

Transitions in the route of cocaine administration – characteristics, direction and associated variables.

Cocaine transitions

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Abstract

Aims. To examine transitions in the route of administration of cocaine and the variables associated with them. **Design.** A cross-sectional study undertaken between January 1996 and October 1997. **Setting.** Fifteen different services that offer treatment, counselling or assistance to drug users or HIV positive patients in the State of São Paulo, Brazil. **Participants.** 294 current or ex-cocaine and crack cocaine users. **Measurements.** A structured interview schedule was developed consisting of 246 questions covering sociodemographic details, drug history, cocaine transitions and HIV-risk behaviours. **Findings.** 87% of patients began using cocaine by snorting but 74% subsequently underwent a transition of route - 68% towards smoking and 20% to injecting. Half of all transitions occurred in the first three years following initiation into cocaine use. Factors associated with transitions were: younger age at cocaine initiation, more frequent use at peak usage, starting to use cocaine by snorting or injecting, a lower level of scholastic attainment and experience with a wider range of drug classes. A cohort effect was apparent with younger cocaine users and those who had begun using after 1990 being more likely to undergo a transition to smoking crack and less likely to start injecting. **Conclusions.** Cocaine transitions are very common and are usually towards routes associated with a higher dependency potential and increased HIV-risk behaviour. Further research is needed to see if transitions can be prevented by early identification of potential cases.

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Introduction

Transitions in the route of administration of a drug refer to a phenomenon whereby a person, who begins using a substance by one particular route, subsequently substitutes that route for another; thereafter this new route is used in preference to the previous one. Transitions have been described with heroin (Des Jaralis et al, 1992; Griffiths et al, 1992; Griffiths et al, 1994; Strang et al, 1997; De la Fuente et al, 1997), amphetamines (Darke et al, 1994) and benzodiazepines (Ross et al, 1997). With cocaine, transitions have only been studied when they have been towards injecting (Irwin et al, 1996).

Transitions have been the focus of study for two main reasons, first because transitions tend to be towards routes that have a higher dependency potential and second because the new routes are often associated with an increase in HIV-risk behaviours (Strang et al, 1992; Des Jarlais et al, 1992; Edlin et al, 1994; Irwin et al, 1996). Several studies have investigated factors that are related to transitions in the route of drug administration (Des Jarlais et al, 1992; Griffiths et al, 1992; Darke et al, 1994; van Ameijden et al, 1994). Among cocaine users one study has looked at this question but only in relation to crack smokers turning to drug injection (Irwin et al, 1996). Irwin et al's study does not look at other types of transition, e.g. smoking to snorting or snorting to injecting and is also complicated by the fact that many of the cocaine users were also current or past heroin users, factors that were strongly associated with undergoing a transition.

Cocaine hydrochloride is widely available in Brazil and is relatively cheap (Dunn and Ferri, 1998). Brazilian studies from the 1980s suggest that among treatment populations, the drug was either being snorted or injected (Lima et al, 1992), but in the early 1990s crack became available and the number of cocaine smokers presenting to services increased

dramatically (Dunn et al, 1996). Heroin has a very limited availability in Brazil and very few cocaine users report having used it. The aim of this study was to examine transitions in the route of administration of cocaine, the variables associated with them and to see what effect, if any, the arrival of crack had upon the transition process.

Methods

Setting

A cross-sectional design was used with patients interviewed between January 1996 and October 1997. Patients came from 15 different settings that offer treatment, counselling or assistance to drug users or HIV-positive patients. The characteristics of the services (and the percentage interviewed in each) are as follows: two public outpatient clinics for drug users (30%), two public inpatient units for drug users (27%), a social worker-based drug counselling service linked to the Police Department (14%), a private drug rehabilitation unit (2%), a municipal clinic for homeless drug users (2%), two public outpatient clinics for patients with HIV disease (16%), and six residential homes or hospices for people with HIV (9%). All services are situated in the State of São Paulo, the majority in the City of São Paulo itself.

Sampling

Although this sample is essentially a convenience sample, we deliberately chose a wide range of services with diverse characteristics to maximise the heterogeneity of patient profiles and patterns of cocaine use. Outpatient clinics and a non-medical counselling service were over sampled in relation to inpatient units so as to give greater representation of subjects from the less severe end of the drug misuse continuum. Patients were also sampled from a private residential rehabilitation unit as well as one specialising in the treatment of homeless drug users, thus giving representation from both extremes of the socio-economic spectrum. A fifth of patients were interviewed in clinics, hospices or hostels for people with HIV disease, as this group is under represented in drug treatment services in Brazil, even though 40% or

more of injecting drug users are estimated to be HIV-positive (WHO Collaborative Study Group, 1993). This strategy seemed to be valid as there were statistically significant differences between the samples obtained at each site in terms of sex ratio ($X^2=27$, d.f.=8, $p<0.001$), age (ANOVA, $F= 11.2$, $p<0.0001$), marital status ($X^2=42.1$, d.f.=16, $p<0.001$) and employment status ($X^2=27.4$, d.f.=8, $p<0.001$).

Procedures

Patients were included in the study if they admitted to having used cocaine or crack more than once in their lives. Only six patients refused to participate, claiming pressure of time and a further three had to be excluded as they were too heavily sedated. Evaluation of the cognitive state of the subjects was left to the clinical experience of each interviewer. A total of 294 patients were interviewed.

An attempt was made to systematically interview all patients who fitted the inclusion criteria on the day on which each service was visited. Usually all patients could be interviewed but on occasions this was not possible, in which case patients were selected according to the order in which their names appeared on the inpatient lists or the order in which they presented to the outpatient clinics.

