Fitpacks over a 6 week period in 183 community pharmacies in WA to be mailed back anonymously. Cross-sectional study.	Aus
Loxley (1995)	↑	↑	>25 years at greater risk compared with those <25 years	n = 872. IDU from Adelaide, Melbourne, Sydney, and Perth recruited by advertising with agencies (e.g. NSPs, health centres) and snowballing. Cross-sectional design.	Aus
NCHECR (2006a)		↓	< 20 years at greater risk compared with those > 20 years	n = 11,229. IDU who had attended NSP sites across Australia. Cross-sectional survey.	Aus
MacDonald (2000)	↑		> 25 years at greater risk compared with those < years	n = 4,141. IDU who had attended selected NSP sites around Australia 1995 – 1997. Repeated cross-sectional surveys.	Aus
Maher (2006)*	=			n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus
Maher (2007)*	=			n = 215. IDU who had injected drugs in the past 6 months and were seronegative or had unknown HCV serostatus. Recruited through outreach, methadone clinics, and NSPs. Prospective cohort study.	Aus
Patti (1993)	↑		Prevalence increases from <25 to 35 years. No further increase after 35 years	n = 645. Regular IV heroin users who had attended methadone maintenance centres in Rome. Cross-sectional design.	Italy
Rezza (1996)	↑		> 28 years at greater risk compared with those < 28 years	n = 746. IDU who had attended a drug treatment centre. Case-control study.	Italy
Robinson (1995)	=			n = 110. IDU who had attended a drug dependency clinic. Records of these clients at initial assessment were examined over a 2 year period. Retrospective cross-sectional design.	NZ
Southgate (2003)		↓	< 25 years at greater risk compared with those > 25 years	n = 2,738. Clients who had attended NSP sites over a week period in October 2001. Cross-sectional study.	Aus
Stark (1995)	↑		Older age associated with greater risk (≥ 30 years at greatest risk)	n = 405. Clients of drug abuse treatment centres, a hospital, and BBV prevention centre who had injected drugs in the last 3 months. Cross sectional design.	Germany

Thomas (1995)*	↑		< 25 years at greater risk compared with those > 25 years	n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Treloar (2003)		=		n = 336. IDU aged between 16 – 25 years who had been injecting for 4 years or less from urban Sydney, urban Brisbane, or rural NSW. Recruited by advertisements in NSPs, treatment centres, health clinics, local press etc. Cross-sectional design.	Aus
Valente (2001)*		↑	< 39 years at greater risk compared with those > 39 years	n = 1,184. IDU who had attended a Baltimore NSP. Cohort study.	US
Van Beek (1994)	↑		Risk increases with age (≥ 35 at greatest risk)	n = 201. All IDU who had attended a primary health care facility in central Sydney and who had undertaken HCV testing. Retrospective cross-sectional study.	Aus
Van Beek (1998)*	↑		< 20 years at greater risk compared with those >20 years	n = 1,078. Clients of BBV prevention centre with history of IDU. Retrospective cohort study.	Aus
Van den Hoek (1990)	=			n = 346. IDU and non-IDU recruited at methadone dispensary sites and STD clinic. Prospective cohort design.	Netherlands
Villano (1997)*	=			n = 1,593. Sample had history of IDU in last 10 years. Cohort study. Mean follow up 6.5 years	US

Key:
↑ denotes older age is a significant predictor of increased risk
↓ denotes younger age is a significant predictor of increased risk (alternatively, older age predicts less risk)
= denotes age is a non-significant factor
*indicates studies of particularly high quality due to design or power

Duration of Injecting

Somewhat more specific than a simple assessment of age, duration of injecting drug use is a further variable often identified in the literature as predictive of greater risk for HCV transmission and the sharing of injecting equipment. Indeed, the vast majority of studies reveal that this variable is a significant predictor of the presence of HCV in univariate analyses, and is often found to be an independent predictive factor in multivariate analyses. Only a small minority find that this variable does not contribute to HCV risk (Dwyer et al., 2002; Van Beek et al., 1998; Villano et al., 1997). Prevalence studies both in Australia and overseas clearly indicate that the longer a person has used drugs intravenously the higher the likelihood that they have contracted the virus (Bell et al., 1990; Chang et al., 1998; Chetwynd, Brunton, Blank, Plumridge, & Baldwin, 1995; Crofts et al., 1993; Diaz et al., 2001; Donahue et al., 1991; Garfein, Vlahov, Galai, Doherty, & Nelson, 1996; Girardi et al., 1990; Lamden et al., 1998; Loxley et al., 1995; MacDonald et al., 2000; Maher et al., 2004; Patti et al., 1993; Robinson et al., 1995; Smyth, Keenan, Dorman, & O'Connor, 1995; Stark et al., 1995; Thomas et al., 1995; Van Beek et al., 1994; Zeldis et al., 1992). The increase in risk as a function of length of injecting drug use is likely due to the effect of cumulative exposure. Incidence studies reveal that the greatest risk period for seroconversion is in the initial years of injecting (Garfein et al., 1998; Hagan et al., 1999; Hagan et al., 2001; Maher et al., 2006; Maher et al., 2007). In a recent study examining the incidence of HCV in Australia, Maher et al. (2007) found that incidence rates in those who had injected for less than one year was 98.2 per 100 person years, 52.2 per 100 person years in those who had injected for one to three years, and 31.4 per 100 person years in those who had

injected for three to six years. In percentage terms, this equates to 29.9% of the total sample having undertaken seroconversion, with 43.6% of the total seroconversions occurring in participants who have been injecting for one year or less, 32.8% of those injecting for one to three years, and 23.4% in those who have been injecting for over three years. In considering results of incidence research such as that cited above, the most risky time for contracting HCV would appear to be shortly following initiating into injecting drugs. This factor is clearly an important one to consider in determining HCV risk. Details of research examining this variable are outlined below in Table 3.

Table 3

Findings of Studies Investigating Duration of Injecting as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Notes	Study Characteristics	Origin
Bell (1990)	↑		Increases with duration (anti-HCV positive group = mean duration 63 months, anti-HCV negative group = mean duration 37 months)	n = 172. IV heroin users who had presented to a drug treatment centre seeking entry to a methadone program. Cross-sectional design.	Aus
Chang (1998)	↑		Those injecting for > 5 years at greater risk than those injecting ≤ 5 years	n = 934. Participants were drug users (injecting and non-injecting) recruited from a drug treatment centre and a prison. Cross-sectional design.	Taiwan
Chetwynd (1995)	↑		Increases with duration. 1-5 years injecting history = 73.5% anti-HCV positive, 11 or more years, 92.5% positive.	n = 116. IDU who had attended a methadone treatment clinic in Christchurch. Cross-sectional design.	NZ
Crofts (1993)*	↑		Those injecting > 8 years at greater risk than those injecting < 8 years	n = 303. IDU recruited by peer workers through social networks, community agencies, and prisons. Prospective cohort study.	Aus
Diaz (2001)	↑		Those injecting > 3 years at greater risk than those injecting < 3 years	n = 557. IDU aged 18 – 29 who had injected in past 6 months and had injected for less than 3 years. Street recruited. Cross-sectional design.	US
Donohue (1991)*	↑		Increases with duration. (71.4% of those injecting for less than 1 year had HCV-antibodies present, 91.7% of those injecting for over 10 years had HCV-antibodies)	n = 225. IDU from Baltimore area enrolled in another study of HIV infection. Prospective cohort study.	US
Dwyer (2002)	=	=		n = 416. Participants had injected monthly for past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Evans (2003)		=		n = 844. Recruited by street outreach, eligible if injected drugs in the past month, under 30 years old, and spoke English. Cross-sectional design.	US
Garfein (1996)*	↑		Those injecting more than 6 months at greater risk than those injecting less than 6 months	n = 716. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Garfein (1998)	↑		Those injecting for at least 2 years at greater risk	n = 229. IDU aged 18 – 29 years. Recruited through community outreach. Prospective cohort study.	US

Girardi (1990)	↑	Risk increases with duration of injecting (1-5 years = 33.3% HCV positive, > 10 years = 84.3% positive)	n = 80. IDU who had attended a methadone treatment program in Rome. Cross-sectional design.	Italy
Hagan (1995)	↑	Those injecting for more than 5 years are at greater risk	n = 28 (case patients), n = 38 (control patients). Participants were IDU who had attended a health department. Case-control design.	US
Hagan (1999)*	↑	Those injecting for more than 1 year at greater risk	n = 647. IDU recruited from drug treatment, corrections, and social service agencies. Eligible if had injected in previous year, over 14 years old, and spoke English or Spanish. Prospective cohort study.	US
Hagan (2001)*	↑	Those injecting for more than 2 years at greater risk	n = 317. Clients who had injected in the past year, were over 14 years old, and spoke English or Spanish were eligible. Recruited from drug treatment and correction centres. Follow up 1 year later. Prospective cohort study.	US
Lamden (1998)	↑	Increases with longer duration (OR = 8.9 in those > 10 years compared with < 3 years injecting)	n = 773. Drug users (injecting & non-injecting) who had hepatitis serology testing between 1992 and 1996 at public health facilities. Retrospective cross-sectional design.	UK
Loxley (1995)	↑	Increases with longer duration	n = 872. IDU from Adelaide, Melbourne, Sydney, and Perth recruited by advertising with agencies (e.g. NSPs, health centres) and snowballing. Cross-sectional design.	Aus
MacDonald (2000)	↑	Those injecting for more than 5 years at greater risk	n = 4,141. IDU who had attended selected NSP sites around Australia 1995 – 1997. Repeated cross-sectional surveys.	Aus
Maher (2004)	↑	Those injecting for more than 3 years at greater risk compared with those injecting less than 3 years	n = 372. IDU in South-West Sydney with history of IDU in last 6 months and had HCV serostatus not known to be positive. Recruited using word-of-mouth and snowballing methods. Cross-sectional design.	Aus
Maher (2006)*	↑	Those injecting for more than 1 year at greater risk	n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus
Maher (2007)*	↑	Those injecting for more than 1 year at greater risk	n = 215. IDU who had injected drugs in the past 6 months and were seronegative or had unknown HCV serostatus. Recruited through outreach, methadone clinics, and NSPs. Prospective cohort study.	Aus
Patti (1993)	↑	> 5 years at greater risk than those < 5 years IV use	n = 645. Regular IV heroin users who had attended a methadone maintenance centre in Rome. Cross-sectional design.	Italy
Rezza (1996)	↑	>2.5 years at greater risk	n = 746. IDU who had attended a drug treatment centre. Case-control study.	Italy

Robinson (1995)	↑		Longer duration of IV drug use (anti-HCV negative group mean 8.1 years, anti-HCV positive group mean 11.8 years)	n = 110. IDU who had attended drug dependency clinic. Records of these clients at initial assessment were examined over a 2 year period. Retrospective cross-sectional design.	NZ
Smyth (1995)	↑		Longer duration of IV drug use. (> 2 years = seroprevalence 95%, duration < 2 years seroprevalence 70%)	n = 272. IDU who had attened drug treatment centre during a one-year period. Cross-sectional design.	Ireland
Stark (1995)	↑		< 5 years (66.1% HCV antibodies present) ≥ 15 years (94.5% HCV antibodies present)	n = 405. Clients of drug abuse treatment centres, a hospital, and BBV prevention centre who had injected drugs in the last 3 months. Cross sectional design.	Germany
Thomas (1995)*	↑		Those injecting for more than 5 years at greater risk (risk increases with duration)	n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Treloar (2003)		↑	Those injecting for more than 2 years at greater risk than those injecting less than 2 years	n = 336. IDU aged between 16 – 25 years who had injected for 4 years or less from urban Sydney, urban Brisbane, or rural NSW. Recruited by advertisements in NSPs, treatment centres, health clinics, local press etc. Cross-sectional design.	Aus
Van Beek (1994)	↑		Increases with longer duration (< 3 years OR = 1, 10+ years OR = 19.3)	n = 201. All IDU who had attended a primary health care facility in central Sydney who had undertaken HCV testing. Retrospective cross-sectional study.	Aus
Van Beek (1998)	=			n = 1,078. Clients of BBV prevention centre with history of IDU. Retrospective cohort study.	Aus
Villano (1997)*	=			n = 1,593. Sample had history of IDU in last 10 years. Cohort study. Mean follow up 6.5 years	US
Zeldis (1992)	↑		Increases with longer duration (odds increase by 1.5 for each 5 years IV use)	n = 585. IDU enrolled in drug treatment programs. Cohort study.	US

Key:
↑ denotes longer duration of injecting is a significant predictor
↓ denotes shorter duration of injecting is a significant predictor
= denotes Duration of Injecting non-significant factor
*indicates studies of particularly high quality due to design or power

Frequency of Injecting

Another variable covarying with years of injection is the frequency of injecting which has also been found to be a significant risk factor, for both needle sharing and for the risk of HCV infection. Generally, studies examining this variable report that those IDU who inject on a daily basis or more frequently have a greater propensity to share injecting equipment and are more likely to contract blood borne viruses (see Table 4). Very few studies have found this factor not to be predictive of needle sharing or HCV transmission risk (Diaz et al., 2001; Hagan et al., 1999; Maher et al., 2007). The reason for the consistent significance of this variable is likely again due to the cumulative risk of injecting, such that the more often an individual engages in an injecting episode, the number of opportunities for contracting blood borne viruses is increased. Alternatively, this finding may also reflect a reduction in hygiene standards when injecting illicit drugs such that the injecting episode carries with it more risk for BBV transmission (Darke et al., 1990). A lowered adherence to strict hygiene procedures when injecting drugs which can be seen in those who inject on a more frequent basis can be indicative of the desire to remove withdrawal symptoms. In users who have developed dependence to a drug, the presence of withdrawal symptoms (e.g. tremors, muscle cramps, nausea, chills, irritability) is an unpleasant experience which occurs as a result of the abrupt cessation of the use of the drug. The experience of withdrawal symptoms therefore creates a strong drive to remove the symptoms, and of course this can be achieved by further use of the drug. The drive to do this can lead to IDU becoming more risky in their injection practices during the rush to remove symptoms as quickly as possible.

Table 4

Findings of Studies Investigating Frequency of Injecting as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Group at Greater Risk	Study Characteristics	Origin
Diaz (2001)	=			n = 557. IDU aged 18 – 29 who had injected in the last 6 months and had been injecting for less than 3 years. Street recruited. Cross-sectional design.	US
Dwyer (2002)	↑	↑	Those who inject at least once daily	n = 416. Participants who had injected monthly for past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Garfein (1996)*	↑		Those who inject at least once daily	n = 716. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Garfein (1998)	↑		Those who inject at least once daily	n = 229. IDU aged 18 – 29 years. Recruited through community outreach. Prospective cohort study.	US
Hagan (1999)*	=			n = 647. IDU recruited from drug treatment, corrections, and social service agencies. Eligible if had injected in previous year, were over 14 years old, and spoke English or Spanish. Prospective cohort study.	US
Hagan (2001)*	↑		Those who inject at least once daily	n = 317. Clients who had injected in the past year, were over 14 years old, and spoke English or Spanish were eligible. Recruited from drug treatment and correction centres. Follow up 1 year later. Prospective cohort study.	US
Lenton (1997)		↑	Those who inject at least once daily	n = 511. Questionnaires included in Fitpacks over a 6 week period in 183 community pharmacies in WA to be mailed back anonymously. Cross-sectional study.	Aus
MacDonald (1997)		↑	Those who inject at least daily, and more than once a week compared with those who inject once a week or less	n = 1,005. All IDUs who had attended 21 NSPs across Australia in a one week period in March 1995. Cross-sectional survey.	Aus
MacDonald (2000)	↑		Those who inject at least once daily	n = 4,141. IDU who had attended selected NSP sites around Australia 1995 – 1997. Repeated cross-sectional surveys.	Aus
Maher (2004)	↑		Those who inject at least once daily	n = 372. IDU in South-West Sydney with history of IDU in last 6 months and HCV serostatus not known to be positive. Recruited using word-of-mouth and snowballing methods. Cross-sectional design.	Aus
Maher (2006)*	↑		Those who inject at least once daily	n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus

Maher (2007)*	=			n = 215. IDU who had injected drugs in the past 6 months and were seronegative or had unknown HCV serostatus. Recruited through outreach, methadone clinics, and NSPs. Prospective cohort study.	Aus
NCHECR (2006a)		↑	Those who inject at least once daily	n = 11,229. IDU who had attended NSP sites across Australia. Cross-sectional survey.	Aus
Southgate (2003)		↑	Those who inject at least once daily	n = 2,738. Clients who had attended NSP sites over a one week period in October 2001. Cross-sectional study.	Aus
Thomas (1995)*	↑		Those who inject at least once daily	n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Treloar (2003)	=	↑	Those who inject at least once daily	n = 336. IDU aged between 16 – 25 years who had injected for 4 years or less from urban Sydney, urban Brisbane, or rural NSW. Recruited by advertisements in NSPs, treatment centres, health clinics, local press etc. Cross-sectional design.	Aus
Valente (2001)*		↑	≥ once per week at greater risk than those who inject < once per week	n = 1,184. IDU who had attended a Baltimore NSP. Cohort study.	US
Van Ameijden (1993)	↑		Those who inject at least once daily	n = 305. Drug users (injecting and non-injecting) recruited from a methadone program clinic and STD clinic. Prospective cohort study.	Netherlands
Van Beek (1994)	↑		Those who inject > once a month at greater risk than those who inject < once a month	n = 201. All IDU who attended a primary health care facility in central Sydney who had undertaken HCV testing. Retrospective cross-sectional study.	Aus
Van den Hoek (1990)	↑		Those who inject at least once daily	n = 346. IDU and non-IDU recruited at methadone dispensary sites and STD clinic. Prospective cohort design.	Netherlands
Villano (1997)*	↑		Those who inject at least once daily	n = 1,593. Sample had history of IDU in last 10 years. Cohort study. Mean follow up 6.5 years	US

Key:
↑ denotes Frequency of Injecting is a significant predictor of increased risk
= denotes Frequency of Injecting non-significant factor
*indicates studies of particularly high quality due to design or power

Drug Choice

A further factor which is routinely examined in this literature is whether the type of drug injected has an effect on the transmission of BBVs or the tendency to share equipment. This may reflect the acute cognitive effects of the drug and/or the dependence potential for the drug (discussed in subsequent sections). The literature indicates that those IDU who use stimulants tend to be marginally more at risk as opposed to those IDU who use opiates (see Table 5 for details of research examining drug choice as a risk factor for sharing and HCV transmission).

The reason for this difference is unclear, however the type of drug primarily used may influence possible BBV transmission due to the frequency with which the drug is injected. Therefore, users who inject drugs with a shorter active period may be more likely to increase their use of the drug because the time at which they are 'high' is not long. As noted above, the more a person injects the more at risk they are for transmitting BBVs.

Drug choice is also a factor which is worthy of investigation due to the pharmacological effect which the drug can have on the user. Briefly, the pharmacological action of the drug can result in cognitive changes leading to disinhibited behaviour and an increase in risk-taking. This is discussed in detail below.

Table 5

Findings of Studies Investigating Drug Choice as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Studies Showing Stimulant Preference Associated with HCV Transmission	Group at Greater Risk	Study Characteristics	Origin
Opioids						
Chetwynd (1995)	=				n = 116. IDU who had attended a methadone treatment clinic in Christchurch. Cross-sectional design.	NZ
Crofts (1993)*	↑			Men who use opiates at greater risk than men who don't use opiates.	n = 303. IDU recruited by peer workers through social networks, community agencies, and prisons. Prospective cohort study.	Aus
Crofts (1994)*	↑			Opiate users at greater risk than amphetamine users	n = 315. IDU recruited through social networks, community agencies and prisons. Cohort design.	Aus
Darke (1990)		↑		Polydrug users and those using higher levels of heroin at greater risk than those using higher levels of cocaine	n = 100. Opiate users in and out of treatment. Recruited by advertising in waiting rooms of methadone clinics and health centres. Cross-sectional design.	Aus
Donohue (1991)	=			Injection of cocaine versus non-injection of cocaine	n = 225. IDU from Baltimore area enrolled in another study of HIV infection. Prospective cohort study.	US
Dwyer (2002)	↑	↑		Sharing: Those at greater risk are those who last injected and injected most over the last month drugs other than amphetamines or heroin HCV: Those at greater risk are those who last injected drugs other than amphetamines or heroin, and injected 2 or more drug types the last time they injected	n = 416. Participants who had injected monthly for the past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Hagan (1999)*	↑			Heroin/speedball users at greater risk than stimulant users	n = 647. IDU recruited from drug treatment, corrections, and social service agencies. Eligible if had injected in previous year, over 14 years old, and spoke English or Spanish. Prospective cohort study.	US

Loxley (1995)	↑			Those who last injected opiates at greater risk than those who last injected amphetamines	n = 872. IDU from Adelaide, Melbourne, Sydney, and Perth recruited by advertising with agencies (e.g. NSPs, health centres) and snowballing. Cross-sectional design.	Aus
MacDonald (2000)	↑			Methadone/heroin users at greater risk than amphetamine users	n = 4,141. IDU who had attended selected NSP sites around Australia 1995 – 1997. Repeated cross-sectional surveys.	Aus
NCHECR (2006a)		↑		Those who inject heroin had higher sharing rates than those who inject amphetamines	n = 11,229. IDU who had attended NSP sites across Australia. Cross-sectional survey.	Aus
Van Beek (1994)	↑			Higher in opiate users than stimulant users	n = 201. All IDU who had attended a primary health care facility in central Sydney who had undertaken HCV testing. Retrospective cross-sectional study.	Aus
Zeldis (1992)	↑			Heroin users at greater risk than amphetamine users	n = 585. IDU enrolled in drug treatment programs. Cohort study.	US
Cocaine and other Psychostimulants						
Diaz (2001)	↑		✓	Those who inject cocaine or speedball at greater risk than those who inject heroin and crack	n = 557. IDU aged 18 – 29 who had injected in last 6 months and had injected for less than 3 years. Street recruited. Cross-sectional design.	US
Garfein (1996)*	↑		✓	Users of cocaine in the last 6 months at greater risk than those who haven't used cocaine in the last 6 months	n = 716. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Garfein (1998)	↑		✓	Users of cocaine and speedball exclusively or with other drugs at greater risk than those who don't use cocaine or speedball.	n = 229. IDU aged 18 – 29 years. Recruited through community outreach. Prospective cohort study.	US
Guadagnino (1995)	↑		✓	Cocaine users at greater risk than non-cocaine users	n = 146. Male heterosexual IDU (injected in the past 12 months) attending methadone maintenance clinic. Cross-sectional design.	Italy
Maher (2004)	↑		✓	Cocaine users at greater risk than	n = 372. IDU in South-West Sydney with history of	Aus

				amphetamine users	IDU in last 6 months and HCV serostatus not known to be positive. Recruited using word-of-mouth and snowballing methods. Cross-sectional design.	
Maher (2006)*	↑		✓	Cocaine users at greater risk than heroin and 'other drug' users.	n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus
Maher (2007)*	↑		✓	Cocaine users at greater risk than heroin or 'other drug' users	n = 215. IDU who had injected drugs in the past 6 months and were seronegative or had unknown HCV serostatus. Recruited through outreach, methadone clinics, and NSPs. Prospective cohort study.	Aus
MacDonald (1997)		=		Study examined last drug injected: stimulants (cocaine or 'speed'), heroin or opiates, methadone, polydrugs, 'other'/not reported.	n = 1,005. All IDUs who had attended 21 NSPs across Australia in a one week period in March 1995. Cross-sectional survey.	Aus
Thomas (1995)*	↑		✓	Those who inject cocaine at greater risk than those who do not inject cocaine	n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Rezza (1996)	↑		✓	IV cocaine users. No comparison group reported.	n = 746. IDU who had attended a drug treatment centre. Case-control study.	Italy
Van den Hoek (1990)	=			Type of drug previously or currently injected. Benzodiazepines, methadone, cocaine, heroin.	n = 346. IDU and non-IDU recruited at methadone dispensary sites and STD clinic. Prospective cohort design.	Netherlands
Polydrugs						
Lamden (1998)	↑			Polydrug users at greater risk than primarily opiate, primarily stimulant, steroids, and 'unknown' drug users.	n = 773. Drug users (injecting & non-injecting) who had hepatitis serology testing between 1992 and 1996 at public health facilities. Retrospective cross-sectional design.	UK
Van Beek (1998)*	↑			Polydrug users at greater risk than those who use one drug	n = 1,078. Clients of BBV prevention centre with history of IDU. Retrospective cohort study.	Aus

Key:
↑ denotes Drug Choice is a significant predictor of increased risk
= denotes Drug Choice non-significant factor
*indicates studies of particularly high quality due to design or power

Sexual Orientation

Sexual orientation has also been examined within the literature as a possible demographic factor which impacts on HCV transmission or the likelihood of sharing injecting equipment. While there has been no specific mention as to why this variable is consistently examined within the existing literature, one would assume that this factor is of interest to researchers to determine whether some cultural difference which exists in this population may alter or contribute to the risk of BBV transmission or the sharing of injecting equipment.

A thorough examination of the literature indicates that this factor does not reliably influence one's likelihood of either sharing injecting equipment or the transmission of BBVs such as HCV. By far the majority of studies report this finding, including those with strong methodology. For instance, Hagan et al. (1999) report that an IDU's sexual orientation does not predict HCV seropositivity despite this study utilising sound methodological procedures including having an ample number of participants, and using a cohort design where the participants were followed up over time. In the review conducted, only a minority of studies report that heterosexuals are at an increased risk, and even fewer studies report that homosexuals or bisexuals are at a greater risk than other sexual identities. Please refer to table 6 below for details of the studies which examine this factor in BBV transmission and the sharing of injecting equipment.

