Final Report

EMCDDA Project (CT.97.EP.04)

Study to Obtain Comparable National Estimates of Problem Drug Use Prevalence for all EU Member States

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Summary

Introduction

The project CT.97.EP.04 to improve comparability of national prevalence estimates of addiction in all EU member states including Norway is a follow-up study of the pilot project CT.96.EP.06 (EMCDDA 1997a). The project CT.97.EP.04 extends the methods recommended by the pilot work group to estimate prevalence of problem drug use in all EU member states.

Definition of Target Group

In order to attain comparable estimates of the extent of problem drug use in different countries, the same methods, equivalent data sources, and as a consequence, the same definition of problem drug use in all countries was used. In accordance with the local estimation prevalence project (EMCDDA 1997b), problem drug use was defined as intravenous drug use (IDU) or long duration/regular use of opiates, cocaine and/or amphetamines. Ecstasy and cannabis were not included. Due to differences in demographic structures, it was also necessary to use the same age group when prevalence rates, i.e., prevalence per 1000 inhabitants, were compared. It was agreed upon to provide prevalence estimates for the age group 15-54.

Methods

In the planning meeting for the follow-up project (CT.97.EP.04) it turned out that, due to the available data bases, no method recommended from the participants of the pilot project would be applicable across all countries. In order to avoid the exclusion of countries, it was agreed to apply methods which were not used in the pilot work. The participants also agreed to include the back calculation method proposed by the EMCDDA project to develop dynamic models (CT.96.EP.05) as an additional tool. The BC method uses data of AIDS incidence to make inferences on the dynamics of HIV incidence in the past years. Since most countries would not be comparable across one single method it was hoped to get a range of different estimates for each country for which cross-national comparisons could be made under the assumption that all estimates reflect either problem drug use (PDU), problem opiate use (POU) or intravenous drug use (IDU). The following methods were used in the project:

- The demographic method
- The multiplier method with the data sources
  - Treatment data
  - Police data
  - Mortality data
- Capture-recapture method
- The multivariate indicator method
- Mathematical modelling of HIV/AIDS epidemic

The methods estimate the prevalence rates of different target groups that can be seen as subordinate to one another. The multivariate indicator method uses information of very different data bases all shedding light on the prevalence from different perspectives. Therefore, it was assumed that it estimates problematic drug use. However, depending on the

method used to derive the independent local estimates it may be “anchored” on a different method and therefore target group. It is not yet clear, how this influences the derived estimates. The demographic method and the other multiplier methods estimate mainly prevalence of problematic opiate use, and thus a certain subgroup of problematic drug use, whereas the back calculation method (BC) clearly targets intravenous drug use, which for most countries is intravenous use of opiates, and therefore reflects an even smaller subgroup of opiate users. Capture-recapture approaches can be applied to a variety of data sources and target groups. For the present report, the method was utilised to estimate mainly problematic opiate use, but the estimate may include other subgroups of drug users as well, depending on the specific data sources of the single countries. More specific definitions are given within each country report.

Participants of the Follow-up Project

Experts from all EU countries and Norway were asked to take part in the study. With the exception of Spain, experts from all EU countries were interested and confirmed their participation. Experts were either recommended by the national Focal Point or were working at the Focal Point. For further details see the list of participants.

Results

The summary tables show the results for all methods. The ranges given refer to minimum and maximum estimates obtained by the application of different multipliers or in the case of the back calculation method to different denominators. For the capture-recapture method a confidence interval is given for Finland. For Ireland the upper and lower bounds refer to the point estimates of two different target groups. For Sweden the confidence intervals for two different estimates referring to different target groups are reported. With the exception of Austria, Portugal and Greece at least one estimate could be provided for each participating EU country. Since no country report was available for Spain no results are given for this country.

For Belgium, the Netherlands, Norway and Sweden only one estimate is provided. Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg and the UK were able to apply more than one method. It should be noted, however, that each estimate may be based on a slightly different target population and therefore may not be directly comparable to each other even within the same country. Table A-1 indicates the number of problematic drug users, problematic opiate users or IDUs per thousand inhabitants; Table A-2 shows the absolute numbers and Table A-3 gives an overview of the population sizes used to obtain the prevalence rates of Table A-1.