Interviews were conducted by three researchers, the majority ($n=262$, 89%) by the first author (J.D.) and the rest by a psychiatrist and a psychologist, both with clinical experience in the drug misuse field, who had been trained to use the interview schedule. Training consisted of observing the first author (J.D.) perform five interviews and then being observed by the same for a further five. Subsequent interviews were intermittently observed to try to maintain a high level of consistency. The inter-rater reliability of the instrument has not yet been measured. Subjects gave verbal consent to maintain anonymity. All patients were guaranteed that any information given would be treated confidentially and would not be shown to others, including those working in the service where the patient was being treated. We were frequently surprised by the willingness of subjects to offer additional information on sensitive

issues, such as criminal activity and sexual behaviour. No patient refused to answer any of the questions or dropped out before completing the interview. Patients were reassured that non-participation in the study would not affect their treatment in any way. Interviews were conducted in private in a room away from other patients and staff. The project was approved by the ethics committee and also by the director of each service that participated in the study.

A structured interview schedule in Portuguese had been especially designed for use in this study and had been extensively piloted beforehand, using methods described by Oppenheim (1992). The interview consists of 246 questions. The areas that the interview covers are: sociodemographic details, drug history, initiation into cocaine use, transitions in the route of cocaine administration, pattern of cocaine use during peak usage, recent use, injecting history, criminal history, treatment experience, cocaine overdose, drug use by other family members and HIV-risk behaviour. Responses to question were dichotomous, multiple choice or numeric in format. There were only 8 open questions for which verbatim responses were recorded. As several questions have a screening function so that the time taken to apply the instrument varies between 30 and 50 minutes. HIV testing was not carried out but results of previous tests were recorded and where possible checked in the case notes.

A transition in the route of administration of cocaine was defined using the operational criteria of Griffiths et al. (1994), as a change in the exclusive or predominant route of administration lasting one month or more.

Subjects

Two hundred and ninety-four patients were interviewed. Ninety percent ($n = 265$) were men and 10% ($n = 29$) women. The mean age at interview was 27.1 years (S.D.= 7.8 yrs., range = 10 – 49 yrs.). Sixty-two percent ($n= 183$) were single, 24% ($n = 71$) married or co-habiting and 14% ($n = 40$) separated, divorced or widowed. Fifty-eight percent of patients ($n = 169$) were born in São Paulo City itself, 22% ($n = 64$) outside the city but within the State of São Paulo and 20% ($n = 60$) in other States (only one person had been born in another

country). Thirty-seven percent (n = 105) were working at the time of interview, 46% (n = 135) unemployed, 14% (n = 40) on sick-leave or retired on the grounds of ill-health, and the remainder (5%, n = 14) were students or full-time housewives. In terms of education only 1% (n = 3) had had no schooling whatsoever, 61% (n = 180) had only gone to primary school, 28% (n = 81) to secondary school and 10% (n = 30) to university. Monthly legitimate income, i.e. income from non-illegal activities, was calculated in terms of the number of minimum wages earned in the last month or, for hospitalised patients, during the month prior to hospitalisation. At the time of study the minimum wage was R\$114 (U\$114) per month. Thirty-four percent (n = 101) of interviewees earned less than one minimum wage per month, 27% (n = 78) between 1 and 3 minimum wages, 19% (n = 54) between 3 and 5 and 21% (n = 61) more than 5.

Statistical Analysis

A data bank was created using SPSS (Statistical Package for Social Scientists) for Windows, version 6.0.1. To compare normally distributed variables with equal variances, the Student t-test, 95% confidence intervals and one way analyses of variance were used. Parametric but skewed data were transformed: *duration of cocaine use* underwent a square root transformation whilst *age at first cocaine use* and *age at interview* underwent \log_{10} transformations. Transformed data were then analysed using parametric tests unless the variances between groups were unequal. To compare the relative frequency of categorical variables the X^2 test was used and odds ratios calculated where appropriate. Trends between three or more groups were analysed in one of three ways: one way ANOVA for linear trends for parametric data with equal variances; Cuzick's method (Cuzick, 19985), based around the Kruskal-Wallis test, for parametric data in which the variances between subgroups were unequal; and the Mantel-Haenszel test for linear association for categorical data. Multiple logistic regression analyses was performed to identify variables associated with transitions. A

Kaplan-Meier survival analysis was used to investigate the occurrence of transitions over time.

Results

History of Drug Use

The licit and illicit drug history of patients is summarised in Table 1. As this was a sample of cocaine users all patients had used this drug. Polydrug use was the norm with patients having experimented with a mean of 4.7 different classes of drugs in addition to cocaine, most commonly tobacco, alcohol, cannabis, solvents and tranquillisers. Apart from the drugs mentioned in Table 1, several other substances had been taken, including: anticholinergics (30%), LSD (17%), a hallucinogenic tea known as “chá de lírio” (15%), psychedelic mushrooms (13%) and opiates (3%). Only three patients reported having used heroin and only two of these had bought it in Brazil.