Table 6

Findings of Studies Investigating Sexual Orientation as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Group at Greater Risk	Study Characteristics	Origin
Chetwynd (1995)	=			n = 116. IDU had had attended a methadone treatment clinic in Christchurch. Cross-sectional design.	NZ
Crofts (1994)*	↓		Higher in heterosexuals than homosexual and bisexual	n = 315. IDU recruited through social networks, community agencies and prisons. Cohort design.	Aus
Diaz (2001)	=			n = 557. IDU aged 18 – 29 who had injected in last 6 months and been injecting for less than 3 years. Street recruited. Cross-sectional design.	US
Donohue (1991)	↓		Higher in heterosexual than other orientations	n = 225. IDU from Baltimore area enrolled in another study of HIV infection. Prospective cohort study.	US
Garfein (1996)*	=			n = 716. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Garfein (1998)	=			n = 229. IDU aged 18 – 29 years. Recruited through community outreach. Prospective cohort study.	US
Hagan (1999)*	=			n = 647. IDU recruited from drug treatment, corrections, and social service agencies. Eligible if had injected in previous year, over 14 years old, and spoke English or Spanish. Prospective cohort study.	US
Loxley (1995)		=		n = 872. IDU from Adelaide, Melbourne, Sydney, and Perth recruited by advertising with agencies (e.g. NSPs, health centres) and snowballing. Cross-sectional design.	Aus
MacDonald (1997)		↑	Higher in bisexual and homosexual than heterosexual	n = 1,005. All IDUs who had attended 21 NSPs across Australia in a one week period in March 1995. Cross-sectional survey.	Aus
Patti (1993)	=			n = 645. Regular IV heroin users who had attended methadone maintenance centres in Rome. Cross-sectional design.	Italy
Thomas (1995)*	↓		Higher in heterosexual	n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Treloar (2003)		↓	Higher in heterosexual than bi- or homosexual	n = 336. IDU aged between 16 – 25 years who had injected for 4 years or less from urban Sydney, urban Brisbane, or rural NSW. Recruited by advertisements in NSPs, treatment centres, health clinics, local press etc. Cross-sectional design.	Aus
Van Beek (1994)	↓		Higher in heterosexual than homosexual	n = 201. All IDU who attended a primary health care facility in central Sydney who had undertaken HCV testing. Retrospective cross-sectional study.	Aus
Van Beek (1998)*	=			n = 1,078. Clients of BBV prevention centre with history of IDU. Retrospective cohort study.	Aus

Villano (1997)*	=	n = 1,593. Sample had history of IDU in last 10 years. Cohort study. Mean follow up 6.5 years	US

Key:

↑ denotes homosexuality found to increase risk
↓ denotes homosexuality found to decrease risk
= denotes Sexual Orientation non-significant factor
*indicates studies of particularly high quality due to design or power

Treatment

An IDU's current drug treatment status is also often considered as a contributing factor to BBV transmission. It would be hoped that being engaged in treatment or having had past treatment would be associated with safer injecting practices, and therefore not be associated with HCV transmission and equipment sharing, however this does not appear to be the case. Some studies report that having a history of being in treatment is a significant factor, however a substantial number report that one's treatment status or history of treatment has no impact on BBV transmission or the sharing of injection equipment (see Table 7 below). A review of the literature would seem to suggest that this factor is not consistently predictive of risky injecting practices. It should be noted however, that studies which demonstrate that treatment has a significant impact report varying treatment conditions. For instance, some report that a history of methadone treatment impacts on HCV transmission, while others report that current treatment is associated, and still others report that not being in drug treatment is related to HCV transmission. Taken as a whole then, it would appear that an IDU's treatment status cannot be said to be predictive of HCV transmission, nor of the sharing of injecting equipment largely due to contamination by these extraneous factors.

The reason for this lack of significance as a predictor variable may be that it is not until IDU experience acute symptoms associated with unsafe injecting that treatment is sought. Once in treatment, risk behaviours may decrease for that period, but then increase once symptoms have resolved. This is, of course, hypothetical and has not been examined in detail in a systematic literature review to date.

Table 7

Findings of Studies Investigating Treatment Status as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Notes	Study Characteristics	Origin
Crofts (1993)*	↑		Women with history of methadone treatment.	n = 303. IDU recruited by peer workers through social networks, community agencies, and prisons. Prospective cohort study.	Aus
Darke (1990)		↓	Not being in current treatment associated with BBV risk behaviour	n = 100. Opiate users in and out of treatment. Recruited by advertisements in waiting rooms of methadone clinics and health centres. Cross-sectional design.	Aus
Diaz (2001)	↑		Being in treatment.	n = 557. IDU aged 18 – 29 who had injected in last 6 months and had been injecting for less than 3 years. Street recruited. Cross-sectional design.	US
Dwyer (2002)	=	↑	Previous, but not current treatment	n = 416. Participants had injected monthly for past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Lamden (1998)	=			n = 773. Drug users (injecting & non-injecting) who had hepatitis serology testing between 1992 and 1996 at public health facilities. Retrospective cross-sectional design.	UK
Loxley (1995)		=		n = 872. IDU from Adelaide, Melbourne, Sydney, and Perth recruited by advertising with agencies (e.g. NSPs, health centres) and snowballing. Cross-sectional design.	Aus
MacDonald (2000)	↑		History of methadone treatment.	n = 4,141. IDU who attended selected NSP sites around Australia 1995 – 1997. Repeated cross-sectional surveys.	Aus
Maher (2004)	↓		Not in drug treatment over the last year associated with increased risk.	n = 372. IDU in South-West Sydney with history of IDU in last 6 months and HCV serostatus not known to be positive. Recruited using word-of-mouth and snowballing methods. Cross-sectional design.	Aus
Maher (2006)*	=			n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus
Maher (2007)*	=			n = 215. IDU who had injected drugs in the past 6 months and were seronegative or had unknown HCV serostatus. Recruited through outreach, methadone clinics, and NSPs. Prospective cohort study.	Aus
Rezza (1996)	↓		Methadone treatment in previous 6 months	n = 746. IDU who had attended a drug treatment centre. Case-control study.	Italy
Thomas (1995)*	↑		History of drug treatment.	n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US

Van Beek (1998)	=	n = 1,078. Clients of BBV prevention centre with history of IDU. Retrospective cohort study.	Aus

Key:
↑ denotes treatment involvement increases risk
↓ denotes treatment involvement decreases risk (alternatively, not being in treatment increases risk)
= denotes Treatment Status non-significant factor
*indicates studies of particularly high quality due to design or power

Accommodation

Accommodation status is also examined as a possible predictive variable for the risk of transmission of HCV and the sharing of injecting equipment, however based on the literature reviewed it appears that whether one is in stable or unstable housing does not make a difference in this regard. Most studies report that this factor is not predictive of BBV transmission risk, and only one study found unstable housing to be a risk-factor. This study, conducted by Dwyer et al. (2002) was a cross-sectional design, and therefore deviates in the quality of methodology when compared with the other studies, all of which utilise longitudinal designs and can demonstrate changes over time. However, it should be noted that this study is the only study reviewed which was conducted in Australia, as opposed to the United States and the disparate findings may reflect geographical differences.

The lack in finding accommodation status as a predictor for risk of BBV transmission and sharing of injecting equipment is somewhat surprising. It would not be unreasonable for one to assume that stable housing would produce more safe injecting practices when compared with unstable housing environments. Stable housing would presumably allow one to set up a sterile injecting environment which allows the IDU to inject in an unhurried manner, allowing safe injecting. Unstable housing, by contrast, may require the IDU to inject in an environment which necessitates hurried injecting and which is less sterile, such as is the case with street-based injecting. Indeed, street-based injecting has been found to be associated with BBV transmission (Maher, Dixon, Lynskey, & Hall, 1998; Strathdee et al., 2001). When an IDU is injecting in these environments, a pressure exists to inject quickly so as not to be seen by the police, members of the public, and other users (Southgate et

al., 2003). Unfortunately, the literature reporting that unstable housing does not impact on the sharing of injecting equipment or on BBV transmission risk does not elaborate on this finding. At this stage, the reason for the result is unclear.

Table 8

Findings of Studies Investigating Accommodation Status as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Notes	Study Characteristics	Origin
Diaz (2001)	=			n = 557. IDU aged 18 – 29 who had injected in last 6 months and been injecting for less than 3 years. Street recruited. Cross-sectional design.	US
Dwyer (2002)	=	↑	Those with unstable accommodation at greater risk	n = 416. Participants had injected monthly for past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Evans (2003)		=		n = 844. Recruited by street outreach, eligible if injected drugs in the past month, under 30 years old, and spoke English. Cross-sectional design.	US
Hagan (2001)*	=			n = 317. Clients who had injected in the past year, were over 14 years old, and spoke English or Spanish were eligible. Recruited from drug treatment and correction centres. Follow up 1 year later. Prospective cohort study.	US
Thomas (1995)*	=			n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Villano (1997)*	=			n = 1,593. Sample had history of IDU in last 10 years. Cohort study. Mean follow up 6.5 years	US

Key:
↑ denotes unstable accommodation increases risk
↓ denotes unstable accommodation decreases risk
= denotes accommodation status non-significant factor
*indicates studies of particularly high quality due to design or power

Education

Similarly, the amount of formal education that an IDU has received has been found not to have an impact on whether they are at risk for BBV transmission or the sharing injecting equipment. As can be seen in Table 9 below, the majority of studies find that education level is not a predictive factor. Among the studies reviewed, only a minority found that a relationship existed. Atler et al. (1999) report that education is a significant factor for HCV transmission whereby those with lower education levels are at a greater risk. While this is so, this finding cannot be viewed with the same veracity as other studies which examine education as a risk factor as this sample comprised those from the general population rather than solely examining IDU.

The reason for education not impacting on the risk for the transmission of HCV or for the risk of sharing injecting equipment is not examined in the literature reviewed. However, it could be hypothesised that the participants in these studies generally have a lower education level than the general population. The population captured in studies such as those reviewed are limited to those presenting to public treatment facilities and Needle and Syringe Programs (NSPs), and therefore do not generally include the more high functioning IDU who are not enrolled in treatment programs or attend NSP facilities. Considering this, the population recruited for such studies is not representative of the actual IDU population, instead reflecting those who are lower functioning. In this way, these studies may be inherently biased, reflecting those who are more likely to have lower education levels. If this is the case, the range of years in education may not be extensive enough to detect a difference in education level as it applies to risk in this context. Of course, the

observed result may simply reflect a real phenomenon where one's level of education simply does not have any predictive value to BBV transmission risk.

Table 9

Findings of Studies Investigating Education as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Notes	Study Characteristics	Origin
Atler (1999)	↑		Lower education levels (≤ 12 years) at greater risk than those with higher education (> 12 years)	n = 21,241. Serology testing conducted on those 6 years and older who participated in a national health survey 1988 – 1994. Not all participants IDU. Cross-sectional study.	US
Chang (1998)	=			n = 934. Participants were drug users (injecting and non-injecting) recruited from a drug treatment centre and a prison. Cross-sectional design.	Taiwan
Dwyer (2002)	=	=		n = 416. Participants had injected monthly for past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Evans (2003)		=		n = 844. Recruited by street outreach, eligible if injected drugs in the past month, under 30 years old, and spoke English. Cross-sectional design.	US
Garfein (1996)*	=			n = 716. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Maher (2006)*	=			n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus
Thomas (1995)*	=			n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Treloar (2003)		↑	Lower education levels (< grade 10) at greater risk than those with higher education (> grade 10)	n = 336. IDU aged between 16 – 25 years injecting for 4 years or less from urban Sydney, urban Brisbane, or rural NSW. Recruited by advertisements in NSPs, treatment centres, health clinics, local press etc. Cross-sectional design.	Aus
Villano (1997)*	=			n = 1,593. Sample had history of IDU in last 10 years. Cohort study. Mean follow up 6.5 years	US

Key:
↑ denotes higher education reduces risk
↓ denotes lower education increases risk
= denotes education is a non-significant factor
*indicates studies of particularly high quality due to design or power

Ethnicity

It is not clear whether one's ethnicity is a risk factor for HCV transmission or the sharing of injecting paraphernalia. Some studies report that this makes no difference, while others report that ethnicity does have an impact (see Table 10). Even amongst the more well-designed studies which utilise prospective cohort designs with large samples and serological testing (eg. Garfein et al., 1996; Thomas et al., 1995) discrepancy exists. While this is so, one study reports that the Afro-American race is at more risk for HCV transmission, while the other concludes that there is no effect of ethnicity on one's propensity to be infected with HCV.

In Australia, several studies from Maher and colleagues (Maher et al., 2006; Maher et al., 2007) with sound methodology suggest that ethnicity is a predictive factor. However, while some studies such as Maher's indicate that there is a significant effect of ethnicity, no one particular race has found to be consistently predictive and groups may be broad (eg. 'other' race in comparison to the dominant group in the population under study) and therefore provide limited information as to the ethnic backgrounds that are more at risk. Taking this literature as a whole then, it would appear that no particular race is more at risk than others in BBV transmission and equipment sharing.

The reason for a lack of clear findings in studies examining ethnicity as a factor may be due to research investigating minority status in the majority cultural context, rather than about 'race' as such. This is problematic, as ethnic minorities can be disadvantaged when compared with the majority. For instance, the Indigenous population in Australia underperform when compared with the national population in areas such as literacy, numeracy, student attendance, retention into secondary

education (Commonwealth of Australia, 2001) and therefore relationships with BBV risk behaviours is more complicated than simply examining race. The factor of 'ethnicity' in reality may comprise a number of other contributing factors, such as education as outlined above. While this is one possible explanation as to why ethnicity is not clearly identified within the current literature as a risk factor for BBV transmission and the sharing of injecting equipment among the IDU population, studies which examine this variable do not commonly provide an explanation as to why this variable is under examination as a possible factor, nor explain why it is not consistently reported as a risk factor in existing research.

Table 10

Findings of Studies Investigating Ethnicity as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Studies Showing that Asian Ethnicity is predictor of HCV transmission	Group at Greater Risk	Study Characteristics	Origin
Australian Studies						
Dwyer (2002)	=	=			n = 416. Participants had injected monthly for past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Maher (2004)	↑		✓	Asian greater risk than non-Asian	n = 372. IDU in South-West Sydney with history of IDU in last 6 months and HCV serostatus not known to be positive. Recruited using word-of-mouth and snowballing methods. Cross-sectional design.	Aus
Maher (2006)*	↑			Prospective cohort study, (n = 368). Ethnic minority at greater risk than non-ethnic minority	n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus
Maher (2007)*	↑			Culturally and Linguistically Diverse (CALD) background greater risk than Anglo-Australian.	n = 215. IDU who had injected drugs in the past 6 months and were seronegative or had unknown HCV serostatus. Recruited through outreach, methadone clinics, and NSPs. Prospective cohort study.	Aus
Southgate (2003)		↑		Asian and Indigenous at greater risk	n = 2,738. Clients who had attended NSP sites over a one week period in October 2001. Cross-sectional study.	Aus
Treloar (2003)		=			n = 336. IDU aged between 16 – 25 years who had injected for 4 years or less from urban Sydney, urban Brisbane, or rural NSW. Recruited by advertisements in NSPs, treatment centres, health clinics, local press etc. Cross-sectional design.	Aus

American Studies				
Atler (1999)	=		n = 21,241. Serology testing conducted on those 6 years and older who participated in a national health survey 1988 – 1994. Not all participants IDU. Cross-sectional study.	US
Diaz (2001)	=		n = 557. IDU aged 18 – 29 who had injected in last 6 months and had been injecting for less than 3 years. Street recruited. Cross-sectional design.	US
Hagan (1995)	↑	White race greater risk than non-white	n = 28 (case patients), n = 38 (control patients). Participants were IDU who had attended a health department. Case-control design.	US
Garfein (1996)*	=		n = 716. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Thomas (1995)*	↑	Afro-American race greater risk than non-Afro-American. (n = 1356)	n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US
Valente (2001)*	↑	'Other race' greater risk than African American. (n=1184)	n = 1,184. IDU who attended a Baltimore NSP. Cohort study.	US
Zeldis (1992)	↑	African American, Hispanic, and 'other' greater risk than White race	n = 585. IDU enrolled in drug treatment programs. Cohort study.	US

European Studies			
Van Ameijden (1993)	=	n = 305. Drug users (injecting and non-injecting) were recruited from a methadone program clinic and STD clinic. Prospective cohort study.	Netherlands

Key:
↑ denotes Ethnicity is a significant predictor
= denotes Ethnicity non-significant factor
*indicates studies of particularly high quality due to design or power

Prison History

The high prevalence of HCV among the prison population has long been identified as a significant problem, both here in Australia and overseas. A national survey of the BBV status of Australian prison entrants in 2007 reported the prevalence of HIV in less than 1%, HCV in 35%, and core HBV anti-bodies in 21% of the sample (Butler & Papanastasiou, 2008). Of these prison entrants, 55% reported a history of IDU (Butler & Papanastasiou, 2008) and research indicates that a substantial portion of incarcerated offenders have had some exposure to illicit drugs. In 2001, the Australian Institute of Criminology conducted survey research with adult male offenders who were incarcerated. Of those surveyed, over 80% reported ever having used cannabis, heroin, amphetamines, or cocaine, and current regular use in the six months prior to imprisonment was reported by 62% of offenders (Makkai & Payne, 2003). A similar study conducted with female incarcerated offenders in 2003 reports strikingly similar results, where over 80% reported ever having used drugs, and 62% reported being regular drug users in the six months prior to their arrest (Johnson, 2004).

As Crofts et al. (1995) explains, a substantial number of prison entrants are injecting drug users and are in prison because of drug use and engagement in illegal activity in order to generate money for drugs. This relationship has been supported by both the female and male offenders reports cited above. While the progression of these offences appears to differ between the sexes, where in general criminal activity precedes illegal drug use in male offenders (Makkai & Payne, 2003), and in female offenders illegal drug use precedes criminal activity (Johnson, 2004), they are nevertheless clearly related. When these samples were asked as to whether they felt

that drug and alcohol abuse contributed to their offending, 41% of the female offenders (Johnson, 2004) and 51% of male offenders (Makkai & Payne, 2003) reported that there was a causal relationship. Attribution for this relationship was broadly categorised into economic compulsive effects, psychopharmacological effects of drugs, and that drugs and/or alcohol lead to crime. The male incarcerated offenders study also reports that while cash is the primary method to obtain illegal drugs, other methods include violence and trading stolen goods (Makkai & Payne, 2003), again highlighting the link between illicit drug use and crime.

As the above research highlights, there is a strong relationship between crime and drug use. Because injecting drug use is associated with the transmission of BBV, the prison population has a greater prevalence of BBV than the general population, leading to imprisonment logically being a risk factor for BBV transmission amongst IDUs. However, there is a double edged sword here, as IDU have a higher prevalence of BBVs due to their drug use and unsafe injecting practices, however once in prison there are further factors present which allow for the quick spread of viruses. In Australia, prisoners do not have access to sterile injecting equipment, which results in an increased likelihood of sharing, lending, and reuse amongst the prison population. Other prison practices such as tattooing and unprotected sexual intercourse contribute to the spread of viruses such as HIV, HCV, and HBV (Crofts et al., 1995).

Indeed, the large majority of Australian studies find that having a prison history is a predictor of HCV infection, and evidence also suggests this is a risk factor for the sharing of injecting equipment (see Table 11). Some particularly well-designed studies have been conducted showing this trend, and credence should be given to these studies. For instance, the study by Maher and colleagues (2006)

demonstrates strong methodology, where 368 IDU were followed up every three months until study completion at three years or until seroconversion. In terms of similar studies conducted overseas, the results of these indicate that prison history is not predictive of HCV transmission risk or of equipment sharing risk. Villano et al. (1997) demonstrates this in a study using strong longitudinal methods, where he followed up IDU for a mean of 6.5 years. The reason for the differing results obtained in Australia compared with overseas studies is unclear.

Table 11

Findings of Studies Investigating Prison History as a predictor of HCV Transmission and Equipment Sharing

Study	HCV	Sharing	Group at Greater Risk	Study Characteristics	Origin
Bell (1990)	↑		Duration of imprisonment in months	n = 172. IV heroin users who presented to a drug treatment centre seeking entry to a methadone program. Cross-sectional design.	Aus
Chetwynd (1995)	=			n = 116. IDU who attended a methadone treatment clinic in Christchurch. Cross-sectional design.	NZ
Crofts (1993)*	↑		History of imprisonment	n = 303. IDU recruited by peer workers through social networks, community agencies, and prisons. Prospective cohort study.	Aus
Diaz (2001)	↑		History of imprisonment	n = 557. IDU aged 18 – 29 who had injected in last 6 months and had been injecting for less than 3 years. Street recruited. Cross-sectional design.	US
Dwyer (2002)	=	=		n = 416. Participants had injected monthly for past 6 months. Recruited via snowballing, posted advertisements, NSP sites. Cross-sectional design.	Aus
Lamden (1998)	=			n = 773. Drug users (injecting & non-injecting) who had hepatitis serology testing between 1992 and 1996 at public health facilities. Retrospective cross-sectional design.	UK
Maher (2004)	↑		Imprisonment over last year	n = 372. IDU in South-West Sydney with history of IDU in last 6 months and HCV serostatus not known to be positive. Recruited using word-of-mouth and snowballing methods. Cross-sectional design.	Aus
Maher (2006)*	↑		Recent prison ('recent' not defined)	n = 368. HCV negative IDU who had injected drugs in the past 6 months. Recruited through direct approaches, outreach, NSPs, methadone and sexual health clinics. Prospective cohort study.	Aus
MacDonald (2000)	↑		Imprisoned in last year	n = 4,141. IDU who attended selected NSP sites around Australia 1995 – 1997. Repeated cross-sectional surveys.	Aus
NCHECR (2006a)	↑	↑	Imprisonment in last year	n = 11,229. IDU who attended NSP sites across Australia. Cross-sectional survey.	Aus
Patti (1993)	=			n = 645. Regular IV heroin users who attended methadone maintenance centres in Rome. Cross-sectional design.	Italy
Southgate (2003)		↑	Imprisonment in last year	n = 2,738. Clients who attended NSP sites over a week period in October 2001. Cross-sectional study.	Aus
Stark (1995)	↑		History of imprisonment	n = 405. Clients of drug abuse treatment centres, a hospital, and BBV prevention centre who had injected drugs in the last 3 months. Cross-sectional design.	Germany
Thomas (1995)*	=			n = 1,356. Clients with history of IDU in last 10 years recruited from health centres and probation offices. Cohort study.	US

Van Beek (1998)*	↑	History of imprisonment	n = 1,078. Clients of BBV prevention centre with history of IDU. Retrospective cohort study.	Aus
Villano (1997)*	=		n = 1,593. Sample had history of IDU in last 10 years. Cohort study. Mean follow up 6.5 years.	US

Key:
↑ denotes prison history is a significant predictor of increased risk
= denotes prison history non-significant factor
*indicates studies of particularly high quality due to design or power

Impulsivity

The section above highlights that a variety of demographic variables have been implicated as being predictive of needle sharing. However, an area which has not been examined in detail within the existing literature, and which also may have an impact on needle sharing, is that of personality variables. In particular, the trait of impulsivity is one which logically would appear to influence one's decision regarding whether to share needles or not to share. One would expect that an individual impulsive in nature would not engage in a detailed and balanced decision making process, but rather would consider the immediate rewards of the situation and therefore choose to share, if placed in such a situation, in order to become intoxicated or to ameliorate withdrawal symptoms, disregarding the potential consequences of this behaviour. Since this factor has been little examined in the literature to date, it is one which is well worth investigation and therefore forms a substantial focus of the current study. The concept of impulsivity has received much attention in the personality literature over several decades, and the popular models and conceptualisations of impulsivity are reviewed briefly in the paragraphs which follow.

Typically, impulsivity is conceptualised as a personality trait where behaviours involve rashness, a lack of foresight or planning, and a lack of reflection and deliberation (Dawe & Loxton, 2004). Within the psychological personality literature, much attention has been paid to this construct due to its obvious implications to risk-taking. However, the precise nature of this construct and the elements which comprise it has been the source of some contention among theorists.

While there have been many postulations as to the exact nature of this trait (e.g. Cloninger, 1987; Dawe & Loxton, 2004; Eysenck & Eysenck, 1978; Gray, 1987; Zuckerman & Kuhlman, 2000), several key theories remain popular amongst the recent literature. Among these is Gray's behavioural inhibition and behavioural activation system (BIS/BAS) theory of personality (Gray, 1987). In his theory, Gray asserts that there are two key dimensions of personality which reflect the tendency for individuals to respond to environmental cues differently, depending on the sensitivity of two neurological systems. The first of these systems is the behavioural inhibition system (BIS). Neurologically, this system is thought to involve the septohippocampal system, which comprises the hippocampus proper, dentate gyrus, entorhinal cortex, subicular area, and the posterior cingulated cortex (Gray & McNaughton, 2000). The BIS is theorised to be responsible for controlling the experience of anxiety in response to environmental cues. Gray also contends that the activation of this system inhibits goal seeking behaviour due to the inhibition of behaviour which may result in negative outcomes.