TABLE 1

Cocaine Using Careers

The duration of cocaine use was calculated from age at first cocaine use to age at last use. The data were markedly and positively skewed with a median of 6.3 years (interquartile range: 3.4 to 10.9 years). Patients were asked to identify a period in their lives when their cocaine use had been heaviest, for 59% (n = 173) this had occurred with crack, 23% (n = 68) with snorted cocaine and 18% (n = 53) with injected cocaine. Sixty-three percent (n = 173) of patients stated that they had been using cocaine on a daily basis during this period (71% of crack smokers, 66% of injectors and 40% of snorters). There was a trend for frequency of cocaine use to increase from snorting, to injecting through to smoking (Mantel-Haenszel test for linear association, $X^2 = 15.6$, d.f. =1, $p < 0.0001$). There was also a trend for those who smoked crack at their peak usage to have been involved in acquisitive crime or drug trafficking, compared to those who had been injecting or snorting cocaine (Mantel-Haenszel test for linear association, $X^2 = 21.9$, $p < 0.0001$). On “heavier” days, crack users consumed a

median of 10 rocks (range: 1 to 60, approximately 0.5 to 30g), whilst cocaine snorters used a median of 5g per day (range 0.5 to 25 g) and injectors also 5g per day (range: 0.5 to 30g). Sixty-three percent of patients said that they had binged on cocaine with binges lasting a median of 3 days, during which the drug would be consumed continuously without the user stopping to either eat or sleep.

Initial Routes of Cocaine Administration

Eighty-seven percent (n = 255) of patients had first used cocaine by snorting, 7% (n = 21) by smoking and 6% (n = 18) by injecting. The mean age at cocaine initiation was 18.9 years (S.D.= 5.6, range 7 - 46). At the time of interview, initial cocaine injectors tended to be older (mean age = 33.7yrs, S.D.=6.6) than initial cocaine snorters (26.9yrs, S.D.= 7.5) who in turn were older than initial crack smokers (24.3yrs, S.D.= 9.5) - Kruskal-Wallis ANOVA, $X^2 = 16.4$, d.f.= 2, $p < 0.001$. However, there was no statistically significant difference in age at cocaine initiation between the different initial administration groups (Kruskal-Wallis ANOVA, $X^2 = 2.4$, d.f.= 2, $p = 0.3$). Initial crack smokers had the shortest median duration of cocaine use (3.1yrs, S.D.= 2.2), injectors the longest (12.0yrs, S.D.=5.4) and snorters an intermediate value (7.7yrs, S.D.= 5.3) - Kruskal-Wallis ANOVA, $X^2 = 31.7$, d.f.= 2, $p < 0.0001$. Initial crack smokers had experimented with fewer classes of drugs (mean = 3.1, S.D.= 1.3) than either initial cocaine snorters (4.8, S.D.= 1.8) or injectors (5.7, SD= 2.1) - Kruskal-Wallis ANOVA $X^2 = 20.6$, d.f.= 2, $p = 0.0001$. There was no evidence that any of the three groups had begun using licit or illicit substances (cigarettes, alcohol, solvents or cannabis) at an earlier age. Neither was there evidence that any of them had had a more accelerated passage from licit substance use to cocaine use.

Transitions

Transitions in the routes of administration of cocaine from initial use to most recent use are shown in Figure 1. This figure maps out in detail the cocaine using pathways along which our sample proceeded with three principal milestones: initial route, experimentation not

leading to a transition and transitions. Data are presented in two ways, first by initial route of administration (snorting, smoking and injecting) and second by number of transitions (none, one, two and multiple).

FIGURE 1

Overall, 74% (n = 218) of patients underwent at least one transition with 55% (n = 163) undergoing just the one, 17% (n = 49) two and 2% (n = 6) three. There were 279 individual transitions, 68% (n = 189) of which were towards smoking crack, 20% (n = 56) to injecting and 12% (n = 34) to snorting.

With the three principal routes of cocaine administration, one can identify 6 possible transition permutations. Of the 279 individual transitions, the frequencies of these permutations were as follows: snorting to smoking 55%, snorting to injecting 20%, injecting to smoking 13%, injecting to snorting 6%, smoking to snorting 6% and smoking to injecting 0%. Of users who underwent a transition from injecting cocaine to smoking crack, only a minority cited lack of venous access as the principal reason (11%), more common explanations included preoccupations with health (30%) and a preference for crack (32%). Likewise among injectors who turned to snorting, lack of venous access was cited by only 20%.

Eight percent (n = 23) of all transitions were reverse transitions back to a previous route of administration, with 87% (n = 20) occurring among initial cocaine snorters who returned to snorting after a period of injecting or smoking.

The median time interval from initiation into cocaine use to first transition was 24 months (interquartile range: 12 – 60 months). As the initial cocaine snorters formed the largest group, we decided to investigate further the time interval to first transition. The median interval from snorting to injecting cocaine (n = 55) was 12 months (interquartile range: 5 – 48) and from snorting to smoking crack (n = 142) 24 months (interquartile range: 12 – 60). This difference was statistically significant (Mann Whitney U test, $p > 0.002$).

For patients who underwent a second transition (n = 55), the median time interval from first to second transition was 44 months (interquartile range: 18 – 84), which was significantly longer than the interval to first transition (Mann Whitney U test, p <0.04).

Transition versus Non-Transition

To investigate the variables associated with transitions in greater detail, we dichotomised the sample into those who had undergone at least one transition (n= 218) and those who had not undergone any (n= 76). There was no difference in age at interview between the transition and non-transition group (difference between transformed means = -0.01, 95% C.I.= -0.05 to 0.025) or in the proportion of men and women who underwent a transition (75% vs 79%, $X^2 = 0.45$, d.f.= 1, p >0.5). Transitions were associated with a longer duration of cocaine use, a younger age at cocaine initiation, starting to use cocaine by snorting or injecting, experimentation with a wider range of drug classes and more frequent cocaine use at peak usage (Table 2). Patients who had undergone a transition were also more likely to know someone who was HIV positive (77% vs 61%, $X^2 = 6.0$, d.f. = 1, p <0.02) and to have had an HIV test (78% vs 66%, $X^2 = 4.9$, d.f. = 1, p <0.03).

TABLE 2

The non-transition group can be subdivided into those who had only ever used the one route (n = 49, 17%) and those who had experimented with other routes without undergoing a transition (n = 27, 9%). These subgroups were nominated *stable cocaine users* and *stable cocaine experimenters*, respectively. Likewise the transition group can be subdivided into those who only underwent just the one transition (n = 163, 55%) and those who underwent two or more (n = 55, 19%). These subgroups were nominated the *single* and *multiple transition groups*. We hypothesised that these four groups represented progressive states in terms of cocaine involvement. Therefore, we investigated the variables that had been found to be associated with transitions in the dichotomous analyses above using statistical tests for

trends across the four subgroups. Trends were found for four of the variables studied - the results of these analyses are shown in Table 3.

TABLE 3

Cohort Effect

Since crack arrived in São Paulo in the late 1980s, one might expect there to have been a cohort effect with younger cocaine users being more likely to undergo a transition to smoking than older ones. This was examined by looking at patients who initiated their cocaine use before or after 1990, the year from which crack use began to increase. There was no difference in the proportion of patients undergoing a transition before or after 1990 (53% and 57%, respectively $X^2 = 3.2$, d.f. = 1, $p > 0.10$), however, the direction of the transitions was different. Forty-two percent of transitions to smoking occurred in cocaine users who had begun using before 1990 compared to 58% after this date; the corresponding figures for transitions to injecting were 82% and 18% and to snorting 54% and 46% ($X^2 = 24.4$, d.f. = 2, $p < 0.0001$).

Similarly, using median age at interview (25.7 years) to dichotomise the data, there was no difference in the proportion of patients undergoing a transition who were above or below this age (49% and 51%, $X^2 = 1.3$, d.f. = 1, $p > 0.26$). However, 62% of transitions to smoking occurred among patients below the median age compared to 38% above it. The corresponding figures for those undergoing transitions to injecting and snorting, below and above the median age, are 20% vs 80% and 46% vs 54%, respectively ($X^2 = 28.0$, d.f. = 2, $p < 0.0001$).

Logistic Regression Analysis

Multiple logistic regression analyses was performed to investigate the variables associated with cocaine transitions. Forward stepwise regression was used. Three initial models were tested before developing a final model. The initial models (and the variables entered into the analyses) were as follows: (i) sociodemographic (age, sex, level of schooling and marital status), (ii) transition antecedents (number of drug classes used, age at cocaine

initiation and initial route of cocaine administration) and (iii) transition associated variables (duration of cocaine use, criminal involvement and frequency of cocaine use at peak). The variables that were statistically significant ($p < 0.05$), and whose odds ratios did not include unity, were then entered into the final model. Only five variables were retained in the final regression equation, which are shown in Table 4. This equation was significant ($X^2 = 67.3$, d.f. = 6, $p < 0.0001$) and had a good fit. The regression analysis shows that transitions were associated with an earlier onset of cocaine use, snorting or injecting as the initial routes of cocaine administration, a lower level of schooling, more frequent cocaine use at peak usage and having used a wider range of drug classes.

TABLE 4

Survival Analysis

A Kaplan-Meier survival analysis was performed using first transition as the outcome event. Time to first transition was calculated as the difference between age at first cocaine use and age at first transition. For patients who did not undergo a transition, the data were censored at the date on which the interview occurred, for current cocaine users, or age at last cocaine use, for those who were currently abstinent from cocaine. The survival analysis was only performed for initial cocaine snorters as they represented the single largest group of patients ($n = 255$). The mean survival time was 5.7 years (95% C.I. = 4.8 – 6.6) whilst the median was 3 years (95% C.I. = 2.3 – 3.7). Table 5 summarises the probability of surviving without a transition during the first 10 years following initiation into cocaine snorting.

TABLE 5

Discussion

This is the first study that has examined in detail, both from a descriptive and analytical point of view, transitions in the route of administration of cocaine. The major findings are that among cocaine users in contact with treatment services, transitions are extremely common, being reported by over seventy percent of patients. The most common

transition is towards smoking crack (68%) followed by to injecting cocaine (20%). Half of all transitions occur in the first three years following initiation into cocaine use. Factors associated with transitions are younger age at initiation into cocaine use, more frequent use at peak usage, starting to use cocaine by snorting or injecting, having a lower level of scholastic attainment and experience of a wider range of drug classes. A cohort effect was apparent with younger cocaine users and those who had begun using after 1990 being more likely to undergo transitions to smoking crack and less likely to start injecting.

The main limitation of this study is that the sample is essentially a convenience sample and, therefore, the results cannot be generalised to the whole population of cocaine users. However, we tried to obtain a more heterogeneous sample by interviewing patients in 15 different settings with markedly different characteristics. Indeed 17% of our patients (all from HIV treatment agencies) had never had any contact with a drug treatment service. Other researchers working in this area have tried to make their samples more representative by including patients not in contact with treatment services (Des Jarlais et al, 1992; Griffiths et al, 1994; Darke et al, 1994; Irwin et al, 1996). Due to financial restrictions and time constraints, we were unable to collect data from this population. Had we done so, it seems likely that there would have been a greater proportion of patients not undergoing transitions. Future research into cocaine transitions should be undertaken with a larger community based sample, using sampling methods similar to those employed by Griffiths et al (1994).