The second of Gray's dimensions is the behavioural activation system (BAS) which is believed to involve dopaminergic, particularly the mesolimbic dopaminergic pathways of the brain, as well as the catecholaminergic pathways (Dawe, Gullo, & Loxton, 2004; Stellar & Stellar, 1985). The activity of dopamine in these pathways is pivotal for reward and reinforcement and activates in response to reinforcers including food, sex, and drugs of abuse. The neural substrate of BAS has been found to share many similarities to the neural pathways which underlie the reinforcing effects of these experiences (Dawe et al., 2004), and therefore is also involved in the promotion of reinforcement and reward. It is postulated that those who have heightened BAS sensitivity are likely to engage in goal directed behaviour

and to experience pleasant emotions such as happiness when confronted with cues of possible reward. Gray asserts that the BAS system is analogous to impulsivity, in that those individuals who have a heightened BAS sensitivity are more sensitive to signals of reward and thus engage in behaviours to seek out these rewards while ignoring potential future punishment. In their development of a scale to assess BIS and BAS sensitivity, Carver and White (1994) further refined the BAS component into three subscales reflecting different aspects of behavioural activation. The 'Reward Responsiveness' subscale focuses on positive responses to the occurrence of anticipation of a reward. The 'Drive' subscale comprises items relating to the persistent pursuit of desired goals. Finally, the 'Fun Seeking' subscale centres on the desire for new rewards as well as a willingness to approach a potentially rewarding event on the spur of the moment.

Cloninger (1987) proposed that there are three main dimensions of personality, which he termed novelty seeking, harm avoidance, and reward sensitivity. He asserted that varying levels and combinations of these dimensions can explain individual differences in personality. The 'novelty seeking' dimension is most analogous to impulsivity, and Cloninger describes this personality dimension as "a heritable tendency toward intense exhilaration or excitement in response to novel stimuli or cues for potential rewards or exploratory activity in pursuit of potential rewards as well as active avoidance of monotony and potential punishment" (p. 575). He explains further that individuals who are high in the dimension of novelty seeking but lower in the other two dimensions are characterised as impulsive, exploratory, fickle, excitable, tempered, extravagant, and disorderly. Biologically, Cloninger (1987) explains that novelty-seeking traits reflect differences in the brian's 'incentive' system, which is associated with changes in the modulation of dopamine

through nirgrostriatal, mesolimbic and mesofrontal projections. The author also notes that dopamine agonists such as amphetamines, cocaine, alcohol and opiates facilitate dopaminergic transmission and therefore behavioural activation.

A further conceptualisation of impulsivity is Zuckerman's 'sensation seeking' construct. Initially Zuckerman examined sensation seeking in order to determine an individual's response to sensory deprivation (Zuckerman, 1971), however over time this has developed into determining the various components that lead to one behaving in an impulsive manner. Zuckerman's term 'sensation seeking' is synonymous with impulsivity and has recently been defined as "...a trait defined by the seeking of varied, novel, complex and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience" (cited in Zuckerman & Kuhlman, 2000).

Eysenck's conceptualisation of personality is regarded as prominent work in this field. In particular, his concepts of impulsivity and venturesomeness are particularly significant. These concepts exist within Eysenck's Impulsiveness, Venturesomeness and Empathy (IVE) questionnaire of the Eysenck Personality Scales (Eysenck & Eysenck, 1978). Within this theoretical framework, impulsivity refers to rash, unplanned impulsive behaviour without consideration of the consequences. On the other hand, venturesomeness refers to impulsive acts in which consequences have been weighed and considered to be acceptable risk.

A number of scales have been developed to assess impulsivity in relation to each of these theoretical conceptualisations. Eysenck and colleagues (Eysenck & Eysenck, 1978) have developed the IVE scale to assess their formulation of each of these constructs. The tri-dimensional personality questionnaire (TPQ) was developed by Cloninger (1987) as a measurement tool for his model of personality, which

includes the aspect of impulsivity which he termed novelty seeking. To assess Gray's notion of the existence of two motivational systems, Carver and White (1994) designed the BIS/BAS scales as a measure of one's dispositional sensitivity to each of these systems. Zuckerman (1978) has also developed a tool to assess sensation seeking, named the sensation seeking scale (SSS).

In addition to the instruments mentioned above, an alternative measure of impulsivity is Arnett's (1994) Arnett Inventory of Sensation Seeking (AISS). This tool was developed as a result of dissatisfaction with other models of impulsivity, and in particular as a result of the limitations of the SSS which was then widely used. For instance, Arnett (1994) criticised the SSS on several grounds, including the fact that it used a forced choice format, used outdated language, referred to physical activities such as skiing and mountain climbing which may therefore elicit responses that reflect changes in age and physical ability rather than sensation seeking. Finally, Arnett (1994) highlighted that the scale was subject to a serious confounding factor – that it contains items on alcohol use, drug use, and sexual behaviour, which are the types of behaviour under examination in many studies which employ this scale. Arnett's (1994) AISS sought to address these flaws by providing a valid tool which uses a Likert-type response format, does not contain items that are intrinsically age-related, and does not contain items that involve illegal or norm-breaking behaviour so as not to define sensation-seeking on the basis of rule breaking and to recognise that it can be expressed in a legal fashion. Arnett's scale also differed from alternative scales such as the SSS because it provided a focus not just on the novelty of stimulation, but also emphasised the role of the intensity of stimulation. In the conceptualisation of sensation seeking, novelty of stimulation refers to seeking out novel sensations while intensity of stimulation refers to seeking out sensations which

are intense in experience. For instance, items developed by Arnett (1994) to assess novelty include "I can see how it would be interesting to marry someone from a foreign country" and "I would have enjoyed being one of the first explorers of an unknown land", while items to assess intensity include "When I listen to music, I prefer it to be loud" and "I can see how it must be exciting to be in a battle during a war". Zuckerman's (1978) conceptualisation focussed on complexity of stimulation, however Arnett dropped this from the AISS due to research indicating that intensity was more of a defining quality of sensation seeking in comparison with complexity. Therefore, Arnett (1994) had addressed a number of limitations of the measurement of sensation seeking in the development of the AISS.

While there have been a number of theories relating to the nature of impulsivity, there appears to be some overlap between the models, and accordingly many measures of impulsivity are correlated. For instance, Carver and White (1994) argue that Cloninger and Gray's models of impulsivity stem from essentially the same theoretical background and can be thought of as one and the same conceptualisation. While this must be recognised, the very existence of such a vast array of literature leads one to thinking that this is not a simple, unified, and unidimensional construct. Indeed, many researchers have subjected their theories and associated assessment tools to factor analyses, in an effort to more clearly define the impulsivity construct. As a result of such investigation, it is now generally accepted among theorists that impulsivity is in fact a multidimensional construct.

So, if impulsivity is to be viewed as a multidimensional construct, how many factors are there and what are they? To attempt to answer this question and remove some of the ambiguity surrounding the different conceptualisations of impulsivity and the elements which comprise this construct, a series of factor analyses have been

conducted by a number of researchers. Even so, some of these studies reveal a two-factor structure, while others conclude that impulsivity is comprised of three-factors. Still others propose that the structure of impulsivity is comprised of four factors (eg. (Jorm et al., 1998; Lynam & Miller, 2004; Whiteside, Lynam, Miller, & Reynolds, 2005). These differing results may be explained by the fact that these researchers are utilising different measures of impulsivity (eg. the Urgency, Premeditation, Perseverence and Sensation Seeking (UPPS) impulsivity scale, the BIS/BAS scales) and applying factor analyses to different data sets. This then creates a differing structure which is less likely to produce the same number of factors.

The existence of such different views of the number of factors of impulsivity meant that the answer to the initial question remained unanswered. Dawe, Gullo and Loxton (2004) therefore conducted a comprehensive review of this body of literature to further reduce this haziness and concluded that most factor analytic studies determine that impulsivity is a structure comprised of two distinct factors. The first of these factors can be described as rash impulsiveness, and reflects a tendency to act rashly and without consideration of consequences. This domain is derived from scales such as Eysenck's impulsivity scale, Cloninger's Novelty Seeking Scale, and Zuckerman's Sensation Seeking Scale. The second factor which is seen in the literature and which Dawe et al. (2004) identify in their review of the literature more closely resembles Gray's BAS conceptualisation. This can be referred to as 'reward sensitivity', and reflects individual variation in sensitivity to rewarding stimuli in the environment. Dawe et al. (2004) apply this model to substance abuse and propose that those individuals who are prone to abusing drugs have a more sensitive BAS, and are therefore more receptive to the rewarding effects of drugs and other stimuli. The authors also state that this model is also related to response disinhibition, which

reflects pre-existing individual differences in frontal cortex functioning which can be exacerbated by chronic drug use. Independently conducted confirmatory factor analysis supports the notion of these two components to impulsivity (Franken & Muris, 2006).

Impulsivity and risk-taking remain an area of great interest to researchers because of the behaviours that can occur in this context, and which potentially have serious negative consequences. The link between impulsivity and various behaviours has been examined by a meta-analysis (n = 194) by Bogg and Roberts (2004). These authors examined the relationship between various facets of conscientiousness and health related behaviours, where conscientiousness is defined as "individual differences in the propensity to follow socially prescribed norms for impulse control, to be task- and goal-directed, to be planful, to delay gratification, and to follow norms and rules" (John & Srivastava, 1999, cited in Bogg & Roberts, 2004). Therefore, conscientiousness is inversely related to the construct of impulsivity. This research revealed that the facet of conscientiousness referred to as self-control (i.e. the propensity to inhibit impulsive thoughts, feelings, and behaviours) was negatively correlated to a variety of health related behaviours, including excessive alcohol use (meta-analysed r=-.29), drug use (r=-.24), risky driving (r=-.25), and risky sex (r=-.15). Therefore, it can be seen that rash impulsiveness is associated with a number of behaviours which have the propensity to result in negative health outcomes. Studies by Franken, Muris, and Georgieva (2006) and Johnson, Turner, and Iwata (2003) provide further support for the association between drug use and impulsivity, finding that people dependent on drugs had higher BAS scores than controls. Other research also supports the relationship between impulsivity and drug use (Conrod, Pihl, Stewart, & Dongier, 2000; Johnson et al., 2003). The relationship

between sexual risk taking and impulsive personality traits has also been confirmed by other research (Hoyle, Fejfar, & Miller, 2000; Mashegoane, Moalusi, Ngoepe, & Peltzer, 2002; Trobst, Herbst, Masters III, & Costa Jr, 2002).

As well as being associated with the HIV/AIDS risk behaviour of risky sexual practices, impulsivity has also been associated with needle sharing amongst IDU populations. This link was investigated in a study by Odum and colleagues (Odum, Madden, Badger, & Bickel, 2000) using a sample of opioid-dependent patients enrolled in an outpatient substance abuse treatment program. Using a titration procedure, the authors investigated the indifference points at various delays regarding their preference for obtaining hypothetical money and heroin outcomes, either immediately or after a delay. Participants were also asked to choose between whether they would share a needle to inject heroin immediately with a previously used needle, or wait one week to inject heroin with a sterile needle. The results of the study revealed that those participants who chose to use the non-sterile needle rejected the delayed money option (and therefore chose the immediate money outcome) more often than those participants who chose not to share needles, suggesting that the impulsive preferences were not simply specific to the context of heroin. The authors conclude that needle sharing may be a result of delayed consequences not being considered, or not having an impact on IDU current behaviour during decision-making processes. Therefore, it appears that those IDU with a propensity not to consider the consequences of their behaviour and who are therefore impulsive, are more likely to share needles.

The association between impulsivity and needle sharing was also found in a study by Trobst and colleagues (Trobst et al., 2002). These authors found that those who were deemed at a high-risk for HIV/AIDS due to their engagement in a variety

of sexual (e.g. sex with IDU, condom use) and substance use (e.g. sharing needles) risk behaviours were significantly more impulsive than those deemed to be at a low or medium risk. In this study, impulsivity was measured using the Impulsivity facet of Neuroticism in the Revised NEO Personality Inventory. The group of high-risk participants who exhibited impulsive personality traits were described by the authors as having particular difficulties with resisting cravings and urges. Brook et al. (1997) also found a relationship between what they termed poor emotional control and needle-sharing in sample of female IDU. The authors define poor emotional control as impulsivity as measured by the Personality Research Form, as well as deviant sexual behaviour.

It is clear from the literature that there is a link between substance abuse and the personality characteristic of impulsivity. To elucidate the reasons for this link, a field of research has been expanding in relation to the neurobiological correlates with impulsivity. From this perspective, researchers in this field propose that this association may be explained, at least partially, by neurobiological changes within the brain which can occur as the result of drug dependence and addiction. Robinson and Berridge (2003) state that addictive drugs affect the neural circuitry involved in pleasure, incentive motivation, and learning, and that these can in turn affect impulsivity. The reward system is said to include dopamine projections for the ventral tegmental area and substantia nigra to the nucleus accumbens (NAcc) and striatum, as well as glutamate inputs from the prefrontal cortex, amygdala and hippocampus. The reinforcing effect of drugs is thought to at least partially be explained by increases in mesolimbic dopamine release. Koob (2006) states that four neurotransmitters/neuromodulators play a critical role in the reinforcement of drugs,

those being the mesolimbic dopamine, opioid peptide, γ-amiobutyric acid (GABA), and endocannabinoid systems.

The role of the neurotransmitter serotonin has been found to be of pivotal importance in the development and behavioural expression of impulsivity. Animal studies have examined the role that serotonin plays in impulsivity by varying serotonergic neurotransmission as well as through lesions in brain sites where the neurotransmission of serotonin is abundant. Evenden (1999) notes that one of the most significant discoveries was made by Soubrié (1986) who found that when the neurotransmission of serotonin is reduced in animals, these animals exhibit difficulty in being able to adopt passive or waiting attitudes, thereby effectively exhibiting impulsive behaviour. Lesion studies such as that by Fletcher (1995) have also demonstrated that the reduction of serotonergic activity within the median raphé nuclei modulates behavioural inhibition. The role of serotonin in impulsivity has also received support from studies with human patients. For example, Linnoila, Virkkunen, George, and Higley (1993) found that in a sample of aggressive individuals, cerebro-spinal fluid (CSF) 5-hydroxindoleacetic acid (5-HIAA) was reduced only in those participants whose aggression was impulsive in nature. These, along with other existing research provide compelling evidence that serotonin forms at least part of the biological basis of impulsivity.

A somewhat complementary position is one which highlights the role of the frontal lobes in impulsive behaviour. The involvement of the frontal lobes is essential for controlling impulses and inhibiting socially unacceptable behaviour, and when damage to this area occurs, impulsive behaviour is typically seen. For example, Miller (1992) conducted a series of studies in patients who had undergone a frontal lobectomy and found that patients exhibited impulsive behaviour in the form of

making a guess of what an object or a missing word was based on little information. While this is so, the patients were able to judge their chances of success as well as controls, however they exhibited a poorer ability to withhold making a guess until they had more information. Further research using monkeys found that damage to the frontal cortex, or more specifically the vetromedial frontal cortex, results in a reduced ability to modify behaviour in the face of changed reinforcement patterns when this area is lesioned (Roskilde, 1979). Robbins (1996) contends that, with damage, behaviour occurs not as a result of reasoned consideration, but due to previously conditioned responses. These responses, however, may not be appropriate for the given situation and can therefore be inappropriate, and resemble impulsive behaviour. It should be noted that the frontal lobes receive substantial dopaminergic and serotonergic inputs.

Within the substance abuse literature, supporters of the position that changes within the frontal lobes are important in understanding impulsivity, argue that as a result of continued and prolonged drug use, damage to the frontal lobes occur, leading to a reduced ability to regulate and inhibit impulses. Yücel, Lubman, Solowij, and Brewer (2007) conducted a review of existing literature covering the neurobiological and neuropsychological correlates of long-term drug addiction. The authors report that a clear conclusion can be drawn; that across the drug classes, extensive neurological deficits can be seen in those who engage in long-term substance use. Primary among these deficits is impairment to executive function and inhibitory control; however deficits were also apparent in areas of working memory and decision making. These deficits were in many cases apparent through both neuroimaging technology and as a result of neuropsychological testing. For example, research into heavy and long-term alcohol drinkers found that among other

neuropsychological impairments, deficits were found within the domain of executive functions (problem solving, response inhibition, decision-making, and judgement). Structural magnetic resonance imaging (MRI) studies have found structural neuronal injury and volume loss in areas of the frontal lobe, temporal lobe, and cerebellum (Mann et al., 2001; Pfefferbaum, Sullivan, Mathalon, & Lim, 1997). This type of damage is consistent with results seen in neuropsychological testing amongst this population. Similar results have been seen in other drug classes, including opiates, cannabis, inhalants, and MDMA, with areas affected including the frontal, temporal, parietal, basal ganglia, and cerebellar brain systems. In particular, Yücel and colleagues report that the ventromedial prefrontal cortex (vm-PFC) and the dorsal subregion of the anterior cingulated cortex (d-ACC) have been identified as playing critical roles in inhibitory control.

The difficulty for researchers in this field, however, is in extricating whether these neuropsychological deficits are solely due to drug use or are a complex interplay between a number of factors. Yücel and colleagues (Yücel & Lubman, 2007; Yücel et al., 2007) explain that such factors can include a pre-existing vulnerability to impulsivity (e.g. genetic polymorphisms, personality characteristics, behavioural disorders), drug use patterns (e.g. duration of use, type of drug use, frequency), exposure to head injury, and so on, and these all have the ability to contribute to impulsive behaviour. While at this time the question about whether these effects can occur solely due to drug use, or due to pre-existing factors, or a combination, is unknown. However, Yücel and Lubman (2007) state that what we can conclusively say is that those who exhibit these neurological dysfunctions are "likely to be an increased risk for making decisions that are impulsive, focussed on short-term gains, and lack inhibitory control"(p. 37). The association between

impulsivity and neurobiological changes, particularly within the prefrontal cortex and frontostriatal system, is therefore quite apparent.

Yet another theoretical approach is one which essentially combines the abovementioned theories. This model hypothesises that there is a synergistic effect between heightened sensitivity to the rewarding stimuli through sensitisation of the mesolimbic dopamine system and the amygdala, combined with an inability to consciously inhibit impulsive behaviour, which may be the result of prefrontal dysfunction (Jentsch & Taylor, 1999). This position therefore draws on research suggesting that chronic drug use results in an augmentation of dopamine release within the reward system, but more specifically, the nucleus accumbens. This leads to sensitisation such that there is an increase in approach behaviour and responding in the presence of a conditioned reinforcer (eg. drug cues). Jentsch and Taylor (1999) also explain that the role of the amygdala is also an important one in elucidating the cause of impulsivity and drug addiction. The authors contend that neuroadaptations within this structure as a result of chronic drug use augment the associations made between stimuli and reward (eg. drugs, syringe, contextual factors), and these factors then lead to an increase in impulsive and drug-seeking behaviour. These factors, coupled with prefrontal dysfunction, mean that behaviour occurs in the context of increased disinhibition and recidivism to drug taking.

As this brief review of literature into the neurobiology of impulsivity and addiction has indicated, understanding precisely what factors are at play neurobiologically to result in impulsive behaviour is by no means straight forward or clear cut. What is apparent, however, is that there are a number of areas which do play a role. As outlined above, this includes various neurotransmitter systems (such as serotonin, GABA, and dopamine), neurobiological changes in the frontal lobes

and NAcc, modulation of stress systems, and genetic factors. Following a comprehensive review of the literature within each field of research, Evenden (1999) concludes that across fields, researchers generally agree that impulsivity is constructed of a number of factors which operate independently as a result of different biological processes. In addition, these biological processes are likely to be more complex than simply one type of neurotransmitter, or one area of the brain and involve interactions between systems as well as between biological and social factors. The above review indicates support for this position. Regardless, the implications of this for the study of BBV transmission risk are that, while impulsivity may be influenced by pre-existing differences (such as organic or genetic reductions in dopaminergic function), neurological insult (such as prefrontal cortex lesions), or drug use (acute changes in dopaminergic or serotonergic function as a result of the use of certain drugs or long-term plastic changes resulting from chromic administration), all of which are germane to the experience of an IDU. As such, assessment of levels of impulsivity and related constructs such as responsibility are clearly relevant to the prediction of injecting risk behaviours.

Pharmacological effects of drug use

It is now widely accepted that particular illicit and pharmaceutical substances can affect the consumers' cognitive function such that impairment to decision making and judgement is seen. This can result in the greater likelihood of engaging in behaviours typically conceived of as risky, such as needle sharing, unprotected sexual intercourse, driving a vehicle while under the influence, and other such

behaviours. The observation of these effects has been noted in both laboratory based experiments as well as in field studies and naturalistic environments.

The pharmacological effect of benzodiazepines on neuropsychological and cognitive functioning has been extensively examined within the literature. Results of these studies indicate a clear impairment of functioning as a result of benzodiazepine use. Further, this impairment has been found to be of a dose-dependent nature, such that riskier behaviour is seen in accordance with higher doses. Lane and colleagues have conducted a number of laboratory studies demonstrating this effect. Using a hypothetical gambling task, the researchers found dose-related effects after administration of alprazolam (Lane, Tcheremissine, Lieving, Nouvion, & Cherek, 2005) and also flunitrazepam (Lane, Cherek, & Nouvion, 2008). At higher doses, participants demonstrated increases in the selection of the risky option, and in the case of flunitrazepam, high doses also changed decision-making processes which were related to changes in learning and memory. After administering a neuropsychological assessment battery to participants who had been administered diazepam, Deakin, Aitken, Dowson, Robbins, and Sahakian (2004) found that compared to controls, those in the experimental group exhibited impairments in their performance on tests of planning and reaction time, and also make more risky choices on a risk taking task. In more descriptive studies and those involving IDU populations, benzodiazepine use has been associated with higher levels of BBV risk-taking such as sharing injecting equipment more frequently and with a greater number of people (Darke, Hall, Ross, & Wodak, 1992; Darke, Ross, Cohen, Hando, & Hall, 1995; Darke, Swift, Hall, & Ross, 1993; Fry & Bruno, 2002; Klee, Faugier, Hayes, Boulton, & Morris, 1990a; Metzger et al., 1991). Klee, Faugier, Hayes,

Boulton and Morris (1990a) also found an effect of benzodiazepine use and increased sexual risk behaviour.

Much research has been conducted regarding the biological processes which underlie the association between benzodiazepine consumption and impulsivity. There is now ample evidence that this drug modulates the GABA-A receptor complex, particularly those present within the prefrontal cortex and also within the limbic regions. The activation of the GABA receptors as a result of benzodiazepine use may produce pharmacological effects such as disinhibition when given at intoxicating doses. Research indicates that this disinhibition occurs as a result of changes in memory and learning about past gains and losses, which in turn means that there is a reduced ability to take this into account and make decisions appropriately to expected outcomes (Lane et al., 2008; Lane, Tcheremissine et al., 2005). Klee, Faugier, Hayes, Boulton and Morris (1990a) also state the effect that benzodiazepines have on memory may mean that IDU have difficulty in recalling which users have shared equipment. The hypothesis that benzodiazepines act on GABA receptor sites, which in turn affects decision making and other cognitive processes has been supported both by neuroimaging studies as well as through neuropsychological assessments of executive and cognitive function. It appears that the effect that these drugs have on areas of the prefrontal cortex, particularly the orbitofrontal and dorsolateral regions, are vitally important in producing disinhibition (Deakin et al., 2004).

While a large amount of research has focussed on the effect of benzodiazepine use on risk-taking, a number of other studies demonstrate that other drug classes can also have a similar impact. The effect of alcohol is known commonly to affect an individual's judgement and perception, such that consumers

may engage in behaviours riskier in nature than they would if sober. Indeed, research by Burian, Liguori, and Robinson (2002) found that in a simulated driving task, alcohol significantly increased risk-taking when in a high risk situation. Lane, Cherek, Pietras and Tscheremissine (2004) demonstrated in a laboratory setting that alcohol produced dose-related effects whereby riskier options were chosen on a gambling task at increased doses of alcohol. Alcohol has also been demonstrated to affect risky driving practices, and this study also demonstrated that heroin and cannabis also influenced risky driving (Darke, Kelly, & Ross, 2004). With regard to alcohol, Lane, Cherek, Pietras, and Tcheremissine (2004) propose that risk taking may be associated with changes in dopamine circuits within the midbrain, as well as changes in the GABAa receptor complex. George, Rogers and Duka (2005) propose that serotonin may also play a pivotal role.

The impact that 3,4-methylenedioxymethamphetamine (MDMA) or ecstasy has on risk-taking has also been the subject of research, and demonstrates that this drug also can affect one's judgement and decision making abilities. Though the effects cannot be as clearly demonstrated in laboratory studies due to obvious ethical limitations, survey research with illicit drug consumers provides supporting evidence of such a relationship. This research suggests that while ecstasy may not compel all users to engage in sexual activity while intoxicated, those who do are more likely to engage in sexual risk-taking behaviours such as having multiple partners and engaging in sex without a condom (McElrath, 2005). It has also been reported that high users of ecstasy take more sexual risks than low users (Theall, Elifson, & Sterk, 2006). This is also supported by Butler and Montgomery (2004) who reported that high users of ecstasy had higher levels of impulsivity, venturesomeness, and novelty seeking behaviour than non-drug users, and engaged in more risk taking when

compared with non-drug users, cannabis, and less frequent ecstasy users. A recent meta-analysis found that, as well as having neurocognitive deficits in the area of executive functioning, abstinent ecstasy users also demonstrated deficits in functions of attention and concentration, as well as verbal and nonverbal learning and memory (Kalechstein, De La Garza, Mahoney, Fantegrossi, & Newton, 2007). Although substantial literature exists supporting the role of ecstasy in impulsivity, other experimental research has found no such effect. For instance, Roiser, Rogers, and Sahakian (2007) examined participants' behavioural responses to a gambling task, and found no differences in terms of impulsivity between participants with ecstasy use, polydrug use, and drug naïve controls. As this indicates, there is some discrepancy amongst findings in relation to ecstasy use and impulsivity, however certainly these findings suggest a role of ecstasy in impulsivity.