As this was a cross-sectional study, a causal relationship to the variables found to be associated with transitions cannot be assumed. Some of these, such as frequency of cocaine use, could have occurred concomitantly or even following a transition; though others clearly happened before this event, e.g. age at initiation into cocaine use and initial route of administration. The most appropriate way to investigate risk factors for transitions would be to undertake a cohort study of new initiates into cocaine use. However, a cross-sectional study, such as this, gives an indication of the kind of variables that should be investigated.

Recall bias must also be addressed as subjects were being asked to remember the sequence and timing of events that had often happened several years earlier. To improve recall patients were asked to associate drug transitions with significant events in their lives, for example marriage, unemployment, migration and HIV seroconversion. The interviews were conducted in private and in an unhurried manner, so as not to lead to patient distraction or anxiety. Also patients were excluded if they appeared to be under the influence of drugs, including those used in the detoxification process. However, it is possible that events were not always remembered with complete accuracy, although research suggests that drug users generally give truthful and accurate information (Hubbard et al, 1984).

Transitions in the route of cocaine administration were found in 74% of our patients, which compares with 39% of a sample of 408 heroin users from London, U.K. (Griffiths et al, 1994) and around 40% of 301 regular amphetamine users from Sydney, Australia (Darke et al, 1994). Both of these studies included patients that were not in contact with treatment services, which may account for some of the observed difference. In Griffiths et al's study, the most frequent transition was from smoking heroin to injecting it (65%) followed by injecting to chasing (19%), whilst among Darke et al's amphetamine users, transitions to injecting were the most common followed by injecting to either snorting or swallowing. Smoking amphetamines was very rare in the latter sample, only 1% began by using this route and it does not seem to have featured as a route of transition. In our study the two most common transitions were from snorting to smoking (55%) and snorting to injecting (20%). These differences in the direction of transitions between cocaine, heroin and amphetamine users can in part be explained by the different preferred initial routes of administration. Heroin users in London tended to start by chasing the dragon (59%) whilst amphetamine users from Sydney usually began by snorting (58%). Our cocaine users usually started by snorting (87%) as did the majority (60%) of a sample of 150 cocaine users from London interviewed in 1991 (Gossop et al, 1994). A study from New York in 1987 (Kleinman, 1990) reported that 82% of

cocaine users began by snorting whilst a more recent study from Miami put the figure at 96% (Pottieger et al, 1992).

In our regression analysis we found that transitions were associated with younger age at cocaine initiation, starting to use the drug by snorting or injecting, a lower level of scholastic attainment, more frequent cocaine use at peak usage and experience with a wider range of drug classes. In a logistic regression, Darke et al (1994) found that amphetamine transitions were associated with length of amphetamine using career, polydrug use, severity of dependence, lower social functioning and more frequent amphetamine use. Only male gender predicted transitions in heroin use in the regression analysis performed by Griffiths et al (1994). Three studies have looked at the specific transition to injecting, one among heroin snorters (Des Jarlais et al, 1992), another among cocaine smokers (Irwin et al, 1996) and the third among a mixed sample of heroin and cocaine users (van Ameijden, 1994). Similar factors were found in each study, including having a close relationship with an injecting drug user, past experience with drug injecting and past treatment experience. In Irwin et al's (1996) study, a transition from crack smoking to injecting was associated with ever having snorted heroin and with snorting heroin at the same time as smoking crack. In Des Jarlais et al's (1992) study of heroin snorters, subsequent injecting was related to having used cocaine and heroin together.

The question as to why transitions occur cannot be answered by a cross-sectional study. Three prospective follow-up studies have investigated this question in more detail (Des Jarlais et al, 1992; van Ameijden et al, 1994; Irwin et al, 1996). All studies aimed at identifying factors associated with subsequent drug injection and consistent findings were reported. Drug injection was related to more intense drug use prior to the transition, concomitant use of other substances and having a close relationship with an intravenous drug user. However, none of these studies looked at other transitions, such as snorting to smoking or injecting to smoking. Our findings give some indication that there may be a kind of "dose

response”, with the categories *stable cocaine users*, *stable cocaine experimenters*, *single transitions* and *multiple transitions* being progressively associated with an earlier age at cocaine initiation, a wider range of experience with other drug classes, more frequent cocaine use and a longer duration of use. The pharmacological properties of cocaine and the patterns of use are unlikely to be the only factors that play a role in the transition equation. The relative price of cocaine powder and crack, the availability and reliability of supplies and the perceived risks associated with particular routes (e.g. risk of HIV infection among injecting drug users) may also be important (Dunn and Ferri, 1998).

None of our patients reported undergoing a direct transition from smoking to injecting cocaine; this despite the fact that 82% had smoked cocaine and 32% had injected it. In Griffith et al’s (1994) study of heroin users, smoking to injecting was the most frequent individual transition. It has been suggested that chasing the dragon is a difficult procedure, requiring a fair degree of skill (Strang et al, 1997). The drug is usually placed on tin-foil, heated with a lighter and the ascending plume of smoke is “chased” with a hollow tube and inhaled. With this method it is easy for the user to lose a substantial amount of the drug into the environment. Hence, the more dependent user may find injecting heroin a more efficient method of administration. In Brazil, crack is usually smoked in a home-made pipe. The pipe often consists of a yoghurt pot perforated with the casing of a ballpoint pen. The opening of the pot is completely covered with aluminium foil that has been repeatedly perforated. The rock of crack is then placed on top of the foil and heated directly with a lighter. Patients report that crack fumes descend and pass through the perforations in the foil into the yoghurt pot, where they are inhaled. Anecdotally, it appears that smoking crack does not require much skill and that very little of the drug is lost. Consequently, injecting may not represent such an advantage in terms of the efficiency of administration. Indeed, 13% of our patients underwent a transition away from injecting to smoking. Only a minority of these cases stated that this

transition was motivated by a lack of venous access (11%), the most common reason given being a preference for the effects of crack (32%).

It is important to ask whether it would be possible to prevent transitions and thereby reduce much of the drug-related harm associated with cocaine injecting and crack smoking? Our results show that in terms of time, there is a fairly considerable window of opportunity between first cocaine use and first transition (mean = 6yrs, median = 3yrs). However, it is likely that most patients are not in contact with drug treatment services at the time they undergo a transition. Therefore, without more proactive measures, such as outreach work, early identification of cocaine users and the development of strategies to prevent transitions, it is unlikely that conventional services would have much impact on the transition process. If outreach interventions were developed, how easy would it be to identify potential transition cases? Our regression analysis offers five factors that could be used: earlier age at cocaine initiation, initial route of administration, lower level of scholastic achievement, frequency of cocaine use and number of drug classes used. Although the overall sensitivity and positive predictive value of our model were high (89.5% and 81%, respectively), the specificity was low (35.5%), suggesting that any intervention offered might be given to a considerable number of patients who were not actually at risk of undergoing a transition. This should not lead to therapeutic nihilism but the development of better studies, such as cohort studies of recent cocaine initiates, to identify more specific factors that would have some clinical utility.

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Table 1. History of licit and illicit drug use among cocaine users in São Paulo (n = 294)

Drug	Ever used %	Ever used on daily basis %	Used in last month %	Used in last year %	Mean age at 1st use yrs (SD)
Tobacco	87	87	81	85	14.2 (3.2)
Alcohol	88	42	72	84	15.0 (2.7)
Cannabis	96	68	38	63	15.1 (3.2)
Solvents	54	11	1	3	15.2 (3.4)
Amphetamines	24	5	0	1	17.6 (3.1)
Cocaine	100	63	61	88	18.9 (5.6)
Tranquillisers	51	30	20	28	22.3 (5.6)

The denominator for the percentages of daily use, use in last month and use in last year refer to the total number sample (n = 294) and not the number ever having used that particular drug.

Table 2. Variables related to transitions in the route of administration of cocaine (n = 294).

Variable	Transition	No Transition	Odds Ratio	Difference between means	95% C. I.
Mean duration of cocaine use (yrs) ^{-1/2*}	2.7	2.2	-	0.5	0.23 – 0.78
Log ₁₀ mean age at 1st cocaine use	1.25	1.30	-	0.05	0.02 – 0.08
Initial cocaine route (%): sm vs sn/iv†	33 78	67 22	6.81	-	2.63 – 17.6
Mean no. drug classes used	4.9	4.2	-	0.7	0.21 – 1.17
Used cocaine ≥5 days pr week at peak (%)	79	47	4.15	-	2.38 – 7.24

* Square root transformation of duration of cocaine use in years.

† Smoking (sm) vs snorting (sn) or injecting (iv).

Table 3. Trend analyses between stable cocaine users, stable experimenters, single transitions group and multiple transitions group (n=294).

Variable	Stable cocaine users (n=49)	Stable cocaine experimenters (n=27)	Single transition group (n=163)	Multiple transition group (n=55)	Test Statistic	p
Mean age at cocaine initiation (yrs)	22.3	18.8	18.4	17.6	$z = 3.4^*$	<0.001
Mean no. drug classes used	3.6	5.2	4.5	6.0	$F = 34.8^\dagger$	<0.0001
Median duration of cocaine use (yrs)	3.6	4.3	6.3	11.6	$z = 5.6^*$	<0.0001
Used cocaine ≥ 5 days per week (%)	43	55	78	82	$X^2 = 25.9^\ddagger$	<0.001

* z statistic – Cuzick’s method for linear trend, based around Kruskal-Wallis test – nonparametric test used due to unequal variances between groups.

† one way ANOVA for linear trend (groups show equal variances).

‡ Mantel-Haenzsel test for linear association.

Table 4. Logistic Regression Analysis showing variables in final regression equation that are related to cocaine transitions

Variable	p	Odds ratio	95% C.I.
Age at cocaine initiation	0.01	0.94	0.89 – 0.98
Initial route of cocaine administration*	0.002	5.75	1.96 – 16.4
Frequency of cocaine use at peak†	0.000	4.3	2.35 – 7.93
Level of schooling‡	0.000	5.6	2.14 – 14.6
No. drug classes used	0.029	1.2	1.02 – 1.43

* intravevous and snorting vs smoking.

† use 5 to 7 days per week vs use 4 or less days per week

‡ no schooling or primary school level only vs higher education

Table 5. Survival analysis for initial cocaine snorters (n=255) showing risk of surviving without a transition over subsequent 10 years.

Year of Use	Cumulative Survival	Standard Error
First	0.70	0.029
Second	0.55	0.031
Third	0.46	0.032
Fourth	0.41	0.032
Fifth	0.34	0.031
Sixth	0.26	0.030
Seventh	0.24	0.030
Eighth	0.22	0.029
Ninth	0.19	0.028
Tenth	0.19	0.028

Figure 1. Transitions in the route of administration for initial cocaine snorters (Sn), smokers (Sm) and injectors (Iv).