Neurobiologically, the increase in impulsive behaviour seen in participants who use ecstasy is hypothesised to be due to the modulation and depletion of serotonin within the brain. Animal studies indicate that low serotonin levels results in an increase in impulsive behaviour (Bizot, le Bihan, Peuch, Hamon, & Thiebot, 1999; Wogar, Bradshaw, & Szabadi, 1993), and higher levels of serotonin decrease impulsive choices (Bizot et al., 1999; Poulos, Parker, & Le, 1996). Research with human participants which manipulates central serotonergic levels by dietary tryptophan depletion and loading provides support for hypothesis that the relationship between serotonin levels and impulsivity also exists in humans. For instance, Schweighofer, Bertin, Shishida, Okamoto, and Tanak (2008) utilised this research paradigm and conclude that low-serotonin levels causes impulsivity, as evidenced by a higher level of reward choices than for control serotonin levels. Therefore, the literature supports the theory that serotonin levels are closely linked

with impulsive behaviour, and in particular that low levels of serotonin are associated with an increase in impulsivity. Coexisting research into the relationship between MDMA and serotonin reveals that while the acute action of MDMA is to flood the synapses with serotonin (thereby producing effects such as euphoria, a sense of well-being, and happiness), research using animals (Evenden, 1999; Reneman et al., 2002) and human participants (Morgan, 1998; Ramaekers & Kuypers, 2006; Sevy et al., 2006) indicates that the long-term consequence of MDMA consumption is a depletion of serotonin levels. This depletion of serotonin that is seen as a result of ecstasy use is hypothesised by such authors as Butler and Montgomery (2004) to lead to greater impulsivity and risk taking.

Other drug classes such as stimulants (e.g. cocaine) and opioids (e.g. heroin) have been implicated in research examining risk-taking. Obviously again, research into this area cannot be done in a laboratory setting and so rely on survey information or similar methodologies. Brand and his colleagues chose to examine the hypothesis that opioids impact risk-taking by using a sample of opiate dependent patients, requiring the participants to undertake a gambling task as an operationalisation of risky behaviour (Brand, Roth-Bauer, Driessen, & Markowitsch, 2008). Those patients who were opiate dependent tended to choose the risky alternatives more frequently than the control group, the authors explaining that this demonstrates abnormalities in decision-making which may also extend to dysfunctional behaviour in their daily lives. A study by Somlai, Kelly, McAuliffe, Ksobiech, and Hackl (2003) reveals that the injection of cocaine or crack was a significant predictor of sexual risk behaviour, again suggesting that the pharmacological effect of cocaine can impact risk-taking. Research by Stout and colleagues (Stout, Busemeyer, Lin, Grant, & Bonson, 2004) also supports the view that cocaine can influence risk-

taking. By using a gambling task paradigm (Iowa Gambling Task), cocaine users maintained responding to high-risk options despite negative consequences, which is a pattern of behaviour not present in controls.

There has also been some preliminary evidence of the effect of cannabis on risk-taking. Again, in a laboratory setting, Lane and colleagues (Lane, Cherek, Tcheremissine, Lieving, & Pietras, 2005) administered varying doses of cannabis to participants as well as placebo cigarettes to the control group. Participants were required to undertake a risk-taking task. At the highest cannabis dose, participants chose the risky response option significantly more than other groups. The authors also note that the sensitivity to reinforcing and aversive outcomes was altered, which may be the reason for more risky options being chosen. Similar findings have been found from studies demonstrating that those participants in the cannabis condition exhibited increased risk-taking behaviours compared to drug-naïve controls when undertaking a gambling task (Lane, Yecham, & Busemeyer, 2006; Whitlow et al., 2004). Lane and colleagues hypothesise that the changes in decision making seen in studies such as the ones cited above where cannabis has been consumed may occur as a result of altered sensitivity to consequences due to changes within the mesolimbic prefrontal cortical network (Lane, Cherek et al., 2005).

It is clear from the results of the above studies that the pharmacological effect of the drug results in neuropsychological changes, including altered judgement, planning, decision-making, and disruption to memory processes. The precise mechanisms at play which result in these changes are hypothesised by many researchers. Within the neuropsychology field it is now well accepted that the frontal lobes play a pivotal role in the regulation of behaviour. Termed executive functions, these include a number of cognitive abilities including planning, divided-attention,

decision-making, the ability to monitor and change behaviour as needed, and to initiate or stop behaviours as is appropriate to the situation etc. As cited above, the literature review presented by Yücel et al. (2007) provides a clear conclusion that the long-term exposure of drugs results in neurological deficits, including deficits to the executive functions. Therefore, there is now compelling evidence that the frontal lobes are affected neurochemically as the result of the use of particular drugs. Much research is also being conducted as to the precise mechanisms that are at play in drug abusers that results in the more risky decisions being made in research paradigms such as those that utilise the Iowa Gambling Task (IGT). This research supports the notion that risky decisions in this context (i.e. choosing disadvantageous decks) is the result of a motivational bias for immediate gains and a 'myopia' for distant consequences, and greater attention to wins than losses (Stout, Rock, Campbell, Busemeyer, & Finn, 2005; Yechiam, Busemeyer, Stout, & Bechara, 2005). Even in conditions where participants are given feedback as to what result they would have had if they had made other (safer) choices on the IGT, drug abusers still made more risky choices (Yechiam, Stout, Busemeyer, Rock, & Finn, 2005). Again, these authors postulate that this result is due to these participants being drawn to potentially large outcomes even though it is a risky choice. Yechiam et al. (2005) state that this result supports the theory that signals of reward carry more weight than signals of risk because of drug users' stronger appetitive processes and weaker disinhibitory control. Yechiam et al.'s (2005) position here parallels that of Dawe and Loxton's (2004) model (previously outlined) which posits that impulsive behaviour seen in drug users is the result of two components; a 'reward sensitivity' (a heightened sensitivity to rewarding stimuli which resembles Gray's BAS conceptualisation) and 'response disinhibition' (a tendency to disregard risk or

consider future consequences). Concurrent research also indicates that drug abusers have a reduced awareness of errors leading to less advantageous choices (Garavan & Stout, 2005).

While the above studies highlight the behavioural and neurochemical changes which occur during intoxication with substances, there is also research examining the long-term effects of drug use. For instance, in the study conducted by Brand, Roth-Bauer, Driessen, and Markowitsch (2008) mentioned above, the participants completed the experimental protocol only after having completed detoxification from opiate dependence. Mean days of abstinence was 14.38 days, however risk taking was observed amongst these participants at a significantly higher level than controls. A meta-analysis of studies examining the long-term cognitive effects of prolonged benzodiazepine use following discontinuation was carried out by Barker and colleagues (Barker, Greenwood, Jackson, & Crowe, 2004). The authors found generalized cognitive deficits when compared with controls, including deficits in sensory processing, speed of processing, problem solving, attention and concentration, working memory, and general intelligence. These effects were present in a sample of long-term benzodiazepine users (mean 108 months) who had withdrawn from this medication for a mean of 42 months. Similarly, Stewart (2005) reports cognitive dysfunction in patients who were treated over a long period with benzodiazepines, and while improvement was seen upon discontinuation, these patients did not return to levels of functioning that matched controls. These publications are amongst a growing number demonstrating support for the notion that benzodiazepines and other drug classes can have prolonged impacts on cognitive functioning. As outlined above, the association with long-term ecstasy use and impulsivity is also one which is becoming recognised.

Psychological Distress

The presence of psychopathology and the impact that this has to blood borne virus risk transmission has been examined by a number of researchers. This combined research has consistently found that psychological distress plays a key role in impacting blood borne virus risk behaviours, in terms of both risky practices in injecting drugs and also risky sexual practices. One such study which clearly demonstrates these findings is by Darke, Ross, Cohen, Hando and Hall (1995). Using a sample of frequent amphetamine users, these authors found that psychological distress was an independent predictor of needle sharing, and that with each extra point obtained on the General Health Questionnaire (where higher points indicate increased psychological distress), the odds of the injector having recently shared needles rose by 8%. A number of other studies also find a significant relationship between general levels of psychiatric distress and needle sharing, particularly among IDU enrolled in methadone maintenance treatment programs (e.g. Brook et al., 1997; Darke, Swift, Ross, & Hall, 1994; Kleinman et al., 1994; Metzger et al., 1991; Woody, Metzger, Navaline, McLellan, & O'Brien, 1997). Adding to the above research, Disney et al. (2006) found that psychiatric comorbidity increases HIV risk. In this study, participants who were diagnosed as having antisocial personality disorder as well as an Axis 1 disorder exhibited greater substance use disorders and higher HIV risk than participants who were diagnosed as having one or no psychiatric disorder. As well as there being a relationship between emotional distress and sharing needles, Trobst, Herbst, Masters and Costa (2002) found a link between emotional distress and HIV/AIDS sexual risk behaviours.

A recurrent theme which is present among research into psychiatric symptoms and blood borne virus risk behaviours is that of Antisocial Personality Disorder (APD). This disorder is characterised by impulsive behaviour, a lack of responsibility, a careless disregard for others, and extensive criminal activity. Rates of APD amongst substance abusing populations are high, both in studies conducted in North America as well as in Australia. These rates range from 31% to 71%, however most report a prevalence of APD in the vicinity of 40% (Brooner, Bigelow, Strain, & Schmidt, 1990; Brooner, Greenfield, Schmidt, & Bigelow, 1993; Compton, Cottler, Shillington, & Price, 1995; Darke, Swift, & Hall, 1994; Darke, Williamson, Ross, Teesson, & Lynskey, 2004; Disney et al., 2006; Gill, Nolimal, & Crowley, 1992; Kelley & Petry, 2000). It must be noted however, that a diagnosis of APD is not synonymous with psychopathy. In a study by Darke, Kaye, and Finlay-Jones , only 11% of the sample who met diagnostic criteria for APD also met criteria for psychopathy using the Revised Psychopathy Checklist developed by Hare (1980). Gerstley and colleagues (Gerstley, Alterman, McLellan, & Woody, 1990) argue that a diagnosis of APD is over-inclusive amongst the IDU population because the mere use of an illicit substance generates similar behaviours and features characteristic of APD as a result of using expensive and illicit drugs. For instance, the authors state that behavioural problems such as irresponsibility, impulsivity, and criminality can occur as a result of drug use. These behaviours can be considered antisocial, however may be borne out of the substance use itself, rather than being caused by an antisocial personality feature. The study by Darke, Kaye, and Finlay-Jones (1998) provides support for this position.

Despite this, many studies examine those substance users who qualify for a diagnosis of APD (as opposed to psychopathy). These studies have consistently

found that this population is at a higher risk of blood borne virus infections due to a greater likelihood of these people engaging in risky drug use and sexual practices compared to non-APD drug users. For example, Kelley and Petry (2000) found that those participants with APD had higher rates of injecting drug use, lower rates of needle-cleaning and greater numbers of sexual partners when compared with non-APD participants. Similar findings have been reported by a number of other authors (eg. Brooner et al., 1990; Compton et al., 1995; Gill et al., 1992). Kelley and Petry (2000) also found that the relationship between blood borne virus risk behaviours and the presence of APD exists despite there being no difference in APD versus non-APD participants' knowledge of HIV and risks for transmission. Not surprisingly, research also confirms that those with APD have higher odds of infection with HIV than non-APD drug abusers, and this has been found to be the case even after controlling for ethnicity, gender, and treatment status (Brooner et al., 1993). This reinforces the link between impulsivity and BBV transmission risk.

Other psychiatric conditions such as mood and anxiety disorders have also been implicated in engagement in BBV risk behaviours. For instance, Johnson, Yep, Brems, Theno and Fisher (2002) found that in a sample of 513 street drug users, those participants who reported sharing needles and injecting equipment had higher levels of depression than those participants defined as non-sharers, however the authors do not state whether this effect is independent of frequency of injecting. Similarly, Mandell and colleagues (Mandell, Kim, Latkin, & Suh, 1999) found that in a community sample of IDU, those which higher depressive symptoms had higher levels of needle sharing, both after cleaning it with bleach and without cleaning it, and this effect remained significant even after adjusting for demographic characteristics, life events, drug use patterns, and social and drug networks. Other

research provides further support for the association between symptoms of depression and needle sharing (eg. Hawkins, Hawkins, Latkin, & Chowdury, 1998; Strathdee et al., 1997), and over and above this, Stein and colleagues demonstrate that this relationship is related to severity, such that the greater the depression severity, the greater is the frequency of injection risk behaviour (Stein, Solomon, Herman, Anderson, & Miller, 2003), consistent with the Darke et al (1995) study using the GHQ. Research by Murphy et al. (2001) also supports a link between depression and BBV sexual risk behaviours in a sample of HIV infected adolescents, and found that the odds of participants having had unprotected sex at last intercourse increased by 50% if depression symptoms were present as opposed to participants who were not depressed. There is also some evidence of other mood disorders such as dysthymia being associated with needle sharing (Abbott, Weller, & Walker, 1994).

Though more limited in number, a few studies also examine the particular relationship that anxiety has on BBV risk. The results of these studies suggest that the presence of anxiety is also emerging as a further factor which significantly impacts whether an IDU will engage in risky behaviours. In a recent study, Reyes et al. (2007) investigated the effect of severe anxiety symptomatology and HIV risk behaviour in a sample of 557 IDU. The authors report that participants with severe anxiety symptoms were more likely to share needles, cotton, and rinse water, to pool money to buy drugs, than those who do not have severe symptoms of anxiety. These participants were also more likely to engage in backloading, which has been identified as a risk factor for BBV transmission (Jose et al., 1993). Jose et al. (1993) explain that backloading is a process where IDU use their syringes to mix drugs and give measured shares to other IDU by squirting the drug solution into the syringes of

other IDU. Participants with severe anxiety in Reyes et al.'s (2007) study were also more likely to practice risky sexual behaviours, such as unprotected vaginal or oral sex. Lundren, Amodeo, and Chassler (2005) also found a relationship between anxiety and needle sharing.

The literature is clear in demonstrating the link between BBV risk behaviours in those who have increased levels of psychological distress, either generally or as a diagnosis of anxiety, depression or APD. Although many researchers do not comment on the possible reasons behind this association, several authors have postulated why this association exists. The relationship between APD and BBV risk behaviours is thought by several authors to be simply an expression of the underlying characteristics of the disorder. These characteristics include irresponsible and reckless behaviour, poor impulse control, and low harm avoidance, and therefore the relationship with needle sharing is not surprising (Brooner et al., 1993; Compton et al., 1995). Kelley and Petry (2000) found in their study that participants with APD were more likely to use cocaine and heroin than non-APD clients and argue that because these drugs are more often used intravenously, the increase in needle risk behaviours amongst this population may be due to prolonged and more frequent use of these drug classes.

With regard to more general psychological distress, Kleinman (1994) notes that high levels of psychiatric distress acts as a barrier between the cognitive knowledge of the risks associated with needle sharing and making behavioural change to reduce these risks. It appears then that the depressed mood is the more powerful of the two, and results in more careless behaviour, perhaps due to a reduced sense of self-worth or hopelessness. It may also reflect a sense of low self-esteem which reduces the IDUs confidence in their ability to reject offers from others to

share. Mandell, Kim, Latkin and Suh (1999) believe that when in a depressed mood, some IDU may try to overcome this by injecting with a group of people. This increases injecting risk, however also provides social interaction and support which can assist to alleviate the depression. Stein, Solomon, Herman, Anderson and Miller (2003) offer several other reasons for the association between depression and increased injection risk behaviour. Firstly, they postulate that those with depression have less confidence in giving careful thought to the consequences of life decisions, thereby leading to reduced participation in preventative behaviours. Secondly, depression is known to affect cognitive functions such as concentration and attention, and this may promote greater carelessness in drug use activities. Thirdly, a poorer ability to cope with stressful life events may lead to heightened levels of needle sharing. Metzger et al. (1991) suggests that the presence of high levels of depression and anxiety lead to poorer treatment outcome and relapse, and therefore a reduced effectiveness of treatment may explain the relationship between psychological distress and BBV risk. Specifically in relation to anxiety, Reyes et al. (2007) contends that the presence of anxiety symptomatology such as poor confidence in own abilities to prepare drug solutions, use condoms, and prepare for injection and sexual episodes, may lead to a greater engagement in BBV risk behaviours.

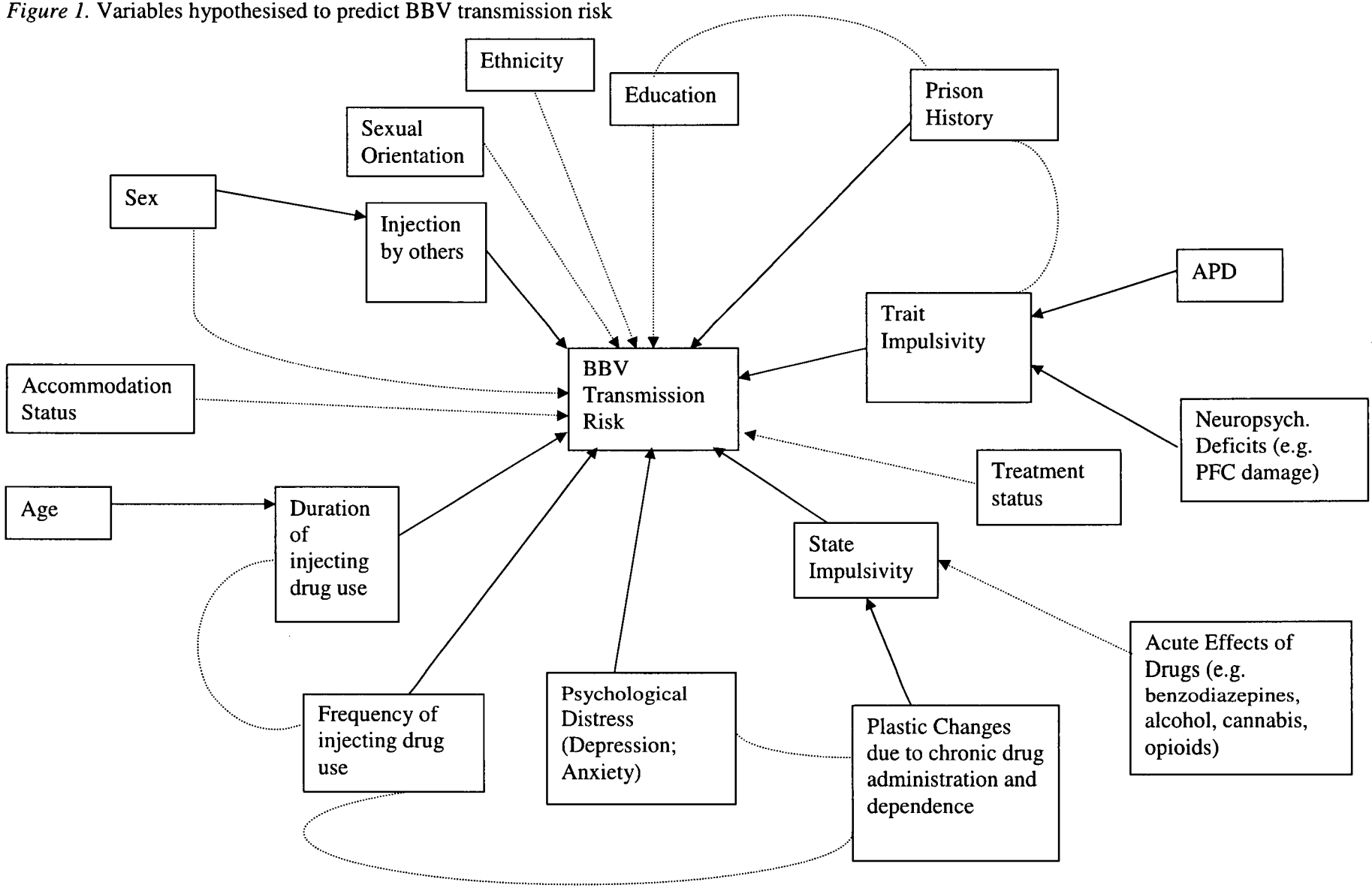
Conclusion

It is clear from above review of the literature that the transmission of blood-borne viruses remains a significant problem worldwide. While preventative and educational efforts have resulted in the reduction of transmission rates of some blood-borne viruses such as HIV, the incidence of HCV transmission remains

staggering. The reason for the difficulty in slowing down the transmission of the virus is partly due to the highly transmittable nature of the disease, in that it has a higher viral infectivity content that HIV (Gerberding, 1995). Additionally, however there appears to be some complacence amongst at-risk populations. Primary among those at risk of becoming infected with BBV are IDU, and research has revealed that having knowledge about HIV transmission amongst this population is not enough, as it does not equate to behavioural change (Metzger et al., 1991). It is clear then, that something else is at play which results in some IDU putting themselves at increased risk while others do what they can to minimize that risk. Because there is no vaccine available to protect against HCV and the rates of transmission are so high, it is important to identify which factors are involved in its transmission if prevention is to take place.

As the review of the literature above indicates, there have been a number of factors which have been consistently shown to put IDU populations at an increased risk of BBV transmission. Some demographic variables such as being of female gender, being younger in age, and having a longer duration of injecting history are generally found to be significant contributors to BBV risk. However, some of these may be secondary characteristics of another variable (for example, being injected by others, which is more common among females than males) and others may be collinear (for example, age and duration of injecting career). The personality characteristic of impulsivity is also a predictor, as is the presence of psychopathology such as depression, anxiety, and antisocial personality disorder, and general psychological distress. The pharmacological effect that substances have on risk taking is also very much a predictor of engaging in BBV risk behaviours. A summary of the variables and their relationship to BBV risk is given in figure 1 below.

Figure 1. Variables hypothesised to predict BBV transmission risk



Despite the fact that these factors have all been shown independently to be significant predictors, there have been no studies specifically examining the combined and relative effects that these variables have. While the literature suggests that all of the above mentioned factors are important, it is not clear which of these variables are most important for understanding risk behaviour. Some authors do state the importance of further research being conducted to increase our understanding of risk behaviour in this context. For example, Darke, Swift, Hall and Ross (1993) note the relationship between psychological dysfunction, benzodiazepine use, and injecting risk taking, and argue that this is an area which requires further research. Similarly, Staiger, Kambouropoulos and Dawe (2007) contend that personality variables need to be considered in substance misuse treatment programs, particularly anxiety and impulsivity related traits. Darke, Swift, Ross and Hall (1994) highlight the importance of understanding and treating psychopathology to encourage the reduction of substance use and BBV risk behaviours.

The implications of doing such research would potentially be very significant. By determining which variables are most important in predicting BBV risk behaviours, IDU can be screened to identify those most at risk. For instance, if the research reveals that significant predictive factors are female gender, younger age, and benzodiazepine use, then those IDU who fit these criteria would indicate elevated risk for engaging in BBV risk behaviours. This population can then be prioritised for interventions to reduce this risk and also be administered interventions which are specifically designed for this group. Identification of this subgroup using information gleaned from such research would therefore enable harm reduction resources to be used in the most effective way possible, where harm reduction efforts are targeted to the most vulnerable of IDU.

Ecological validity for such a project comes from intervention projects demonstrating that a targeted approach can have real and significant results in reducing harmful behaviours. Conrod, Castellanos, and Mackie (2008) recently conducted a randomised control trial with teenagers to determine whether targeted interventions could prevent the development of harmful binge drinking patterns. Participants had an intervention program delivered to them if they exhibited personality factors deemed to be risky for the development of unhealthy drinking trends, and were followed up six and twelve months post-intervention. Results revealed that the intervention was particularly efficacious, with the growth of binge drinking being delayed on average by six months. The intervention was mostly effective for those participants who had elevated sensation-seeking personality traits. Such a study demonstrates that interventions conducted in those deemed to be at elevated risk can indeed be successful in assisting to prevent the development of harmful behaviours.

A recent harm reduction project conducted in Tasmania has shown that individually targeted brief intervention sessions with IDU can be successful. This project was conducted with IDU and provided participants with education about the prevention of harms associated with injecting drug use. The results indicated sustained reductions in risky injection practices (Hallam, 2006). The disadvantage to such interventions however, is that they are relatively expensive when compared to alternative education options for this population, such as information pamphlets. Therefore, having knowledge that can enable guidance in the development of screening options, thereby allowing intervention to those most at risk, can provide valuable information in the fight against BBV transmission as well as provide an attractive intervention option for funding bodies.