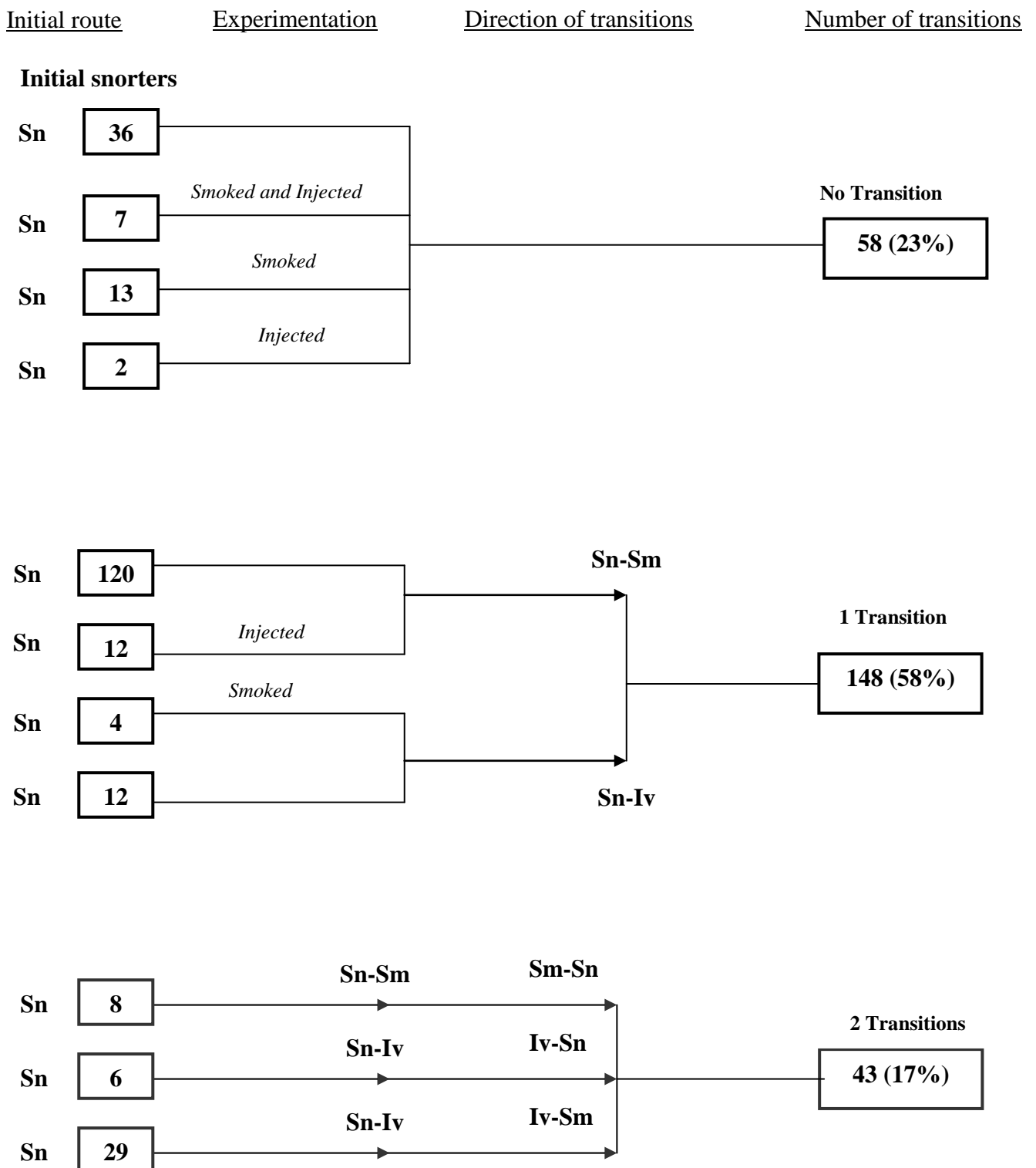
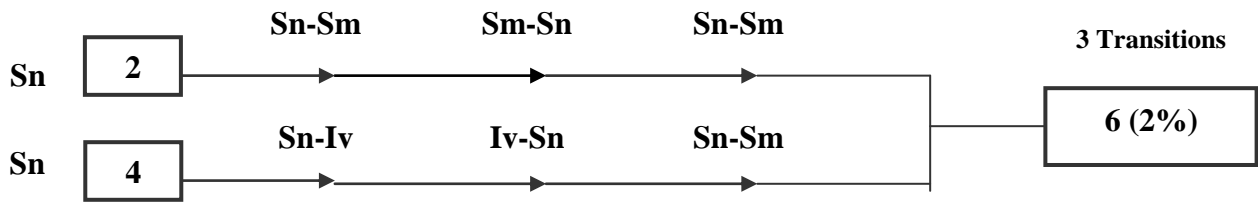


Fig. 1 cont.