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Empirical Study

Predictors of Injecting Risk Behaviours in a sample of Injecting Drug Users

Empirical Study Abstract

Incidence of blood-borne viruses such as Hepatitis B, Hepatitis C, and HIV have begun to rise in recent years, with Hepatitis C now being the most communicable disease in Australia. Spread by blood-to-blood contact, it is now recognised that by far the majority of new cases of blood-borne viruses are transmitted during the process of injecting illicit drugs, through behaviours such as the sharing of injecting equipment. Previous studies have identified a number of factors that independently predict the risk of injecting drug users (IDU) engaging in these risk behaviours. These factors include demographic, drug use and injection variables, psychological distress factors (i.e. anxiety and depression), and impulsivity factors, however to date no research has comprehensively examined these risk factors in a combined sense in order to establish which IDU are at a heightened risk for engaging in risky injection episodes. The current study sought to address this, and utilised a multivariate regression modelling approach with a sample of 269 regular IDU in Tasmania to examine the contribution of the above factors to the prediction of the engagement in various injecting risk behaviours. The study details factors which emerged as significant predictors to transmission through needle and syringe contamination, other equipment contamination, contamination from injecting others, exposure from being injected by others, needlestick contamination, as well as overall risk. While the factors which significantly contribute to risk in the various aspects of transmission behaviours vary, the factors of unstable accommodation status, amphetamine use, alcohol use, less occasions of self-injection, higher symptoms of anxiety, and a desire to seek out novel stimulation emerged as the most significant contributors to overall risk. Of these, elevated anxiety symptoms and reduced episodes of self-injection

were clearly the most important factors as identified in a multivariate model for overall risk of engaging in blood-borne virus risk behaviours. This finding suggests that while there is value in delivering blood-borne virus transmission intervention efforts to all IDU, particular attention and emphasis should be paid to those IDU exhibiting the above risk factors. Specific strategies for intervention is discussed in the below report.

Blood-borne viruses

Blood-borne viruses (BBV) are those which are spread via blood-to-blood contact, the most common of which are the hepatitis B virus (HBV), hepatitis C virus (HCV) and the human immunodeficiency virus (HIV). While a vaccine is available to control the impact and spread of HBV, there is no such measure available to assist with limiting the transmission of HIV and HCV. Chronic infection with these viruses leads to devastating consequences. In the case of HIV, progression of this virus may lead to the development of acquired immunodeficiency syndrome (AIDS), a syndrome which lowers the immune system and thereby leaves one vulnerable to contracting illnesses which are then fatal. With regard to HCV, the health outcomes of chronic infection are the development of cirrhosis of the liver, hepatocellular carcinoma, and liver failure. As well as the physical costs that infection with these viruses brings, there a number of psychological and socioeconomic factors that can impact on one's experience of the virus. These include the breakdown of relationships, difficulty in sustaining paid employment, feelings of fear, anxiety, depression, and stigmatisation by the general community as well as healthcare professionals (Community Affairs References Committee, 2004; Parliament of NSW, 1998).

There are a number of routes which have been recognised as methods by which the transmission of BBVs can occur. These include vertical transmission (mother-to-child), needle-stick injuries, tattooing, piercing, acupuncture and sexual contact where blood-to-blood contact is present. Prior to 1990, recipients of blood

products in Australia were also at risk of BBV transmission as screening for the presence of HCV antibodies was not available at this time.

While any of the above methods can transmit BBV, by far the majority of new cases of BBVs are transmitted during the process of injecting illicit drugs. During this procedure, there are many opportunities for blood-to-blood contact to occur, and it has been estimated that just over 80% of prevalent HCV cases are transmitted this way (Dore et al., 1999; Ministerial Advisory Committee on AIDS, 2006). It has been identified that a large contributing factor to these high rates is the practice of sharing or re-using injecting equipment (by either lending to or borrowing from other IDU) that can occur within IDU populations. It is now well recognised that the sharing of any injecting paraphernalia, be it needles, syringes, swabs, water vials, tourniquets, spoons etc., carry with it a risk of transmitting BBVs (Crofts et al., 1999; Hagan et al., 2001; MacDonald & Wodak, 2003; Maher et al., 2006; Thorpe et al., 2002).

HCV has now become the most common communicable disease in Australia (Dore et al., 2003) and at the end of 2005 there were over 264,000 people living with HCV antibodies in Australia (Ministerial Advisory Committee on AIDS, 2006). Reports document a 45% increase in new HCV infections in Australia between 1997 and 2001, and estimate that the prevalence of HCV is set to triple by 2020 unless changes are implemented to curb the rising rates of transmission (Law et al., 2003). Among the injecting drug user (IDU) population, prevalence of HCV is in the range of 50 to 70% (Law et al., 2003), with an increase in new cases estimated to be at 15% per year (Crofts et al., 1997). In recent years, incident diagnoses of HIV have also began to rise, with the National Centre in HIV Epidemiology and Clinical Research

(2006b) reporting a increase in rates by 41% between 2000 and 2005. Clearly, the spread of these viruses has become an important issue both in Australia and globally.

In response to the increasing rates of HIV which occurred in the 1980s, a number of campaigns were introduced in Australia and worldwide to reduce the spread of the virus. This included education to the 'at risk' IDU population, including education about safe injecting practices, as well as improved access to clean injecting equipment. These interventions were considered to be successful, in that HIV incidence rates and rates of sharing equipment were reduced. However, while these campaigns were successful in curbing rates of HIV transmission, HCV incidences did not enjoy the same success. The greater difficulty in controlling the spread of HCV is attributed to the fact that this virus is more efficiently transmitted than HIV, such that extremely small volumes of blood can still transmit the virus (Gerberding, 1995). High background prevalence rates also hamper efforts to reduce virus transmission (Crofts et al., 1999) .

It is clear that while interventions have assisted in the reduction of BBV transmission rates, there remains much work to be done to curb the soaring rates of HCV and control the recent rise of new cases of HIV. Currently, many interventions are provided to all IDU due to this population being recognised as a primary risk-group, however, knowledge is required as to what specific factors lend one IDU to engage in BBV risk behaviours such as needle-sharing while another IDU may not, in order to best target interventions, given limited resources.

Risk Factors

A number of studies have been conducted to examine whether specific factors impact on the sharing of injecting equipment and HCV transmission. While some

studies find significant effects, a review of the literature clearly reveals that an IDU's ethnicity (e.g. Dwyer et al., 2002; Garfein et al., 1996), level of formal education (e.g. Chang et al., 1998; Maher et al., 2006; Thomas et al., 1995) and sexual orientation (e.g. Diaz et al., 2001; Garfein et al., 1998; Hagan et al., 1999) is not consistently associated either with the transmission of HCV or with the sharing of injecting equipment. Research also suggests that the type of treatment and whether one is engaged in treatment services does not consistently impact on these risks (e.g. Maher et al., 2006; Van Beek et al., 1998). Similarly, whether one has stable or unstable housing appears unrelated to risk of HCV transmission and equipment sharing (e.g. Hagan et al., 2001; Thomas et al., 1995; Villano et al., 1997).

While the factors outlined above appear not to predict the sharing of injecting equipment or HCV transmission, other factors do seem to influence an IDUs risk of these outcomes. The clear majority of studies which examine the presence of prison history as a factor reveal this is significant in predicting both the risk of HCV transmission as well as predicting the sharing of injecting equipment (e.g. Crofts et al., 1993; Maher et al., 2004; Van Beek et al., 1998). Although results are somewhat discrepant between studies, a trend also exists suggesting that female IDU are at a greater risk for the transmission of HCV (e.g. MacDonald et al., 2000; Maher et al., 2006; Maher et al., 2007) in addition to being more likely to share injecting equipment (Dwyer et al., 1994; Montgomery et al., 2002). Varied findings are also apparent in terms of whether the IDUs drug choice is a significant predictor, however taken as a whole the literature suggests that regular stimulant users are at a marginally increased risk when compared with opiate users (e.g. Crofts et al., 1994; Maher et al., 2006; Van Beek et al., 1994). Those IDU who inject on a daily or more frequent basis are also generally found to be at a greater risk for HCV transmission

than those who inject on a less frequent basis (e.g. Dwyer et al., 2002; MacDonald et al., 2000; Villano et al., 1997). This likely reflects the cumulative risk that each injection episode brings. In addition to the above factors that appear to be assocated with BBV transmission risk, Injecting in a public location such as street-based injecting has also been associated with an increase in BBV transmission (Maher et al., 1998; Strathdee et al., 2001), presumably due to a pressure to inject quickly so as not to be seen by the public, therefore taking less care in adhereing to safe injecting practices. Being injected by others and injecting others has also been associated with increased BBV transmission (Hahn et al., 2002) due to there being more opportunities for second-person contamination (Stoové & Fry, 2006).

Age of the IDU and duration of injecting drug use are two variables which are consistently found to be significant, whereby the older the IDU is, and the longer the duration of IDU use, the greater the likelihood of having contracted HCV (e.g. Chang et al., 1998; Chetwynd et al., 1995; Diaz et al., 2001; Hagan et al., 2001; MacDonald et al., 2000). Incidence studies reveal that the greatest risk for HCV transmission is in the initial years of injecting and younger age, and younger IDU are also found to be more likely to share needles and injecting paraphernalia (Crofts et al., 1995; Hagan et al., 1999; Van Beek et al., 1998). Together, these studies indicate that the most risky time for BBV transmission to occur is during the initial years of injecting, when the IDU is likely to be younger, and perhaps taking more risks with injecting (such as sharing equipment). However, the older the IDU and the longer the years of injecting, the greater is the likelihood that the IDU has contracted HCV, presumably as a function of cumulative exposure.

Impulsivity

A further factor which has been identified within the literature as impacting on BBV risk behaviours is that of impulsivity. Impulsivity is typically conceived of as a personality trait where behaviours involve rashness, a lack of foresight or planning, and a lack of reflection and deliberation (Dawe & Loxton, 2004). Dawe, Gullo, and Loxton (2004) conducted a comprehensive literature review into the field of impulsivity, and concluded that impulsivity generally consists of two factors; 'rash impulsiveness' where one tends to act rashly and without consideration as to consequences, and 'reward sensitivity' which reflects individual variation in sensitivity to rewarding stimuli in the environment. This conceptualisation is largely consistent with Arnett's model of impulsivity, which refers to two components being the novelty of stimulation (seeking out novel sensations), and the intensity of stimulation (seeking out sensations which are intense in experience) (Arnett, 1994). In relation to the IDU population, one would expect that an IDU high in impulsivity would be more likely to take risks in terms of sharing equipment for the sake of immediate outcomes rather than considering the potential consequences of such behaviour when compared with an individual with lower impulsivity characteristics.

In line with this, research indicates that this construct is related to a number of negative health outcomes, including excessive alcohol use, drug use, risky driving, and risky sex (Bogg & Roberts, 2004; Conrod et al., 2000; Hoyle et al., 2000). The relationship between impulsivity and needle-sharing has also been directly examined, finding that these variables are indeed significantly related. For instance, Trobst and colleagues (Trobst et al., 2002) found that those IDU who were deemed at a high risk for HIV due to their engagement in a variety of sexual (e.g. unprotected sex) and substance use (e.g. sharing needles) risk behaviours were significantly more

impulsive than those deemed to be low and medium risk. Odum and colleagues (Odum et al., 2000) propose that those IDU who choose to share injecting equipment do so because delayed consequences of this behaviour (e.g. contracting HCV) is not considered during the decision making process, leading IDU to choose the immediate reward (i.e. administering the drug in a risky manner).

Psychological Distress

The relationship between the presence of psychopathology and BBV risk behaviours amongst the IDU population has been examined by a number of researchers, the results of which consistently indicate that these are indeed related. This relationship is perhaps most startlingly demonstrated by a study conducted by Darke, Ross, Cohen, Hando and Hall (1995) who found that, in a sample of regular amphetamine users, psychological distress was an independent predictor of needle sharing, and that with each extra point obtained on the General Health Questionnaire (where more points indicates higher distress), the odds of the injector having recently shared needles rose by a notable factor of 8%. Such a relationship between psychological distress and needle sharing is reported in a number of other studies (Brook et al., 1997; Darke, Swift, & Hall, 1994; Kleinman et al., 1994; Metzger et al., 1991; Woody et al., 1997).

The presence of mood and anxiety disorders has also been found to significantly impact on whether an IDU will engage in risky behaviours. Several studies demonstrate that those IDU with higher depressive symptoms reported higher levels of needle-sharing (Johnson et al., 2002; Mandell et al., 1999). Stein, Solomon, Herman, Anderson and Miller (2003) reports that this relationship is related to severity, such that the greater the depression severity, the greater the frequency of

injection risk behaviour. Similarly, emerging research indicates that the presence of anxiety disorders is a significant factor in contributing to BBV risk behaviours. Reyes et al. (2007) found that IDU with severe anxiety symptoms were more likely to share needles, cotton, and rinse water, pool money to buy drugs, and engage in backloading when compared with those who do not report severe symptoms of anxiety.

The reason for the association between the presence of psychopathology and risk for BBV transmission has been hypothesised by a number of researchers. Theories include that psychological distress acts as a barrier between the knowledge of risk factors for BBV transmission and making behavioural change to reduce these risks, perhaps due to a reduced sense of self-worth and hopelessness, and also perhaps due to having less confidence in one's ability to give careful thought as to one's decisions (Kleinman et al., 1994; Stein et al., 2003). Also, it is hypothesised that cognitive deficits associated with depression such as reduced concentration and attention may result in carelessness in drug use activities (Stein et al., 2003).

Pharmacological Effects of Drug Use

The pharmacological effects of several illicit and pharmaceutical substances are now well recognised as impacting on cognitive functions, particularly those involved in decision making, which can lead to poor choices such as having unprotected sexual intercourse, sharing injecting equipment, and driving while under the influence.

Primary amongst the drugs shown to impact decision making processes are the benzodiazepines. Laboratory studies clearly indicate that impairment in decision making occurs as a result of benzodiazepine use. Lane and colleagues demonstrated

this by asking participants to complete a hypothetical gambling task, and found dose-related effects whereby at higher doses participants chose risky options more often (Lane et al., 2008; Lane, Tcheremissine et al., 2005). In descriptive studies of IDU, benzodiazepine use has been found to be related to more frequent sharing of injecting equipment and sharing with a greater number of people (Darke et al., 1992; Darke et al., 1993; Fry & Bruno, 2002; Klee et al., 1990a; Metzger et al., 1991).

While much research exists demonstrating the impact that benzodiazepines have on risk-taking behaviours and decision-making processes, other drug classes have also been shown to have similar effects. Alcohol and cannabis have been shown to affect decision making processes in laboratory settings, whereby participants in the experimental groups chose riskier options in a hypothetical gambling task than control participants (Lane et al., 2004; Lane, Cherek et al., 2005). Descriptive studies examining the impact of opiates, stimulants, and MDMA report that these substances are also associated with risk-taking behaviours such as unprotected sexual intercourse, and choosing risky options in gambling tasks (Brand et al., 2008; McElrath, 2005; Somlai et al., 2003; Theall et al., 2006).

Neurobiologically, it is hypothesised that alterations in the functioning of the frontal lobes are responsible for impairments in the processes of decision making, judgement, and planning which result in risky choices being made. The precise mechanisms at play to result in such risk-taking is still under contention amongst researchers, however modulation of various neurotransmitter systems such as dopamine, serotonin, and the GABA-A receptor complex is thought to play a role, at sites including the prefrontal cortex, limbic system, and the midbrain. For instance, in the case of benzodiazepines, research indicates that the GABA-A receptor complex within the prefrontal cortex and limbic regions is modulated with

benzodiazepine use, which results in the pharmacological effect of disinhibition and impulsive behaviour. These behavioural changes are indicated to result from alterations in the ability to recall what was learned about past gains and losses, meaning that an individual's ability to take this information into account when informing decisions is compromised (Lane et al., 2008; Lane, Tcheremissine et al., 2005).

While such neurochemical changes are noted after the acute administration of the drug, research also reveals that disinhibition and impulsive choices can occur following the cessation of drug use. Yücel, Lubman, Solowij, and Brewer (2007) conducted a review of existing literature covering the neurobiological and neuropsychological correlates of long-term drug addiction and concluded that across the drug classes, extensive neurological deficits can be seen in those who engage in long-term substance use. Primary among these deficits are impairments to executive function and inhibitory control; however deficits were also apparent in areas of working memory and decision making. Specifically, Barker, Greenwood, Jackson and Crowe (2004) examined the long-term cognitive effects of benzodiazepine use and that that this resulted in deficits in sensory processing, speed of processing, problem solving, attention and concentration, working memory, and general intelligence, even after discontinuation of the drug.

Similarly, residual changes to cognition following long term MDMA use has also been found to occur such that damage is seen in the neural circuits that are activated during the acute administration of the drug (e.g. the hippocampus in MDMA users). During the process of developing dependence to a drug following the chronic administration of the drug, changes in neural circuits and functioning also occurs.

As the above review indicates, both acute and long-term use of the drug classes noted above can result in a number of neurobiological changes leading to impaired decision-making processes. A poor ability to make appropriate decisions can then result in behaviours associated with increased risk, such as injecting in conditions that are associated with a greater risk for BBV transmission (e.g. sharing equipment, being injected by others).

Rationale for Current Study

As is evident from the research cited above, there have been many studies conducted to determine the risk factors for BBV transmission and the sharing of injecting equipment. The impetus to find out which individuals are at a heightened risk of contracting BBVs is due to the need to target interventions at the most vulnerable group, thereby delivering interventions at the most efficient and effective way possible. In Australia, interventions are generally being provided to all accessible IDU, regardless of their propensity to take risks in relation to sharing injecting equipment. However it is apparent from existing research that some characteristics, such as the presence of certain demographic factors, an impulsive personality, psychological distress, and the use of particular substances can place an IDU at a greater risk for engaging in such behaviours as sharing equipment that can lead to contracting and transmitting BBVs. While these factors have been shown to independently impact on risk for BBV transmission, what is ideally required is an understanding as to the combined and relative effects that these variables have and which of these are the most important for understanding this risk behaviour.

By determining which variables are the most important in predicting BBV risk behaviours, it may be possible to screen IDU to identify those most at risk and

this subgroup can then be prioritised for more in depth interventions. In this way, the intervention can be delivered in the most efficient manner possible, thereby having the greatest impact on reducing the spread of BBVs such as HCV. The current study therefore aims to bridge this gap, by determining the relative impact of each of the risk factors outlined above, thereby determining which factors have the greatest impact on BBV risk behaviours.

Hypotheses

Based on the findings of previous literature summarised above, we would anticipate that higher levels of psychological distress (anxiety and depression) and impulsivity will be significant predictors of risky injection practices in a sample of regular IDU. Similarly, it is expected that benzodiazepine, amphetamine (including prescription stimulants), cannabis, MDMA, alcohol and opiate use would be positively associated with BBV risk behaviours. It is also hypothesised that the demographic variables of females, older age, longer duration of drug use, daily injecting, IDU with prison history, and stimulant users will be significant predictors of BBV risk behaviours. Further, it is hypothesised that lower levels of self-injection and having last injected in a public location would be associated with engagement in BBV risk behaviours.

It is hypothesised that higher levels of cocaine and LSD use would not produce significant relationships with BBV risk behaviours, and similarly, it is expected that the IDUs primary spoken language, level of education, sexual orientation, treatment status, and accommodation status will not predict BBV risk.

Method

Participants

Participants of the 2006 and 2007 Illicit Drug Reporting System (IDRS) in Tasmania formed the sample of the current study. The IDRS is a national drug market monitoring system commissioned by the Australian Government Department of Health and Aging which gathers information as to emerging drug trends. Eligibility criteria for participation in the IDRS and the current study were that the individual must have been injecting substances at least once monthly for the past six months, had resided in Tasmania for the past twelve months or more, and were 18 years or older. Participants were recruited through advertisements distributed through Needle and Syringe Program (NSP) outlets, pharmacies (through promotional material included with injection equipment) or health services, and snowball methods (word of mouth by friends or associates). Participants were screened for their eligibility by referring agencies and interviewers. Of the 285 participants who completed the study, 16 cases were excluded from analyses due to incomplete data on the dependent variable measure (BBV-TRAQ-SV). Thus, 269 participants were included in the current study, and the demographic characteristics of this remaining cohort can be found in Table 1.

Table 1.

Demographic Characteristics of the IDU Cohort

Demographic	n=269
Sex (%)	Male 63.2 Female 36.8
Age (mean years)	31.8 (SD 8.0)
Grade at school completed (mean years)	10.0 (SD 1.4)

Post-school qualifications (%)		
	None	56.9
	Trade/Technical	37.2
	University/College	5.9
Employment (%)		
	Unemployed	72.9
	Full time/part time	13.7
	Other	13.4
Accommodation (%)	Stable	91.4
	Unstable	8.6
Treatment in past 6 months (%)		
	None	45.0
	Pharmacotherapy	48.0
	Other	7.0
Duration of injection (mean years)		12.5 (SD 7.3)
Frequency of injection last month (%)		
	Less than daily	67.3
	Daily	32.7
Last location of injection		
	Private	72.9
	Public	27.1
Drugs used in last 6 months		
	Pharmaceutical opioids	88.8
	Methamphetamine	84.0
	Benzodiazepines	79.6
	Cannabis	89.2

Materials and Instruments

IDRS Interview Schedule. The 2006 and 2007 IDRS interview schedules were administered to participants in the 2006 and 2007 cohorts, respectively. This is a standardised tool, and is similar to that used in previous research (Topp et al., 2001). The interview gathers information on demographics; drug use; price, availability, purity, and use of various drugs including heroin, cocaine, methamphetamine, cannabis, opioids, and benzodiazepines. In addition to this, the interview also contains sections on crime, risk-taking (including needle sharing), health, and general drug trends. Full details of these studies and the interview schedules are available in the 2006 and 2007 National IDRS reports (Black et al., 2008; O'Brien et al., 2007).

Arnett Inventory of Sensation Seeking (AISS). The AISS (Arnett, 1994) was used as a measure of impulsivity in the current study. This instrument was developed in response to Zuckerman's conceptualisation of sensation seeking, and focuses on *novelty* and *intensity* as the two components of this concept. The Novelty subscale includes items relating to the seeking of novel stimulation and the willingness to take risks to obtain this stimulation (e.g. *I would like to travel to places that are strange and far away*), while the Intensity scale contains items which reflect the level of stimulus intensity (e.g. *When I listen to music, I like it to be loud*). The AISS consists of 20 items, with two subscales of 10 items each measuring Intensity and Novelty. Items were all presented with a Likert scale response option where participants indicated how much they agreed with the item statement (1 = describes me very well, 2 = describes me somewhat, 3 = does not describe me very well, 4 = does not describe me at all).

At the time of publication, the AISS was found to have internal reliability of Cronbach $\alpha = .70$ for the entire scale, .64 for the Intensity subscale, and .50 for the Novelty subscale (Arnett, 1994). Similar coefficients were found by Zarevski, Marusic, Zolotic, Bunjevac, and Vukosav (1998) who reported .58 for the Intensity scale, and .53 for the Novelty scale. Using data from the current study, Cronbach alpha was found to be .63 for the total scale, .51 for the Intensity subscale, and .51 for the Novelty subscale. The AISS has been criticised for having unsatisfactory internal reliability for the subscales and the total scale (e.g. Roth & Herzberg, 2004). The AISS is considered to have good construct validity (Arnett, 1994; Powell, Hardoon, Derevensky, & Gupta, 1999). Roth and Herzberg (2004) confirm the hypothesised two-factor structure of the AISS (novelty vs. intensity of stimulation) by factor analysis.

They also report satisfying convergent validity when correlated with the NEO-Five Factor Inventory (NEO-FFI), as the Novelty scale was most highly correlated with the NEO-FFI scale 'Openness to Experience' and 'Extraversion' while the Intensity subscale was most highly correlated (negatively) with the NEO-FFI scale 'Agreeableness'. The authors also report good discriminant validity, as indicated by considerably low correlations with the remaining NEO-FFI scales ('Conscientiousness' and 'Neuroticism').

Kessler Psychological Distress Scale (K10). This 10-item scale was used in the current study as a non-specific measure of psychological distress. This scale asks participants to rate their experience of negative emotional states in the 4 weeks prior to the assessment (e.g. *Did you feel tired out for no good reason?*). There are five response options for each question, ranging from 'none of the time' to 'all of the time'. Scores range from 10 to 50, with higher scores indicating high levels of psychological distress.

The K10 is a widely used instrument, often used in health settings and in public health surveys as a screening tool for the possible presence of psychological conditions. Sensitivity and specificity data as well as other measures of validity indicate that the instrument can be used appropriately to screen for the presence of psychological conditions in the community (Andrews & Slade, 2001). For instance, analyses by Andrews and Slade (2001) indicates that of those who score above 30 points on the K10, 82.6% meet DSM-IV criteria for an anxiety, affective, or substance use disorder. The scale has undergone rigorous psychometric testing and found to have both strong reliability and validity (Kessler et al., 2002). The psychometric properties of the scale has been examined within an injecting drug user population in Australia, and found to have both high levels of internal consistency

(Cronbach's $\alpha = .84$) as well as concurrent validity (accuracy of predicting the presence of a DSM-IV affective disorder was 76.7% using a cut-off score of 27) (Hides et al., 2007). Cronbach alpha using the data from the current study was found to be .91. Overall, this instrument has strong psychometric properties and has proven appropriate for use with an Australian IDU population.

Confirmatory factory analyses research by Brooks, Beard and Steel (2006) into the factorial composition of the K10 reveals that this instrument consists of 4 factors and a 2-factor second-order factor structure. The second-order factors have been identified as representing Depression and Anxiety and these categorical divisions were utilised for the current study. Using the current data set, internal consistencies for each of the subscales was acceptable; with Cronbach's α of .79 for the anxiety subscale, and .91 for the depression subscale.