Initial smokers

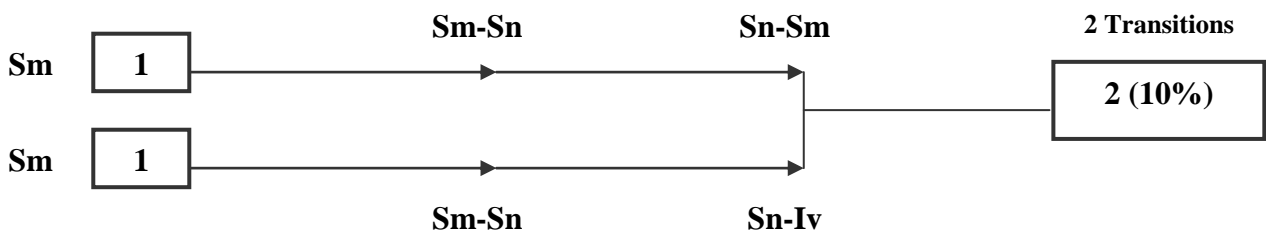
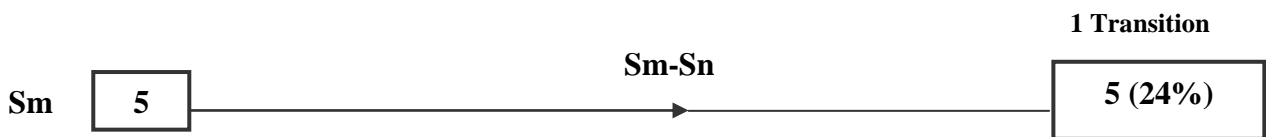
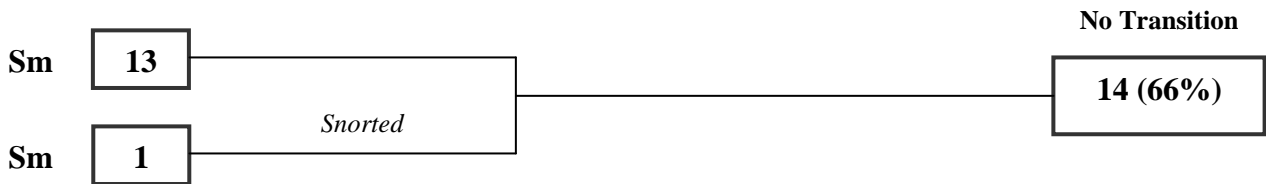
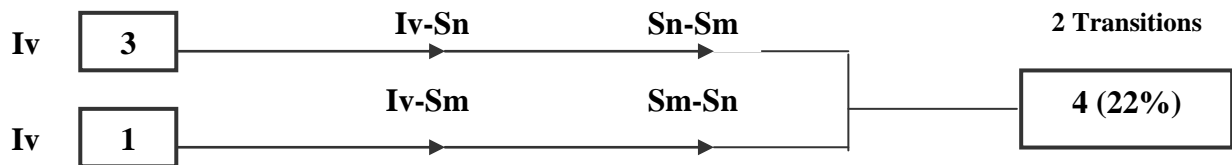
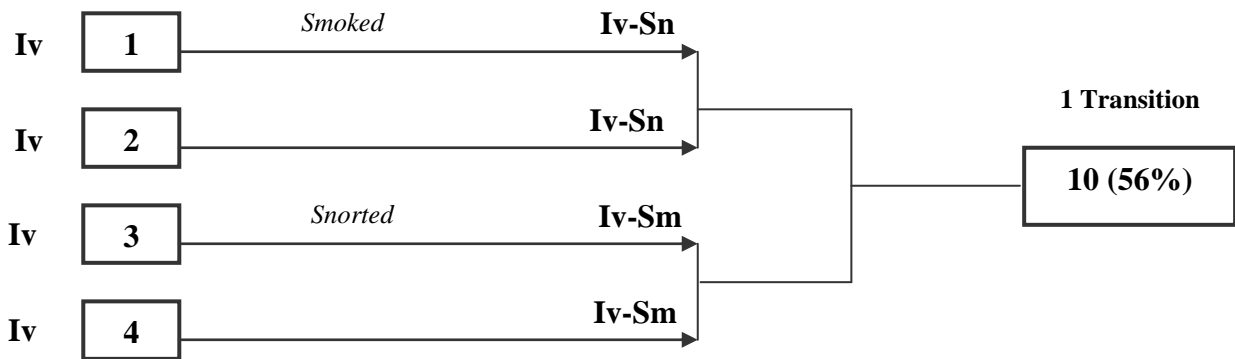
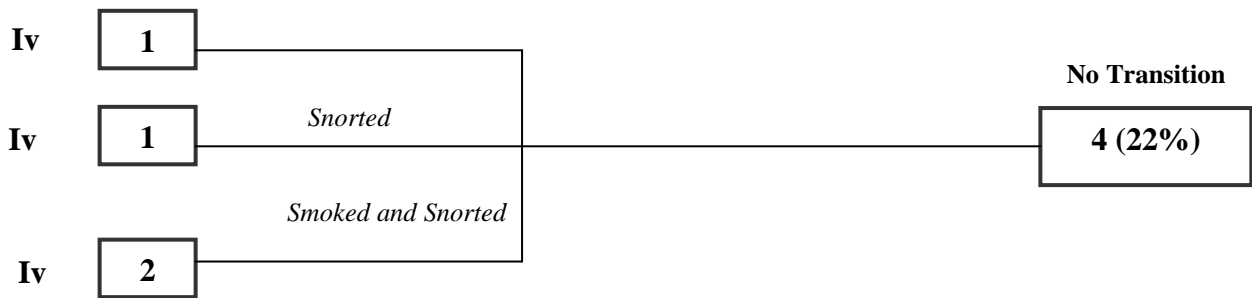


Fig. 1 cont.

Initial Injectors



Iv = injecting
 Sn = snorting
 Sm = smoking (crack)
 → = transition of route

Snorted, Smoked, Injected: refer to patients who experimented with these routes but did not undergo a transition to these routes.