Blood-borne Virus Transmission Risk Assessment Questionnaire (Short Version) (BBV-TRAQ-SV). This 15-item questionnaire was designed for use with IDU populations and examines the risk of BBV transmission which occurs during the injection process (Stoové & Fry, 2006; see Appendix A). It was used in the current study as a measure of such risk by enquiring how frequently participants engage in particular risk behaviours in the month preceding assessment. Three areas of possible transmission risk are examined by the questionnaire; those being contamination by the sharing of needles and syringes, the sharing of other equipment used in the process of injection (e.g. filters, water, spoons), and second person contamination as a result of another person's involvement in the preparation and injecting process. The questionnaire takes approximately 6 – 8 minutes to administer and yields scores for each category ranging from 0 (no times) to 5 (more than 10 times in the past month). Scores are weighted depending on the presence of protective factors, such as

disinfection of injecting equipment. For details of complete scoring procedures, please refer to Stoové and Fry (2006).

Dwyer et al. (2002) undertook psychometric evaluation of the BBV-TRAQ-SV, reporting that three independent factors were identified by principal components analysis; confirming the three subscales outlined above. Modest internal consistencies were found for these subscales (needle and syringe contamination α = 0.60, other injecting equipment contamination α = .81, second person contamination α = .61). Independent psychometric analysis was conducted by Bruno, de Graaff, and Antel (2007) which found internal consistencies for the 15-items (Total BBV-TRAQ-SV score) to be acceptable at α = .81. Poor to good internal consistencies were reported for the subscales (needle and syringe contamination α = 0.52, other injecting equipment contamination α = .70, second person contamination α = .82). For the current study, coefficient alphas were found to be .68 for the total scale, .45 for the needle and syringe contamination scale, .58 for the other equipment contamination scale, and .82 for the second person contamination scale.

BAS Scales. Carver and White's (1994) Behavioural Activation System (BAS) scales were used as a measure of impulsivity in the form of behavioural activation (i.e. responsiveness to something desired). It is a 13-item scale which asks participants to rate their agreement with each statement using 4 point scale, ranging from 1 ('very true for me') to 4 ('very false for me'). The items yield scores for three subscales; BAS Drive (items reflect the persistent pursuit of desired goals e.g. *When I want something, I usually go all-out to get it*), BAS Fun Seeking (items reflect a desire for new rewards and a willingness to approach a potentially rewarding event on the spur of the moment e.g. *I will often do things for no other reason than that they might be fun),* and BAS Reward Responsiveness (items reflect positive

responses to the occurrence or anticipation of reward e.g. *When I get something I want, I feel excited and energized*). For complete details of the scale and scoring please refer to Carver and White (1994). Carver and White also developed an accompanying scale, entitled Behavioural Inhibition System, the items of which reflect reactions to the anticipation of punishment. Together, these scales are referred to as the BIS/BAS scales.

The BAS scales have been subjected to rigorous psychometric examination and the results of these analyses have been consistently positive. Carver and White's (1994) original conceptualisation of the scales consisting of four structures (behavioural inhibition, reward responsiveness, drive, and fun seeking) has been supported by a number of independent studies (e.g. Campbell-Sills, Liverant, & Brown, 2004; Heubeck, Wilkinson, & Cologon, 1998; Jorm et al., 1998; Leone, Perugini, Bagozzi, Pierro, & Mannetti, 2001) using both exploratory and confirmatory factor analyses. Test-retest reliability over an 8-week period has been found to range from .59 (BAS Reward Responsiveness) to .69 (BAS Fun Seeking) for the scales (Carver & White, 1994). Internal reliabilities for the scales have been acceptable, with Carver and White (1994) reporting coefficients from .66 (BAS Fun Seeking) to .76 (BAS Drive) and Campbell-Sills et al. (2004) reporting a range from .73 (BIS) to .82 (BAS Drive). For the current study, moderate coefficient alphas were found (BAS total = .83, BAS Drive = .77, BAS Fun Seeking = .72, BAS Reward = .66).

Validation studies have also been positive, with a number of studies reporting good convergent and discriminant validity. The scales have been found to be related to, but distinguishable from, alternative measures of similar traits (Campbell-Sills et al., 2004; Carver & White, 1994). For instance, the scales have been found to

correlate positively with similar traits (BIS with neuroticism and negative affectivity, BAS with positive affectivity and extraversion) (Campbell-Sills et al., 2004; Carver & White, 1994; Heubeck et al., 1998; Jorm et al., 1998). The construct validity of the scales is also supported by research findings that the BIS scale is successful in predicting the level of nervousness in response to an impending punishment, and the BAS scale is successful in predicting happiness in response to an impending reward (Carver & White, 1994). Concurrent validity analyses have also been positive, finding that the BIS/BAS scales are reflective of temperamental traits rather than transient states (Campbell-Sills et al., 2004).

Procedure

Following screening to determine eligibility, participants were given an information sheet further detailing the content of the interview to assist in informed decision making regarding their involvement. Potential participants were informed that information given was treated as strictly confidential, that their participation was entirely voluntary, and that they were free to withdraw at any time or decline to answer any questions.

Those who agreed to be involved in the study signed a consent form, and then completed the interview protocol face-to-face with the interviewer in a place that was convenient to them, including the premises of health services, NSPs, or private homes when requested by the participant. Ethics approval was granted by the Tasmanian Social Sciences Human Research Ethics Committee. Following the completion of the interview, participants were reimbursed AUD$30 for their time and other expenses.

Data Manipulations and Data Handling

To prepare data for analyses, a number of data manipulations and recoding of variables was conducted. Accommodation status was operationalised such that stable accommodation refers to having one's own house (including renting), or residing in their parents or family's house, while unstable accommodation included living in a boarding house/hostel, a shelter/refuge, or being of no fixed address/homeless. Education was defined as number of years of education and ranged between 0 and 12 years. Treatment status was defined as whether the participant was undertaking treatment at the time of the interview or not undertaking any treatment. Frequency of injecting was divided into three categories; being weekly or less, more than weekly but less than daily, and daily or more frequent injecting. Duration of injecting and age was not categorised, and remained as a scale variables in all analyses. Prison history was defined as whether the participant had ever been imprisoned (not inclusive of remand without sentence). Ethnicity was operationalised to two categories;. 'English' or 'other' as the main language spoken at home however was removed from analyses due to a lack of variability in the data (only one participant responded that their primary language spoken at home was not English). Sexual orientation was also deleted from analyses due to a high number of missing cases. All drug use variables refer to the number of days used in the 6 months prior to interview (maximum = 180).

Variables with missing data were handled using listwise deletion within subsections, leaving a total of 269 participants for demographic and drug use variables, 228 participants for the AISS data, 258 participants for K10, and 249

participants for the BAS variables. Missing data was estimated for the variable *'in the last month did you always self-inject'* using median substitution, such that the median of 0 (which was recorded for n=220 of the 264 complete cases) was used for 5 cases. Multivariate analyses were conducted using full listwise deletion in all cases (n=218).

Data was analysed using univariate and multiple linear regression in a latent variable context and was undertaken using MPlus (Muthén & Muthén, 2009) in order to identify variables that were significantly related to each factor of the BBV-TRAQ-SV. Additionally, in order to produce a more easily interpreted prediction, a categorical outcome variable was produced, being the presence of any BBV transmission risk (a score on the BBVTRAQ >0), and significant predictors of this categorical variable were identified using univariate and multivariate logistic regression models. For all analyses, the Mean and Variance-Adjusted Weighted Least Squares (WLSMV) estimator was used as simulation studies have demonstrated that this estimator provides robust estimates of model coefficients for continuous and ordered categorical data even if data are not multivariately normally distributed (Muthén & Muthén, 2009).

Results

BBV-TRAQ-SV

Just under half of the sample (n = 121, 45.0%) received a score of 0 on the BBV-TRAQ-SV indicating that no BBV transmission risk behaviours were present in the month prior to questionnaire completion (Figure 1). Means and standard deviations for BBV-TRAQ-SV total scale, Needle and Syringe Contamination, Other

Injecting Equipment Contamination, and Second Person Contamination subscales are presented in Table 2.

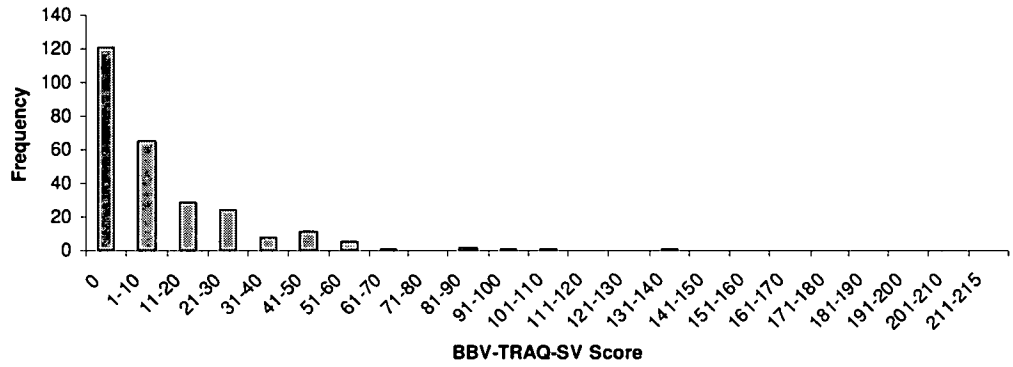

Figure 1. Distribution of responses to the BBV-TRAQ-SV.

Table 2

Means, Standard Deviations, Number of Participants who Scored 0 (no risk), and Possible Score Range for BBV-TRAQ-SV Subscales (N = 269)

	M	*SD*	*0% (n)*	*Range*
Total	11.53	19.07	45.0 (121)	0-215
Needle and Syringe Contamination	3.53	7.65	70.6 (190)	0-100
Other Injecting Equipment Sharing	5.76	12.78	73.2 (197)	0-85
Second Person Contamination	2.25	4.83	68.0 (183)	0-30

Measurement Models

Measurement models were conducted by fitting one factor congeneric models to the BBV-TRAQ-SV scale. Items were treated as ordered categories and the WLSMV estimator was used rather than ordinary least squares, as stimulation studies have demonstrated that this is more robust for ordered categorical and non-multivariate normal datasets (Muthén & Muthén, 2009).

Firstly, confirmatory factor analyses were conducted for the original published model of the full BBV-TRAQ-SV scale and subscales. Results for the fit statistics of Chi-square, Root Mean Square Error of Approximation (RMSEA), and Tucker-Lewis index (TLI) all fall outside of an acceptable range, demonstrating that none of these models provided a good fit to the data (Table 3). It is noted that the Needle/Syringe Contamination, Other Equipment Contamination, and Second Person Contamination factors are fall in the range of acceptable fit indices by the Comparative Fit Index (CFI; $\geq$0.9: Tabachnick & Fidell, 2001). However, in the context of the unacceptable values for all remaining fit indices, none of these measurement models could be accepted as providing good fit to the data.

Table 3

Fit Statistics for Published Model

Factor	Chi-square test of model fit	CFI	TLI	RMSEA
Full scale (items 1-15)	178.38, p<0.001	0.83	0.84	0.17
Needle/syringe contamination (items 1-4)*	6.99, p=0.03	0.96	0.885	0.096
Other equipment contamination (items 5-9)	14.93, p=0.0019	0.961	0.935	0.122
Second person contamination (items 10-15)	55.29, p<0.001	0.958	0.937	0.218

*Items 1-4 produce non-positive definite matrix; analysis conducted treating items as continuous due to absent scores in some categories

Previous research by Bruno, de Graaf, and Antel (2007) conducted an exploratory factor analysis and identified an alternative five factor model of the BBV-TRAQ-SV; being Needle and Syringe Contamination, Other Injecting Equipment Contamination, Exposure from Assisting Others to Inject, Exposure from being Assisted to Inject, and Needlestick exposure. This factor analysis identified

that the psychometric properties of the subscales are improved by separating Second Person Contamination to exposure from being injected by others and injecting others, and that the item assessing needlestick exposure is largely unrelated to the subscale it was originally allocated to (Needle and Syringe Contamination).

Table 4 below presents the results of a confirmatory factor analysis which assessed the extent to which the proposed scales highlighted above fit the data. The Needle and Syringe Contamination factor comprises items assessing injection with another person's used syringe, injection with a needle/syringe after another person has already injected some of its contents, re-using a needle/syringe taken out of a shared disposal/sharps container, and wiping of own injection site with an object which had been used by another. The Other Equipment Contamination factor comprises items assessing injection with a drug filtered through another person's filter, injection with a drug prepared in another person's used spoon or mixing container, and injection with a drug that had come into contact with another person's used needle/syringe. The Contamination after Injecting Others consists of one item only, being injection with a drug that had been prepared immediately after 'assisting' another person with their injection. The Contamination from Being Injected' factor comprised items assessing injection with a drug that was prepared by another person who had already injected or assisted in someone else's injection, injection by another person who had already injected or assisted in someone else's injection, and another person touched your injection site. The Contamination from Needlestick factor consisted of one item, which assessed the receiving of an accidental needle-stick/prick from another person's used needle/syringe. As can be seen in Table 4, the fit statistics for these models uniformly fall within the acceptable ranges and this

model of the BBV-TRAQ-SV structure is clearly more appropriate than the initial published structure (Table 3).

Table 4

Fit Statistics for the Alternative Model (N=269)

Factor	Chi-square test of model fit	CFI	TLI	RMSEA
Needle/syringe contamination (Items 1,2,4,9)	1.27, p=0.52	1.00	1.02	<0.001
Other equipment contamination (Items 5,6,8)	161.13, p=0.97*	1.00	1.00	<0.001
Contamination after injecting others (Item 10)	-	-	-	-
Contamination from being injected (Items 11,12,15)	139.82, p=0.99*	1.00	1.00	<0.001
Contamination from needlestick (Item 3)	-	-	-	-

Note: Item 7 produced non-positive definite matrices due to high multicollinearity with other variables and was therefore excluded; items 13 and 14 had zero variance in this sample so were not able to contribute to these analyses. Single items are not appropriate for confirmatory factor analytic modelling. *Chi-square from analyses using the robust maximum likelihood estimator (MLR) due to convergence problems in WLSMV analyses

Factor loadings for each of the subscales are listed below in tables 5, 6, and 7, respectively. Each of the items was noted to be statistically significant.

Table 5

Factor Loadings for Items Comprising Needle/Syringe Contamination Factor

Item Number	Item Content	Factor loading
1	Injection with another person's used needle/syringe	0.92
2	Injection with a needle/syringe after another person had already injected some of its contents	0.82
4	Re-use of a needle/syringe taken out of a shared disposal/sharps container	0.53
9	Wiping own injection site with an object (e.g, swab, tissue, hanky, towel etc) which had been used by another person	0.64

Table 6

Factor Loadings for Items Comprising Other Equipment Contamination Factor

Item	Item Content	Factor loading
5	Injection of a drug that was filtered through another person's filter	0.52
6	Injection of a drug that was prepared in another person's used spoon or mixing container	0.99
8	Injection of a drug which had come into contact with another person's used needle/syringe	0.58

Table 7

Factor Loadings for Items Comprising Contamination From Being Injected Factor

Item	Item Content	Factor loading
11	Injection of a drug that was prepared by another person who had already injected or assisted someone else's injection	0.87
12	Injection by another person who had already injected or assisted in someone else's injection	0.99
15	Injection site touched by another person (e.g., to feel for a vein, to wipe away blood, or to stop bleeding)	0.92

Linear Regression Analyses

Using this alternative model of the BBV-TRAQ-SV, univariate linear regression analyses were conducted, within a latent variable context (where scale

variables are involved in the analyses, the latent structure of this scale was incorporated in the analysis rather than a subscale, hence reducing measurement error) to determine which variables predict BBV transmission risk as identified on the BBV-TRAQ-SV. This was conducted separately for each of the identified factors, and also for a categorical model which assessed whether the participant had any risk on the BBV transmission risk as measured by the BBV-TRAQ-SV. Note that the variable of the number of days of tobacco use was not able to be analysed as either continuous or categorical data due to distributional problems (almost all cases were daily use, with near-zero variance) and as such is not included in the analyses below. Similarly, the 'intensity' construct of the Arnett Inventory of Sensation Seeking was also unable to be calculated either by treating items as ordinal or continuous due to violations of data assumptions, and therefore is not included in the analyses.

Variables identified in the univariate analyses to be significant or to approach significance ($p < 0.10$) were included in a multivariate linear regression analysis for each factor. All these analyses were conducted with full listwise deletion, leaving a remaining sample of 218 participants. Details as to the results of the univariate and multivariate linear regression analyses for each factor and overall risk is presented below.

Factor 1: Needle and Syringe Contamination

As can be seen in Table 8, a number of variables were found to significantly predict the factor of Needle and Syringe Contamination, although were uniformly of relatively small magnitude (explaining <10% of variance in this factor) . Stable accommodation, the number of days of benzodiazepine injection in the last six

months, depression and anxiety as measured by the K10, and the number of days used prescription stimulants in the last six months were all positively related to Needle/Syringe Contamination. Significant inverse relationships were found between the Needle/Syringe Contamination factor and the 'drive' and 'fun-seeking' concepts of the Behavioural Activation Scale. A number of variables were also identified as approaching significance ($p < 0.1$); being a positive relationship between always self-injecting in the previous month, the 'Novelty' construct of the AISS scale, and the 'reward responsiveness' construct of the Behavioural Activation Scale. The 'Intensity' construct from the AISS scale was not included in univariate analyses due to a failure of the model to be produced as a result of data violations of the assumptions for analysis.

Table 8

Univariate Linear Regression Analyses for Factor 1: Needle and Syringe Contamination

				95% CI of *B*	
Variable	*B*	*p*	R^2	Lower bound	Upper bound
Demographic Variables					
Sex (M=1)	0.025	0.908	0.000	-0.541	0.591
Age	0.002	0.866	0.000	-0.034	0.039
Duration of IV use	0.013	0.332	0.011	-0.022	0.048
IV frequency	0.093	0.574	0.004	-0.333	0.519
Stable accommodation (Unstable = 1)	0.710	0.007**	0.065	0.035	1.385
Prison history (prison = 1)	0.231	0.276	0.014	-0.315	0.778
Years of education	0.028	0.674	0.002	-0.145	0.202
Treatment (1=in treatment)	0.005	0.979	0.000	-0.504	0.514

Pharmacological Effects of Drug Use (number of days used in past six months) and Injection Variables					
IV benzodiazepines	0.008	0.035*	0.048	-0.002	0.017
Benzodiazepines	0.002	0.386	0.021	-0.003	0.007
Amphetamines	0.001	0.726	0.001	-0.004	0.006
Cannabis	-0.002	0.680	0.017	-0.011	0.008
Prescription stimulants	0.008	0.018*	0.046	-0.001	0.018
Cocaine	-0.002	0.975	0.000	-0.186	0.182
LSD	0.031	0.429	0.008	-0.070	0.132
MDMA	0.009	0.547	0.003	-0.028	0.045
Alcohol	0.001	0.780	0.001	-0.005	0.006
Any opiate	0.000	0.851	0.001	-0.005	0.006
Public injection last time (1=public)	0.178	0.452	0.007	-0.433	0.790
Self injection	0.193	0.057(*)	0.037	-0.068	0.453
Psychological Distress Variables: Kessler 10					
Anxiety	0.326	0.012**	0.065	-0.659	0.007
Depression	0.461	0.001***	0.075	-0.813	-0.110
Impulsivity Variables					
AISS Novelty	0.329	0.081(*)	0.025	-0.156	0.814
AISS Intensity ^	-	-	-	-	-
BAS Drive	-0.294	0.048*	0.044	-0.676	0.088
BAS Reward Responsiveness	0.221	0.076(*)	0.021	-0.100	0.542
BAS Fun Seeking	-0.268	0.004**	0.038	-0.511	-0.025

Note: (*) $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ ***$p < 0.001$, ^ Model unable to be produced due to violations of data assumptions.

Table 9 details the multivariate model for the Needle/Syringe Contamination factor, incorporating all variables identified as $p<0.10$ in the univariate analyses. Together, these variables accounted for 31.7% of variance in the latent model of this factor. While each of these predictors when considered individually was a statistically significant predictor of Needle/Syringe Contamination, when these are considered together, the strongest (or, most important) predictors were the construct

of 'fun-seeking' on the Behavioural Activation Scale, which was inversely related to Needle/Syringe Contamination (B = -0.796, p = 0.048) and the frequency of use of pharmaceutical stimulants, which was positively related to Needle/Syringe Contamination (B = 0.008, p = 0.070).

Table 9

Multivariate Model for Factor 1: Needle and Syringe Contamination

			95% CI of *B*	
Variable	*B*	*p*	Lower bound	Upper bound
K10 Anxiety	0.035	0.876	-0.618	0.548
K10 Depression	0.267	0.291	-0.917	0.384
BAS Drive	0.086	0.796	-0.769	0.941
BAS Fun-seeking	-0.796	0.048*	-1.832	0.241
BAS Reward Responsiveness	0.776	0.107	-0.465	2.017
AISS Novelty	0.221	0.683	-1.169	1.61
Stable accommodation	0.463	0.112	-0.288	1.215
Days used IV Benzodiazepines	0.008	0.222	-0.008	0.023
Pharmaceutical stimulants days	0.008	0.070(*)	-0.003	0.02
Self inject	0.015	0.929	-0.424	0.454

Note: (*) p < 0.10, * p < 0.05

Factor 2: Other Equipment Contamination

Univariate analyses for the factor of Other Equipment Contamination revealed that the number of days used alcohol in the last six months, anxiety and depression as assessed by the K10, and always having self-injected in the last month was positively and significantly predicted risk of Other Equipment Contamination on the BBV-TRAQ-SV, with individual predictors explaining up to 14% of the variance in the factor. Two predictors were identified as approaching significance in predicting other equipment contamination risk, and these were a negative

relationship with sex (males being less risky on this variable than females), and a positive relationship with the number of days used benzodiazepines in the last six months (refer to Table 10).

Table 10

Univariate Linear Regression Analyses for Factor 2: Other Equipment Contamination

				95% CI of *B*	
Variable	*B*	*p*	R^2	Lower bound	Upper bound
Demographic Variables					
Sex (M=1)	-0.239	0.052*	0.047	-0.555	0.077
Age	0.001	0.933	0.000	-0.017	0.018
Duration of IV use	-0.001	0.835	0.000	-0.018	0.015
IV frequency	0.059	0.510	0.005	-0.172	0.290
Stable accommodation (Unstable = 1)	0.217	0.165	0.021	-0.185	0.618
Prison history (prison = 1)	-0.147	0.270	0.015	-0.490	0.196
Years of education (continuous)#	0.023	0.452	0.004	-0.055	0.100
Treatment (1=in treatment)#	-0.085	0.398	0.007	-0.345	0.175
Pharmacological Effects of Drug Use (number of days used in past six months) and Injection Variables					
IV benzodiazepines	0.003	0.163	0.019	-0.002	0.008
Benzodiazepines	0.003	0.078(*)	0.175	-0.001	0.008
Amphetamines	0.001	0.275	0.010	-0.002	0.004
Cannabis#	0.000	0.900	0.000	-0.002	0.002
Prescription stimulants#	0.003	0.193	0.023	-0.003	0.010
Cocaine	0.012	0.547	0.005	-0.040	0.064
LSD	0.014	0.432	0.006	-0.032	0.059
MDMA	0.004	0.575	0.003	-0.015	0.024
Alcohol	0.002	0.030*	0.041	0.000	0.005
Any opiate	0.000	0.853	0.000	-0.002	0.002
Public injection	0.003	0.984	0.000	-0.332	0.620

last time (1=public)					
Self injection	0.229	0.000***	0.139	0.062	0.396
Psychological Distress Variables: Kessler 10					
Anxiety	0.291	0.002**	0.116	-0.538	-0.043
Depression	0.245	0.027*	0.077	-0.530	0.040
Impulsivity Variables					
AISS Novelty	0.139	0.256	0.012	-0.176	0.453
AISS Intensity ^	-	-	-	-	-
BAS Drive	-0.052	0.587	0.004	-0.296	0.193
BAS Reward Responsiveness[#]	0.086	0.302	0.012	-0.129	0.301
BAS Fun-Seeking	-0.172	0.154	0.037	-0.483	0.139

Note: (*) $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ ***$p < 0.001$, ^ Model unable to be produced due to data violations of assumptions, [#]Regression model would not converge due to data distributional issues.

In a multivariate analysis (Table 11), the factors identified as significant or approaching significance together accounted for 32.5% of the variance in the latent model of the Other Equipment Contamination factor. When the variables entered in the univariate analyses are examined in this context, the significant predictor of self-injection was identified ($B = 0.260$, $p < 0.001$), along with the number of days of alcohol used in the last six months being positively related to the factor ($B = 0.003$, $p = 0.052$), and anxiety as measured by K10 being positively related ($B = 0.188$, $p = 0.086$) to other equipment contamination although not significantly so ($p < 0.10$). Therefore, the variables of anxiety, self-injection, and number of days of alcohol use were identified as the most important variables in predicting risk of BBV transmission through contamination with other injecting equipment.

Table 11

Multivariate Model for Factor 2: Other Equipment Contamination

			95% CI of *B*	
Variable	*B*	*p*	Lower bound	Upper bound
K10 Anxiety	0.188	0.086(*)	-0.470	0.094
K10 Depression	-0.138	0.298	-0.203	0.478
Sex	-0.134	0.378	-0.525	0.257
Days used benzodiazepines	0.002	0.122	-0.001	0.005
Days used alcohol	0.003	0.052(*)	-0.001	0.006
Self-injection	0.260	0.000***	0.070	0.450

Note: (*) $p < 0.10$, ***$p < 0.001$

Factor 3: Contamination From Injecting Others

Sex (males being more at risk than females) and the number of days used alcohol in the previous six months were found to be positively related to the Contamination from Injecting Others factor when subjected to univariate linear regression analyses, although both predictors explained less than 10% of the variance in this factor. The 'reward responsiveness' construct of the Behavioural Activation Scale was noted to approach significance levels in univariate analyses and was positively related to the factor (see Table 12).

Table 12

Univariate Linear Regression Analyses for Factor 3: Contamination From Injecting Others

Variable	*B*	*p* for *B* value	R^2 for latent variable	95% CI of *B*	
				95% CI of *B* (Low)	95% CI of *B* (High)
Demographics Variables					
Sex (M=1)	0.450	0.027*	0.045	-0.076	0.975
Age	-0.004	0.756	0.001	-0.036	0.028
Duration of IV use	0.000	0.979	0.000	-0.034	0.034
Frequency of IV use	0.070	0.640	0.002	-0.315	0.454
Stable accommodation (Unstable = 1)	-0.051	0.850	0.000	-0.752	0.649
Prison history (prison = 1)	0.001	0.996	0.000	-0.519	0.521
Years of education (continuous)	-0.009	0.898	0.000	-0.183	0.166
Treatment (1=in treatment)	-0.137	0.452	0.005	-0.607	0.333
Pharmacological Effects of Drug Use (number of days used in past six months) and Injection Variables					
IV benzodiazepines	0.002	0.609	0.002	-0.007	0.011
Benzodiazepines	-0.001	0.481	0.005	-0.004	0.002
Amphetamines	0.001	0.652	0.002	-0.004	0.006
Cannabis	0.001	0.263	0.011	-0.002	0.005
Prescription stimulants	0.004	0.238	0.007	-0.004	0.012
Cocaine	-0.106	0.463	0.092	-0.480	0.267
LSD	-0.013	0.828	0.001	-0.166	0.140
MDMA	0.015	0.222	0.010	-0.017	0.048
Alcohol	0.006	0.000***	0.067	0.002	0.010
Any opiate	-0.001	0.596	0.002	-0.004	0.003
Pharmaceutical opiate	0.001	0.690	0.002	-0.004	0.005
Public injection last time (1=public)	-0.097	0.678	0.002	-0.697	0.503
Self injection	-0.012	0.912	0.000	-0.294	0.270

Psychological Distress Variables: Kessler 10					
Anxiety	0.031	0.808	0.001	-0.365	0.302
Depression	0.062	0.671	0.002	-0.441	0.316
Impulsivity Variables					
AISS Novelty	-0.079	0.741	0.001	-0.691	0.534
AISS Intensity ^	-	-	-	-	-
BAS Drive	0.007	0.965	0.000	-0.257	0.266
BAS Reward Responsiveness	0.319	0.057(*)	0.037	-0.113	0.750
BAS Fun Seeking	0.074	0.645	0.002	-0.341	0.490

Note: (*) $p < 0.10$, * $p < 0.05$, ***$p < 0.001$, ^ Model unable to be produced due to data violations of data assumptions.

The multivariate model, comprising all variables identified as statistically significant ($p<0.01$) in univariate analyses (Table 13) accounted for 16.6% of variance in the Contamination from Injecting Others factor. The most important variables in predicting the factors were found to be sex (males more at risk than females: $B = 0.611$, $p = 0.012$), and the number of days of alcohol use in the preceding six months ($B = 0.007$, $p < 0.001$). These variables were both positively and significantly related to the Contamination from Injecting Others factor.

Table 13

Multivariate Model for Factor 3: Contamination From Injecting Others

			95% CI of *B*	
Variable	*B*	*p*	Lower bound	Upper bound
BAS Reward responsiveness	0.250	0.188	-0.239	0.738
Sex	0.611	0.012*	-0.013	1.235
Alcohol days used	0.007	0.000***	0.002	0.012

Note: * $p < 0.05$, ***$p < 0.001$

Factor 4: Exposure From Being Injected

Univariate analyses for the factor of Exposure from Being Injected revealed that duration of IV use, and the number of days of any opiate use in the preceding six months was inversely and significantly related to the factor. The variables of stable accommodation, always having self-injected in the preceding month, anxiety as measured by the K10, and the 'novelty' construct of the AISS was positively and significantly associated with the exposure from being injected factor. A number of variables were also identified as approaching statistical significance in predicting the factors; namely age, and sex (females more at risk than males) were inversely associated, while the number of days of MDMA use and alcohol use in the previous six months, depression as measured by the K10, and having injected in a public location at the last injection time were positively associated with the factor Exposure from Being Injected (see Table 14).

Table 14

Univariate Linear Regression Analyses for Factor 4: Exposure from Being Injected by Others

				95% CI of *B*	
Variable	*B*	*p*	R^2	Lower bound	Upper bound
Demographic Variables					
Sex (M=1)	-0.292	0.085(*)	0.026	-0.730	0.145
Age	-0.018	0.086(*)	0.026	-0.044	0.009
Duration of IV use	-0.028	0.030*	0.054	-0.062	0.005
IV frequency	-0.160	0.249	0.014	-0.518	0.198
Stable accommodation (Unstable = 1)	0.708	0.001**	0.076	0.178	1.239
Prison history (prison = 1)	-0.301	0.112	0.025	-0.788	0.187

Years of education (continuous)	0.015	0.761	0.001	-0.112	0.142
Treatment (1=in treatment)	-0.066	0.689	0.001	-0.494	0.361
Pharmacological Effects of Drug Use (number of days used in past six months) and Injection Variables					
IV Benzodiazepines	-0.003	0.726	0.007	-0.023	0.017
Benzodiazepines	-0.001	0.388	0.012	-0.005	0.003
Amphetamines	0.002	0.355	0.008	-0.003	0.006
Cannabis	0.001	0.209	0.016	-0.002	0.005
Prescription stimulants	0.002	0.586	0.002	-0.007	0.010
Cocaine	0.006	0.858	0.000	-0.079	0.091
LSD	0.000	0.994	0.000	-0.117	0.118
MDMA	0.019	0.065(*)	0.020	-0.008	0.047
Alcohol	0.003	0.070(*)	0.024	-0.001	0.007
Any opiate	-0.003	0.019*	0.053	-0.006	0.000
Pharmaceutical opiate	-0.002	0.143	0.026	-0.006	0.002
Public injection last time (1=public)	0.315	0.075(*)	0.026	-0.141	0.772
Self injection[#]	0.517	0.000***	0.260	0.349	0.685
Psychological Distress Variables: Kessler 10					
Anxiety	0.227	0.044*	0.036	-0.517	0.063
Depression	0.236	0.061(*)	0.033	-0.561	0.089
Impulsivity Variables					
AISS Novelty	0.402	0.009**	0.054	0.006	0.798
AISS Intensity ^	-	-	-	-	-
BAS Drive	0.101	0.490	0.005	-0.275	0.476
BAS Reward Responsiveness	0.037	0.722	0.001	-0.229	0.303
BAS Fun-Seeking	-0.116	0.365	0.007	-0.447	0.214

Note: (*) $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ ***$p < 0.001$, ^ Model unable to be produced due to data violations of data assumptions, [#] Regression model would not converge due to data distributional issues.

Table 15 details the multivariate model for the Exposure from Being Injected by Others factor, and together accounted for 49.6% of the variance in the latent

variable. The most important predictors were not always self-injecting in the month prior to data collection ($B = 0.529$, $p < 0.001$) which was positively related to the factor, as well as anxiety as measured by the K10 which was noted to have an inverse relationship to exposure from being injected by others ($B = -0.484$, $p = 0.001$). Depression as measured by the K10 was also identified as a strong predictor for this factor ($B = 0.397$, $p < 0.001$). However, it is noted that due to this factor assessing only exposure from being injected by others, this excludes those participants who always inject themselves, such that if one does not allow anyone else to assist with injecting, then they are at no risk of exposure to BBV from injection by others.

Table 15

Multivariate Model for Factor 4: Exposure from Being Injected by Others

			95% CI of *B*	
Variable	*B*	*p*	Lower bound	Upper bound
K10 Anxiety	-0.484	0.001***	0.105	0.863
K10 Depression	0.397	0.011*	-0.799	0.006
AISS Novelty	-0.124	0.369	-0.479	0.231
Age	0.000	1.000	-0.049	0.049
Sex	-0.136	0.535	-0.698	0.427
Duration of IV use	-0.002	0.950	-0.072	0.068
Stability of accommodation	0.428	0.103	-0.248	1.104
Days used ecstasy	0.010	0.410	-0.021	0.041
Days used alcohol	0.003	0.174	-0.003	0.010
Days used any opiate	0.000	0.848	-0.005	0.005
Public injection last time injected	0.340	0.193	-0.333	1.012
Self-injection	0.529	0.000***	0.312	0.747

Note: * $p < 0.05$, ***$p < 0.001$

Factor 5: Needlestick Contamination

Table 16 below identifies the results of univariate linear regression analyses in the prediction of BBV transmission through the Needlestick Contamination factor. These analyses revealed that depression and anxiety as measured by the K10 were significant predictors, and were positively related to the factor of Needlestick Contamination, individually explaining up to 20% of the variance in this factor. Having had the last injection occurring in a public place was noted to approach statistical significance, and was also positively related to the factor. Similarly, the variable of IV use frequency was also found to approach significance, and was positively related to the Needlestick Contamination factor.

Table 16

Univariate Linear Regression Analyses for Factor 5: Needlestick Contamination

				95% CI of *B*	
Variable	*B*	*p*	R^2	Lower bound	Upper bound
Demographic Variables					
Sex (M=1)	-0.168	0.532	0.007	-0.860	0.524
Age	-0.005	0.813	0.002	-0.065	0.054
Duration of IV use	0.014	0.584	0.010	-0.050	0.078
Frequency of IV use	0.379	0.076(*)	0.056	-0.171	0.929
Stable accommodation (Unstable = 1)	0.058	0.916	0.000	-1.361	1.476
Prison history (prison = 1)	0.000	1.000	0.000	-0.856	0.856
Years of education (continuous)	0.038	0.632	0.003	-0.167	0.243
Treatment (1=in treatment)	-0.191	0.464	0.009	-0.865	0.483

Pharmacological Effects of Drug Use (number of days used in past six months) and Injection Variables					
IV Benzodiazepines	0.007	0.112	0.037	-0.005	0.019
Benzodiazepines	0.002	0.382	0.014	-0.003	0.006
Amphetamines	-0.001	0.668	0.004	-0.008	0.006
Cannabis	0.000	0.764	0.001	-0.005	0.004
Prescription stimulants	0.002	0.654	0.003	-0.010	0.015
Cocaine	0.005	0.923	0.000	-0.136	0.147
LSD	0.005	0.960	0.000	-0.247	0.257
MDMA	0.011	0.668	0.005	-0.054	0.075
Alcohol	0.000	0.921	0.000	-0.008	0.008
Any opiate	0.002	0.296	0.022	-0.003	0.007
Public injection last time (1=public)	-0.764	0.082(*)	0.104	-1.893	0.366
Self injection	0.150	0.360	0.018	-0.273	0.573
Psychological Distress Variables: Kessler 10					
Anxiety	0.613	0.000***	0.198	-1.021	-0.204
Depression	0.602	0.000***	0.163	-1.014	-0.190
Impulsivity Variables					
AISS Novelty	0.032	0.916	0.000	-0.754	0.818
AISS Intensity ^	-	-	-	-	-
BAS Drive	-0.110	0.630	0.005	-0.698	0.478
BAS Reward Responsiveness	-0.002	0.994	0.000	-0.810	0.805
BAS Fun Seeking	-0.254	0.135	0.026	-0.692	0.184

Note: (*) $p < 0.10$, ***$p < 0.001$, ^ Model unable to be produced due to data violations of data assumptions, # Regression model would not converge due to data distributional issues.

Variables found to be significant or approach significance in the univariate analyses were entered in the multivariate model and together accounted for 21.8% of variance in the Needlestick Contamination factor (see Table 17). While each of the predictors entered into the multivariate analyses were significant predictors individually to the overall factor of Needlestick Contamination, the most important

predictor when the variables were considered together was the variable of anxiety as assessed by the K10. This variable was found to be a statistically significant predictor, and was positively related to the factor of Needlestick Contamination (B = 0.763, p = 0.002).

Table 17

Multivariate Model for Factor 5: Needlestick Contamination

			95% CI of B	
Variable	B	p	Lower bound	Upper bound
K10 Anxiety	0.763	0.002**	-1.39	-0.136
K10 Depression	-0.301	0.228	-0.342	0.944
Frequency of IV use	0.341	0.322	-0.547	1.229
Public Injection last time injected	-3.249	0.992	-867.152	860.654

Note: ** $p < 0.01$

Prediction of Any Risk

Table 18 below indicates the extent to which each variable predicts whether a person had any risk of BBV transmission as measured by the BBV-TRAQ-SV instrument. Univariate analyses revealed that the number of days of alcohol use in the preceding six months, not always having self-injected in the previous month, and the 'novelty' construct of the Arnett Inventory of Sensation Seeking each were found to independently and significantly predict overall BBV transmission risk, and were all positively related to the factor. Depression as measured by the K10 instrument was also found to be a significant predictor of risk, and this was also a positive relationship. The factors of stable accommodation and the number of days of amphetamines used in the previous six months were noted to approach statistical significance, and are recognised as important predictors of risk of BBV transmission.

Both these variables were positively related to the factor meaning that unstable accommodation and more frequent use of amphetamines are associated with a greater likelihood of engaging in BBV transmission risk behaviours.

Table 18

Univariate Linear Regression Analyses for the Prediction of Any Risk on the BBV-TRAQ-SV.

				95% CI of *B*	
Variable	*B*	*p*	R^2	Lower bound	Upper bound
Demographic Variables					
Sex (M=1)	-0.184	0.249	0.008	-0.595	0.227
Age	-0.011	0.268	0.007	-0.035	0.014
Duration of IV use	-0.016	0.135	0.013	-0.044	0.012
Frequency of IV use	-0.153	0.198	0.010	-0.459	0.153
Stable accommodation (Unstable = 1)	0.408	0.073(*)	0.020	-0.178	0.994
Prison history (prison = 1)	-0.117	0.481	0.003	-0.544	0.310
Years of education (continuous)	0.031	0.579	0.002	-0.112	0.173
Treatment (1=in treatment)	-0.054	0.726	0.001	-0.451	0.343
Pharmacological Effects of Drug Use (number of days used in past six months) and Injection Variables					
IV Benzodiazepines	0.004	0.224	0.009	-0.004	0.011
Benzodiazepines	0.001	0.278	0.007	-0.002	0.004
Amphetamines	0.003	0.055(*)	0.024	-0.001	0.007
Cannabis	0.000	0.972	0.000	-0.003	0.003
Prescription stimulants	0.005	0.236	0.012	-0.006	0.015
Cocaine	0.050	0.219	0.022	-0.055	0.155
LSD	-0.014	0.622	0.002	-0.084	0.057
MDMA	0.025	0.117	0.024	-0.016	0.065
Alcohol	0.003	0.048*	0.024	-0.001	0.008
Any opiate	-0.001	0.259	0.007	-0.004	0.002

Public injection last time (1=public)	0.183	0.291	0.007	-0.263	0.630
Self injection	0.400	0.000***	0.116	0.131	0.669
Psychological Distress Variables: Kessler 10					
Anxiety	0.310	0.004**	0.052	-0.583	-0.036
Depression	0.202	0.87	0.019	-0.507	0.102
Impulsivity Variables					
AISS Novelty	0.391	0.045*	0.036	-0.111	0.894
AISS Intensity ^	-	-	-	-	-
BAS Drive	0.174	0.203	0.012	-0.178	0.526
BAS Reward Responsiveness	0.094	0.539	0.003	-0.301	0.489
BAS Fun Seeking	-0.093	0.513	0.004	-0.460	0.274

Note: (*) $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ ***$p < 0.001$, ^ Model unable to be produced due to data violations of data assumptions.

Finally, to assess the overall risk of BBV transmission risk as assessed by the BBV-TRAQ-SV, a multivariate model was created using the variables of K10 anxiety, AISS novelty, stability of accommodation, days used amphetamines, days used alcohol, and self-injection. Together, these variables explain 21.4% of variability and the most important predictors were found to be anxiety as assessed by the K10 ($B = 0.204$, $p = 0.073$), which was positively related to transmission risk, and not always having self-injected in the previous month ($B = 0.418$, $p < 0.001$), which was positively related to the overall factor (see Table 19).

Table 19

Multivariate Model for the Prediction of Any Risk on the BBV-TRAQ-SV.

			95% CI of *B*	
Variable	*B*	*p*	Lower bound	Upper bound
K10 Anxiety	0.204	0.073(*)	-0.496	0.089
AISS Novelty	0.254	0.229	-0.290	0.797
Stability of accommodation	0.142	0.626	-0.607	0.890
Days used amphetamines	0.003	0.147	-0.002	0.007
Days used alcohol	0.003	0.134	-0.002	0.009
Self-injection	0.418	0.000***	0.123	0.714

Note: (*) $p < 0.10$, ***$p < 0.001$

Discussion

The current study aimed to determine which variables are the most important in predicting BBV risk behaviours in a sample of injecting drug users. Based on variables identified in previous research as potentially predictive of BBV risk the variables investigated in the current study included demographic, drug use and injection variables, depression and anxiety, and impulsivity domains. Unstable accommodation, amphetamine use, alcohol use, less occasions of self-injection, higher symptoms of anxiety (K10), and a high tendency to seek out novel stimulation (AISS Novelty) emerged as relevant predictors of the overall risk of engaging in behaviours risky for the transmission of BBVs, however these were not consistent in regard to exposure to risk from contamination or needles or other injecting equipment, or contamination from other aspects of the injecting process (i.e. needlestick contamination, exposure from being injected by another person, exposure from injecting another person). Following are details of each variable examined and their contribution to BBV risk.

Demographic Variables

It was hypothesised that the female sex will be associated with BBV risk behaviours (MacDonald et al., 2000; Maher et al., 2006; Maher et al., 2007). While female sex was not associated with increased risk of exposure on an overall composite measure of risk, the current study demonstrated that females in this sample were more at risk in specific aspects of the injection process: in particular, through the contamination of 'other' injecting equipment (e.g. spoons, water, tourniquets) as well as through exposure from being injected by others. The association between female gender and risk of contamination through being injected by another person is consistent with findings from Evans et al. (2003) who report that in their study of gender differences in injecting in San Francisco, females were more likely to be injected by others and therefore were exposed to more episodes of potential BBV transmission opportunities. The association between female gender and increased risk of contamination through 'other' injecting equipment is of significance, however it is noted that the sharing of peripheral injecting equipment such as waters, tourniquets, and cottons carries with it a relatively lower risk than contamination from shared needles and syringes (De, Roy, Boivin, Cox, & Morissette, 2008). In keeping with these significant variables, the results indicate that being female reduces the risk of contamination when assisting others to inject, as this behaviour was more common among males. Sex was found not to be a significant predictor for the factors of needle/syringe contamination or needlestick contamination. Therefore, female sex in the current context appears to be associated with some elements of BBV transmission risk, however is not a strong predictor of overall risk and does not support the literature (e.g. MacDonald et al., 2000; Maher et

al., 2006; Maher et al., 2007) which report that females are at a greater risk for the transmission of HCV and for sharing injecting equipment.

Previous research indicates that in general, older age is associated with an increase in BBV transmission risk behaviours (e.g. Chang et al., 1998; Chetwynd et al., 1995; Diaz et al., 2001; Hagan et al., 2001; MacDonald et al., 2000) however the results of the current study identified no relationship between age and overall BBV transmission risk. Age was found not to be predictive of contamination through needles and syringes, other injecting equipment, through injecting others, or through needlestick exposure. By contrast, it was identified that as one's age increases, the risk of BBV exposure from being injected decreases, as risk associated with injection by others was more common among younger IDU. Therefore, the results suggest that the hypothesis that older age is associated with an increase in BBV risk is unsupported due to there being no overall association identified between age and BBV risk, and only one significant association with one aspect of BBV risk being identified (namely, risk from injection by others which is higher amongst younger IDU). Similarly, the hypothesis that longer duration of IV use would be associated with an increased risk of engaging in risky behaviours for BBV transmission was not supported, as the results of the current study indicate that the longer one has been injecting for the exposure to BBV as a result of being injected by others decreases. Additionally, this variable was found not to be predictive of overall risk of BBV transmission behaviours, nor any of the alternate factors (contamination through needles and syringes, other injecting equipment, through injecting others, and through needlestick episodes). Taken together, these results suggest a trend (not significantly so) such that younger IDU and those who are newer initiates are those that are at an increased risk of poor injecting practices. This is consistent with the

literature which examines BBV incidence rates (i.e. Crofts et al., 1995; Hagan et al., 1999; Van Beek et al., 1998) and suggests that those who are less experienced are more risky in their injection practices, perhaps due to lack of understanding of the BBV transmission risks associated with injecting, including when being injected by others. Therefore, these results suggest that this group of IDU, specifically those who are younger and who have less injecting experience, should be targeted for BBV interventions. This, however, is identified as a potentially challenging group to target, due to this group being new initiates and therefore less accessible for interventions. As such, intervention efforts may be best targeted to those IDU with more experience who are initiating others to injecting practices. By focussing on this group, education regarding BBV transmission risks can be provided, with the aim of creating a flow-on effect to new initiates.

The frequency of injecting was hypothesised to be a significant predictor for BBV risk, particularly, that those who inject on a daily basis will be at greater risk than those who inject less frequently. The results indicate that this hypothesis was supported in relation to contamination by an accidental needlestick/prick with another person's used syringe, but not in relation to any of the other BBV factors (needle/syringe and other equipment contamination, contamination from injecting others and being injected by others), and similarly was also not predictive of overall risk of BBV transmission behaviours. This hypothesis therefore, was only partially supported and generally runs contrary to the significant body of research (e.g. Dwyer et al., 2002; MacDonald et al., 2000; Villano et al., 1997) which report that the more frequently someone injects, the more at risk they are of BBV transmission, supposedly due to cumulative exposure and more opportunities for BBV transmission to occur and for risky injection episodes. The reason for this variable

not being supported by the current study may be due to the relatively heavy injectors that comprise this sample. To be eligible for participation in the current study, IDU were required to have injected on a minimum of a monthly basis for the previous six months, and therefore reflect a population of regular IDUs, who often inject on a more frequent basis than once per month. This restricted recruiting means that this study identifies risk only in relation to a defined sample who inject on a very regular basis. The result that needlestick exposure is significantly predicted by frequency of injecting is a logical result, given that it reflects a population who are quite enmeshed in injecting behaviour, and are therefore in more contact with needles and are around people who are injecting. Therefore, there are increased opportunities for accidental needlestick injuries. This result suggests that intervention strategies should focus on practical methods to reduce needlestick pricks, such as cleaning up injecting areas regularly, and in particular prior to injecting substances.

It was hypothesised that stability of accommodation would not be predictive of BBV risk behaviours (Hagan et al., 2001; Thomas et al., 1995; Villano et al., 1997), however this hypothesis was not supported. Unstable housing was found to be predictive of the overall risk of BBV behaviours and therefore indicates that those who are in unstable housing were at an elevated risk for contracting BBV. Unstable housing was also found to be predictive of elevated contamination opportunities though needle and syringe sharing as well as exposure opportunities through being injected by another person. Logically, this result makes sense in that one would assume that stable housing would allow a safer injecting environment, while unstable housing may require the IDU to inject in an environment which necessitates hurried injecting and which is less sterile (e.g. street based injecting, or injecting in another person's private house which may result in less control of the injecting environment).

For instance, Southgate et al. (2003) report that when an IDU is injecting in street environments, a pressure exists to inject quickly so as not to be seen by the police, members of the public, and other users therefore potentially leading to more injecting risks being taken.

The hypothesis that IDU with a prison history will increase one's risk of engaging in BBV risk behaviours (Crofts et al., 1993; Maher et al., 2004; Van Beek et al., 1998) was not supported. This variable was not a statistically significant predictor of any aspect of BBV transmission risk. It should be noted that this study assesses IDU who are not currently in prison and assesses their current engagement in risk behaviours. Therefore, due to these IDU being in the community rather than in prison where there is limited access to sterile injecting equipment, this sample theoretically has access to sterile injecting equipment and may be less likely to engage in risky injecting.

Level of education and treatment status were hypothesised to not be significant predictors of BBV risk, and indeed this was the case for the current study. Neither of these variables were found to be predictive of any of the five factors, nor the overall BBV-TRAQ-SV scale, thereby supporting previous findings that whether one is in treatment or not, or whether one has a greater number of years of formal education does not impact on the likelihood of taking risks when injecting.

Pharmacological Effects of Drug Use Variables

Previous literature has identified that a number of drug classes have been implicated in increasing one's risk for engaging in BBV risk behaviours, and as such it was hypothesised that benzodiazepine, amphetamine (including prescription stimulants), cannabis, MDMA, alcohol and opiate use would be positively associated

with BBV risk behaviours while cocaine and LSD would not produce significant relationships with BBV risk behaviours. Indeed, benzodiazepine use by intravenous means was positively associated with risk behaviours through sharing of needles and syringes, and benzodiazepine use generally was associated with the engagement in risk behaviours with other injecting equipment (e.g. sharing spoons, swabs etc). While this was so, benzodiazepine use was not associated with any of the other BBV risk factors, nor related to overall risk. Therefore, benzodiazepine use has a clear association with the engagement in some elements of risky injection practices however this association is not strong enough to be a predictor for overall risk. This finding provides additional support to previous research which finds that IDU who use benzodiazepines tend to be at a greater risk for sharing injecting equipment (e.g. Darke et al., 1992; Darke et al., 1993; Metzger et al., 1991), and is likely a reflection of the production of disinhibition and impulsivity by the drug (Yücel et al., 2007), which in turn affects decision making processes.

Conversely, amphetamine use was found to be a relatively strong predictor of risk of engaging in BBV transmission behaviours. This variable was found to be predictive of overall risk, such that more frequent use of amphetamines resulted in a higher likelihood in BBV risk and therefore supported the hypothesis. While this is so, amphetamine use was not associated with elevated risk on specific aspects of injecting including needle and syringe contamination, other equipment contamination, contamination from injecting others and being injected by others. In addition to frequency of amphetamine use predicting overall risk, more frequent use of prescription stimulants was also found to be predictive of BBV risk behaviours, however only in relation to needle and syringe sharing behaviours.

The hypothesis that cannabis use would be predictive of BBV risk behaviours was not supported, with the results of the current study indicating that higher frequency of cannabis use did not contribute to increased risk of BBV contamination by any method. This findings runs contrary to previous research (e.g. Lane, Cherek et al., 2005) which indicates a relationship between cannabis and risk-taking, however it is noted that in the research by Lane and colleagues (Lane, Cherek et al., 2005) this was based on acute administration of cannabis and was not related to a specific IDU population. A failure to identify a relationship between cannabis use and BBV risk behaviours may also be reflected by the fact that the study population has a generally high level of cannabis use. It was identified that 54.3% of participants reported a daily use of cannabis, and this restricted range in cannabis frequency of use may have compromised the ability to detect a relationship between cannabis use and BBV risk behaviours if indeed one exists.

Consistent with the hypotheses, the frequency of cocaine use and LSD use was found not to be predictive of any form of engagement in BBV transmission risk behaviours therefore suggesting that LSD and cocaine do not affect cognitive processes in the same way or to such an extent as other drug classes in relation to decision making and risk taking. This may be partially sample-dependent as there was a relatively low frequency of use of either of these drugs in the current sample (10% and 17% respectively reported any recent use of cocaine or hallucinogens), consistent with the availability of these drugs in the study context (de Graaff & Bruno, 2007; de Graaff & Bruno, 2008). As such, this finding may not generalise to contexts where cocaine availability is high.

MDMA use was hypothesised to be predictive of BBV risk behaviours, and this was partially supported by the finding that more regular use of MDMA was

associated with an increase in risk of being exposed to BBV through being injected by another person. This finding suggests that those IDU who are less regular injectors, and therefore those who are more often injected by others, also tend to be users of MDMA. This is supported by a significant inverse relationship between frequency of ecstasy use and duration of injecting in this sample ($r=-0.21$, $p<0.001$). While MDMA use was found to be related to risk of BBV transmission through being injected by others, the results also indicate that MDMA use was not associated with elevated risk of needle/syringe contamination, other equipment contamination, contamination through accidental needlestick injuries, or overall risk of engaging in BBV risk behaviours. Therefore, this result appears to generally run contrary to previous findings which note a relationship between MDMA use and risk-taking. However it is noted that previous studies report a relationship between MDMA and behaviours such as unprotected sexual intercourse (McElrath, 2005; Theall et al., 2006) and is not specific to risks taken through the process of injecting drugs. Moreover, the current study sampled an uncommon population of MDMA consumers, those that also inject (White et al., 2006) and as such, these individuals may be distinct from those participating in laboratory studies of risk-taking and/or exposed to multiple other pertinent pharmacological effects of substances (from, for example, amphetamines) which may obscure the specific effects of MDMA.

Alcohol was hypothesised to be predictive of BBV risk behaviours, and this hypothesis was indeed supported. The results indicate that alcohol was related to a general overall risk of engaging in BBV risk behaviours, and has therefore been identified as an important factor in determining those at increased risk for being more careless in the injecting process. This result may be due to acute effects, whereby injection episodes occur while under the influence of alcohol and coordination and

decision making processes are affected, or it also may be reflective of more generalised cognitive changes due to chronic use which affects decision making and in turn, engagement in risky behaviours. Given this finding, it is apparent that NSP workers should be aware that alcohol is a key predictor for BBV transmission risk and those who report frequent alcohol use will be IDU who may benefit from targeted interventions. In addition to alcohol being identified as a predictor for overall BBV risk, the results of the current study also indicate that the more frequently alcohol is consumed, the more likely one is to engage in behaviours that can lead to BBV contamination through injecting equipment such as spoons, waters, swabs, or tourniquets as well as through second-person situations such as when injecting others or being injected by others. Notably, there was no relationship between frequency of injection and frequency of alcohol use in this sample ($r=0.01$, $p=0.87$). Together, these findings indicates that experimental findings that alcohol is related to risky decision making (Lane et al., 2004) are likely to be able to be applied to the IDU population in relation to risk taking during injecting episodes.

More frequent opiate use was hypothesised to be a significant predictor for one's risk of engaging in BBV transmission risk behaviours however this hypothesis was not supported. No significant relationships were found between this variable and the factors of BBV transmission risk, aside from a significant, but inverse, relationship between exposure as a result of being injected by others, such that less frequent opiate use is associated with a greater risk of more careless practices when being injected by another person. This unexpected inverse relationship may indicate that those who regularly inject opiates are people who commonly inject themselves, and therefore, by definition, they won't be injected by others. Correlational analysis supports this, with a relationship between increased frequency of opioid use and self-

injection apparent (r=0.16, p=0.008), as well as between increased frequency of opioid use and a longer duration of injecting (r=0.23, p<0.001). The overall result of opiate use on BBV risk behaviours is obviously contrary to the hypothesis and suggests that in this context, the pharmacological effects of opiates do not impact on elevated risky injection practices (or that the increased injection experience of these participants has over-ridden any specific pharmacological affect of the drug in injection risk behaviour). This finding is consistent with recent laboratory based research which found that prescription opioids did not affect performance on a variety of measures of impulsivity after acute administration (Zacny & De Wit, 2009).

Injection Variables

It was hypothesised that having last injected in a public place would be associated with greater risks in the process of injection perhaps due to being more hurried to avoid detection by the public and police, as well as perhaps being due to difficulties in setting up a clean environment for injection preparation. This variable was not related to overall risk of BBV transmission behaviours. Similarly, having had the previous injection episode occur in a public location was not significantly related to contamination by needles and syringes as well as other injecting equipment, or contamination from injecting others. This variable approached statistical significance in being related to exposure when being injected by others, however was inversely associated with the variable of needlestick contamination, indicating that having the last injecting episode occur in public actually results in less likelihood of receiving an accidental needlestick from another person's used syringe. Therefore, the hypothesis that injecting in a public location results in greater BBV

transmission risk behaviours cannot be said to have been supported by the current study. It is noted however, that risk of contamination from being injected by another person was associated with unstable accommodation as well as approaching significance with last having injected in a public place (and that there was a significant association between last injecting in public and unstable accommodation, r=0.14, p=0.025). The relationship with these two variables suggests that being injected in public place and by another person may be a particularly risky scenario for opportunities for BBV transmission.

The variable of self-injection was hypothesised to be related to BBV transmission behaviours, specifically that the less one self-injects (and therefore is assisted to inject or is injected by someone else) then the greater the risk of contracting a BBV due to greater opportunities for transmission to occur. Indeed, this hypothesis was supported, with the results indicating that the less one self-injects the greater the risk of overall BBV transmission behaviours, as well as risk of needle and syringe contamination, contamination through other injecting equipment, and exposure from being injected by others. Therefore, having another person involved in the injection process is clearly a risk for transmission of BBVs and suggests that intervention efforts should focus on those IDU who don't always self inject. In addition, educating those IDU who inject others is an alternative method which is likely to prove effective also, by using this population to educate their peers on safer injecting practices. By contrast, it is noted that this variable did not predict contamination from needlestick. Also, this variable did not predict contamination from injecting others although this finding is logical given that if an IDU does not inject themselves, then they would be unlikely to inject others, and those who self-inject are not all going to also inject others.

Psychological Distress Variables

Based on the results of previous literature, it was hypothesised that increased levels of psychological distress would be related to the engagement in BBV risk behaviours during the injection process. The results revealed that both the anxiety and depression subscales of the K10 positively related to overall risk on the BBV-TRAQ-SV, as well as to the needle/syringe and other injecting equipment contamination factors, as well as exposure from being injected by others, and needlestick contamination factors. Consistent with previous literature (Johnson et al., 2002; Mandell et al., 1999; Reyes et al., 2007; Stein et al., 2003), these results support the notion that psychological distress predicts the likelihood that an IDU will engage in behaviours known to be associated with BBV transmission. This supports suggestions that psychological distress is a barrier between cognitive knowledge of injecting risks and behavioural change to reduce these risks (Kleinman et al., 1994; Stein et al., 2003). This supports the importance of treatment provision to reduce psychological distress among this population, as this will likely also have beneficial effects on reducing BBV transmission risk behaviour.

Impulsivity Variables

It was hypothesised that higher levels of reported impulsivity would be significantly associated with engagement in BBV risk behaviours. The results reveal that the 'novelty' of stimulation aspect of impulsivity (analogous to the 'reward sensitivity' factor) was associated with some aspects of engaging in BBV risk behaviours thereby partially supporting the hypothesis. Specifically, higher levels of 'novelty' impulsivity were associated with a higher risk of BBV risk behaviours,

specifically in regard to exposure through the process of being injected. Therefore, it would appear that the novelty (i.e. seeking out events that are novel for the purpose of experiencing the stimulation of a new event) of the stimulus is a relavent aspect of impulsivity when predicting those who are more likely to engage in BBV risk injecting behaviours. There was no relationship apparent between AISS novelty and years of injection career (r=0.10, p=0.13), frequency of injection (r=0.11, p=0.12) or injection by others (r=0.11, p=0.10). This suggests that this relationship is not simply relevant to new initiates (who may be less skilled in injection and more likely to be injected by others). This finding is therefore only partially consistent with Dawe and Loxton's (2004) model of impulsiveness who argue that novelty, or reward sensitivity, plays a role in cue-induced cravings and motivation to use drugs while rash-spontaneous impulsivity influences actual drug-taking behaviour and the difficulty to discontinue use even when negative consequences of drug use is recognised. The above findings suggest that novelty not only plays a role for new initiates to use drugs (as is suggested by the theoretical model), but for all IDUs and therefore suggests a role of novelty for ongoing use. The reasons for novelty also being important for ongoing injecting drug use is not easily explained by the two-factor model of impulsivity as presented by Dawe and Loxton (2004).

Impulsivity as measured by the BAS revealed that the 'drive' factor of impulsivity in this context was inversely related to risk, such that the lower one's 'drive' to persistently pursue desired goals, the higher the risk of engaging in needle and syringe contamination behaviours. The 'reward responsiveness' element of BAS which reflects positive responses to the occurrence or anticipation of rewards was positively related to needle and syringe contamination and contamination through injecting others, indicating that higher levels of reward responsiveness are associated

with a higher likelihood of engaging in behaviours likely to result in contamination through these methods. A significant negative relationship was also noted between the BAS concept of 'fun seeking', such that those who have a greater desire for new rewards and who have a willingness to seek these rewards on the spur of the moment have a lower risk of engaging in unsafe injecting practices with needles and syringes (e.g. reusing needles), a finding that runs contrary to the hypothesis. No other contamination routes were found to be significantly related to the BAS element of 'fun seeking'. Together, these demonstrate a complex association between facets of impulsiveness and risk behaviours. This is consistent with the increasing awareness of the complexity of impulsiveness as a construct (e.g. Dawe & Loxton, 2004; Evenden, 1999) and that simple, global, assessments of 'impulsiveness' may not prove fruitful for prediction of BBV transmission risk behaviours. As the magnitude of the relationships between facets of impulsiveness and BBV risk scores was statistically significant, but small magnitude (5% of shared variance or less), the more substantial associations with psychological distress, self injection and other demographic and drug use variables would be more practically relevant in prediction of BBV risk behaviours in a primary health setting.

Summary of Most Important Predictors of BBV Risk Behaviours

While some variables were noted to be positive predictors of some aspects of BBV risk behaviours, the variables most predictive of overall risk for engaging in behaviours known to be associated with BBV transmission were unstable accommodation, amphetamine use, alcohol use, fewer occasions of self-injection, higher symptoms of anxiety (K10), and individuals with a desire to seek out novel stimulation (AISS Novelty). Of these variables, the most important predictors are

increased anxiety symptoms and reduced episodes of self-injection (others involved in the injection process). Odds ratios suggest that those who do not always self inject are approximately four times more likely to engage in BBV risk behaviours, and those that have high levels of anxiety are approximately 1.2 times more likely (20% more likely) to engage in BBV risk behaviours than other regular injecting drug consumers in this sample. Those IDU that have these characteristics are therefore those who are at the greatest risk for engaging in behaviours known to increase risk of contamination while injecting, and therefore are those who are at the greatest risk of contracting BBVs and experiencing the health and psychosocial sequelae of this.

Implications of Research

The identification of these factors being the most important for predicting the engagement in BBV risk behaviours is practically useful as there is now a clear indication as to which IDU are at an increased risk of contracting a BBV, and thereby also as to where prevention efforts will be best directed for maximum impact to reduce BBV transmission amongst this population. As previously mentioned, current interventions are distributed to all accessible IDU regardless of their propensity to participate in risky episodes of injecting which carry more opportunities for the transmission of BBV.

The results presented here demonstrate that health and outreach workers who are involved with the IDU population should target individuals with the characteristics of unstable accommodation, amphetamine use, alcohol use, less occasions of self-injection, higher symptoms of anxiety, and an elevated desire to seek out novel stimulation, as these have been demonstrated to be more strongly associated with aspects of BBV risk transmission behaviours. Once these IDU are

identified as belonging to a risk group for risky injection practices, more intensive interventions are able to be directed to those who are most likely to benefit from such intervention.

In addition to the risk factors listed above, the results reviewed in the preceding paragraphs also indicate that one method for effectively delivering these interventions may be to target the peers of IDU. The finding that new initiates (those who are younger and have less injecting experience) are at an increased risk for engaging in BBV risk behaviours, including being injected by others, brings with it a logistical challenge for reaching these populations who may not be as enmeshed in the culture of injecting drug use, and thus less accessible to intervention efforts (i.e. will not be visiting NSP centres frequently or at all). Therefore, focussing on providing education messages about safe injecting to those IDU more available and experienced in injecting, and who are the individuals who assisting in, or injecting the new initiates, means that these education messages will be also provided to the population at most risk of practising unsafe injecting.

In addition to providing at risk IDU with education regarding methods of BBV transmission and possible health outcomes, health workers need also to regularly deliver messages of practical behaviours to reduce risk. This may involve encouraging self-injection where possible to reduce the risk of second person contamination, using clean and sterile needles and syringes, *in addition to* clean peripheral injecting equipment (e.g. spoons, swabs, waters, tourniquets), not touching other's injection sites, among other similar safety methods, including less commonly considered practical suggestions such as cleaning up injecting areas regularly and before injecting to reduce the risk of accidental needlestick. If such targeted prevention and education methods were effective, this would assist in reducing

overall incidence rates of BBV transmission amongst this population and associated health, economic, and social costs related to BBVs.

Indeed, research investigating the effects of using peers for harm reduction in IDU populations has indicated that this is an effective strategy. For instance, Broadhead et al. (1998) compared the efficacy of harm reduction strategies delivered in a traditional provider-client model (delivered by professional outreach workers) and peer-driven intervention. Peers were given guidance and structured incentives (small monetary rewards) to deliver the intervention. Results revealed that the peer-driven intervention outperformed the traditional intervention in terms of the number of IDUs recruited, the ethnic and geographic representativeness of the recruits, and the effectiveness of the BBV prevention education. The authors note that in addition to these benefits, the strategy was a more cost-effective method of intervention. Similarly, Latkin and colleages (Latkin, 1998; Latkin, Mandell, Vlahov, Oziemkowska, & Celentano, 1996) found that training peer leaders was effective in promoting safe injecting messages amongst IDU social networks, finding that when compared with controls, those involved in networks reported less needle sharing and sharing of cookers. The efficacy of using peer methods in addition to simple education methods is supported by research indicating that education alone is not a significant factor in reducing HIV risk behaviours, and that peer-directed interventions are required for successful outcomes (Madray & Van Hulst, 2000). Other research by Norman et al. (2008) also supports the use of peer-driven models in facilitating HCV treatment, and research by Gaston, Best, Manning, & Day (2009) indicates that these methods can also assist in facilitating the appropriate response to overdose in others. Taken together, these results suggest that using peers as educators

and role models is an effective strategy to effect change in IDUs, and would present as a feasible method to access new initiates to safer injecting drug use.

While the current study has demonstrated clear variables which affect risk-taking in injecting, it is worth noting that the variance explained by the multivariate models is moderate, and there remains much variance not accounted for by the variables analysed in the current study. This therefore suggest that while particular emphasis should be paid to those IDU fitting criteria known to be associated with a greater likelihood of engaging in BBV risk behaviours while injecting, intervention efforts should continue to be provided to all accessible IDU as it is apparent that there are further risk factors that are unknown at this time as well as situational complexities which are not able to be modelled statistically.

Methodological Considerations

It should be noted that while the current research is invaluable in identifying those IDU at greatest risk for engaging in risky injection episodes there are some methodological aspects which do require consideration. The first of these is that this study has been conducted with an IDU population which is specific to Tasmania and therefore these results may not be extrapolated to other populations around Australia or internationally. For instance, in relation to Australian IDU populations, it is known that the Tasmanian IDU differs from the other states in regards to patterns of drug use. Tasmania typically has lower heroin and cocaine use than other states, and higher use of morphine, and currently has the highest use of benzodiazepines in Australia (Stafford et al., 2009). The current study also only examines IDU populations in larger cities in Tasmania, and the results cannot be necessarily extrapolated to those in rural areas.

The second point which bears consideration in relation to the current study is that the data obtained by the Tasmanian IDU population is of a self-report nature, and is therefore subject to difficulties in verification that the data obtained is an accurate report of drug use and risks pertaining to this. Self-report data can be affected by one's ability to accurately recall information (Del Boca & Noll, 2000), which in this population may be additionally affected by cortical damage due to drug use itself (Del Boca & Noll, 2000). Furthermore, self-report data may be affected by respondent characteristics, such as personality characteristics, social desirability and need for approval, cognitive impairment/function, attitudes and beliefs, psychological state (e.g. anxiety, depression), physical condition (e.g. fatigue, intoxication, withdrawal), and motivation to participate (Del Boca & Noll, 2000).

While the difficulties associated with using self-report data should be noted, it should also be considered that studies of this nature are bound to use this method of data collection only, as alternative methods (e.g. experimental designs which under laboratory conditions administer placebos or drug substances to participants, or observe injecting episodes) have obvious ethical constraints due to the illicit nature of these drugs and therefore are impractical to use. While these factors should be noted, research by Darke (1998) has examined the reliability and validity of self-reported drug use and HIV risk-taking among injecting drug users and used external validation procedures (biomarkers and collateral interviews) to determine reliability and validity of this data type amongst this population. Darke concludes that while inconsistencies do occur, self-report data amongst this population is sufficiently valid for research purposes and for gaining a relatively accurate understanding of drug use and risk-behaviours. To further maximise the validity of the data provided in the current study, all interviewers were trained to interview with this population and are

instructed on how best to verify information to maximise the possibility that responses are accurate.

Conclusions

The results of the current study have provided valuable information to assist in the reduction of the spread of BBV such as HCV, HBV, and HIV in Australia and potentially overseas. The research has utilised strong methodological processes with a large sample of Tasmanian IDU to reveal those IDU who are most likely to engage in behaviours such as the sharing of needles/syringes and injection equipment and other risky injecting behaviours that have an elevated risk of facilitating the transmission of BBVs. Those IDU at greatest risk have now been identified as those who have less occasions of self-injecting, greater symptoms of anxiety, are in unstable accommodation, have more frequent levels of amphetamine and alcohol use, or a propensity to seek out new situations for novel stimulation. The most important of these variables has been revealed to be reduced anxiety and less occasions of self-injecting. The incidence rates of BBVs in Australia and worldwide, particularly HCV incidence rates are astounding and are known to be primarily transmitted by injecting practices amongst the IDU population. Having this additional knowledge as to those IDU who are at increased risk for contributing to these high incidence rates will enable prevention efforts to be targeted to these individuals, hopefully assisting in reducing the overall spread of these viruses amongst the IDU population.

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Appendix A: BBV-TRAQ-SV

Section A – Needle & Syringe Contamination

1a In the last month, how many times have you injected with another person's used needle/syringe?

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

↓

(Go to question 2)

1b On those occasions, how often did you rinse it with a combination of full-strength bleach and water (i.e, the '2x2x2' method) before you used it?

Never | Rarely | Sometimes | Often | Every time

2 *In the last month, how many times have you injected with a needle/syringe after another person has already injected some of its contents?*

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

2a* How many different people have used a needle before you in the last month?

None | One person | Two People | 3-5 People | 6-10 People | More than 10 people

↓

(Go to question 3)

2b* Who were these people? *(can pick more than one)*

Regular sex partner | Casual sex partner | Close friends | Acquaintance | Other (specify):

3 In the last month, how many times have you received an accidental needle-stick/prick from another person's used needle/syringe?

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

4a *In the last month, how many times have you re-used a needle/syringe taken out of a shared disposal/sharps container?*

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

↓

(Go to question 5)

4b On those occasions, how often did you rinse it only with full-strength bleach before you re-used it?

Never | Rarely | Sometimes | Often | Every time

Section B – Other Injecting Equipment Sharing

5 In the last month, how many times have you injected a drug that was filtered through another person's filter?

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

6a In the last month, how many times have you injected a drug that was prepared in another person's used spoon or mixing container?

No times	Once	Twice	3-5 times	6-10 times	More than 10 times

↓

(Go to question 7)

6b On those occasions, how often did you clean the spoon or mixing container before using it?

Never	Rarely	Sometimes	Often	Every time

7 In the last month, how many times have you injected a drug prepared with water which had been used by another person?

No times	Once	Twice	3-5 times	6-10 times	More than 10 times

8 In the last month, how many times have you injected a drug which had come into contact with another person's used needle/syringe?

No times	Once	Twice	3-5 times	6-10 times	More than 10 times

9 In the last month, how many times have you wiped your own injection site with an object (e.g, swab, tissue, hanky, towel etc) which had been used by another person?

No times	Once	Twice	3-5 times	6-10 times	More than 10 times

9i* In the last month, how many times have you used another person's tourniquet?

No times	Once	Twice	3-5 times	6-10 times	More than 10 times

Section C – Second Person Contamination

Ca *In the last month, how many times has someone used a needle after you have used it?*

No times	Once	Twice	3-5 times	6-10 times	More than 10 times

10a *In the last month, how many times have you injected a drug that you prepared immediately after 'assisting' another person with their injection (e.g, injecting them, holding their arm, handling used needle/syringe; touching their injection site to feel for a vein, to wipe blood away, or to stop bleeding)?*

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

↓

(Go to question 11)

10b On those occasions, how often did you wash your hands before preparing your mix?

Never | Rarely | Sometimes | Often | Every time

11a *In the last month, how many times have you injected a drug that was prepared by another person who had already injected or assisted someone else's injection?*

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

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(Go to question 12)

11b On those occasions, how often did the person preparing the mix wash their hands before preparing the mix?

Never | Rarely | Sometimes | Often | Every time

12a In the last month, how many times have you been injected by another person who had already injected or assisted in someone else's injection?

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

(Go to question 13)

12b On those occasions, how often did the person injecting you wash their hands before injecting you?

Never | Rarely | Sometimes | Often | Every time

13a In the last month, how many times have you injected with a needle/syringe which had been handled or touched by another person who had already injected?

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

(Go to question 14)

13b On those occasions, how often did they wash their hands prior to handling the needle/syringe that you used?

Never | Rarely | Sometimes | Often | Every time

14a In the last month, how many times have you touched your own injection site (e.g, to feel for a vein, to wipe away blood, or to stop bleeding) soon after 'assisting' another person with their injection (e.g, injecting them, holding their arm, handling their use needle/syringe; touching their injection site to feel for a vein, to wipe away blood, or to stop bleeding)?

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

14b On those occasions, how often did you wash your hands before touching your own injection site?

Never | Rarely | Sometimes | Often | Every time

15a In the last month, how many times has another person touched your injection site (e.g, to feel for a vein, to wipe away blood, or to stop bleeding)?

No times | Once | Twice | 3-5 times | 6-10 times | More than 10 times

↓

(completed survey)

15b On those occasions, how often did the person wash their hands before they touched your injection site?

Never | Rarely | Sometimes | Often | Every time