The demographic and the other multiplier methods using different data estimate in most cases the extent of problem opiate use. With few exceptions the capture-recapture method was as well employed to estimate problem opiate use prevalence. The multivariate indicator method was only applicable in Italy and the UK. In Italy it was used to estimate intravenous heroin use whereas in the UK the prevalence of problematic drug use was estimated. The back calculation method uses the same data base in all countries and estimates refer to the prevalence of intravenous drug use.

Table A-1: Summary of results for the different methods used in the study: Prevalence rates per 1000 inhabitants in the age range 15-54

	Multiplier Treatment data	Multiplier Police data	Multiplier Mortality data	Capture-recapture	Multivariate Indicator	Back calculation (BC)	Other Methods
Target group	**Problematic opiate users**	**Problematic opiate users**	**Problematic opiate users**	**Problematic opiate users**	**Problematic drug users**	**Intravenous drug users**	
Austria							
Belgium							3.6[c)]
Denmark			4.1[7)]			3.4	
Finland[6)]	0.6-0.8		1.4-2.9	3.0-5.0			
France	4.8	5.1				3.8-4.8	5.4[d)]
Germany	2.1-3.1	3.1-3.7[3)]	1.8-2.5				
Greece							
Ireland			2.3-3.8	3.1-6.7[2)]		4.2	
Italy	9.3	5.3		9.1	7.7[5)]	10.1	7.4[d)]
Luxembourg		8.2[1)]					8.6[1,d)]
Netherlands	2.8-3.2						
Norway			2.9-4.2[8)]				
Portugal							
Spain[a)]							
Sweden				0,4-0,7[3,b)] 1,9-2,6[4,b)]			
UK	8.3-10.5		2.7-5.5		8.4-8.9		8.1[d)]

Table A-2: Summary of results: absolute numbers for the age range 15-54

Country	Multiplier Treatment data	Multiplier Police data	Multiplier Mortality data	Capture-recapture	Multivariate Indicator	Back calculation (BC)	Other Methods
Austria							
Belgium							20,200[c)]
Denmark			12,500[7)]			10,200	
Finland[6)]	1,600-2,400		4,000-8,500	8,700-14,500			
France	156,000	164,000				124,000-155,000	176,000[d)]
Germany	94,350-140,600	140,843-165,424[3)]	80,000-112,000				
Greece							
Ireland			4,694-7,884	6,304-13,735[2)]		8,600	
Italy	298,989	171,531		293,814	248,672[5)]	326,000	239,987[d)]
Luxembourg		1,800[1)]					1,900[1,d)]
Netherlands	25,145-29,104						
Norway			7,200-10,300[8)]				
Portugal							
Spain[a)]							
Sweden				1,700-3,350[3,b)] 8,900-12,450[4,b)]			
UK	268,258-341,423		88,900-177,800		273,923-288,675		262,633[d)]

a) country report not available
b) 1992
c) estimate using HIV/AIDS register
d) demographic method (probl. opiate users)
1) hard drug users
2) opiate users - probl. opiate users
3) problematic heroin users
4) problematic amphetamine users
5) heroin IDUs
6) probl. opiate and amphetamine use
7) probl. drug users
8) IDUs

Table A-3: Population size used to calculate the prevalence rates per 1000 inhabitants (age 15-54)

Country	Population size (15-54 years)
Austria	4,608,295
Belgium	5,602,499
Denmark	3,014,995
Finland	2,895,000
France	32,431,857
Germany	45,207,736
Greece	5,580,553
Ireland	2,061,028
Italy	32,315,499
Luxembourg	220,572
The Netherlands	9,117,319
Norway	2,462,300
Portugal	2,680,894
Sweden	4,765,656
UK	32,481,100

Population size has been obtained from the country reports, except for the UK and Norway

Source for UK and Norway: Recent demographic developments in Europe. Council of Europe: 1997

If the different methods are seen as targeting different (subordinate and superordinate) groups, figures derived by the back calculation method should be somewhat lower than figures derived by the multiplier methods and the capture-recapture studies, and those lower than the figures of the multivariate indicator method, as problematic opiate use should always exceed intravenous opiate use. This relationship is complicated by the fact that the back calculation method estimates rather lifetime intravenous drug use than past year prevalence. Nevertheless, in France the prevalence rates of the multiplier methods exceed the rates of the BC, as the back calculation method yield about 4 IDUs per 1000 inhabitants and the multiplier methods about 5 problem opiate users per 1000 inhabitants. The same result was obtained for Denmark with about 3 IDUs (back calculation method) and 4 problem opiate users (multiplier methods) per 1000 inhabitants. However, for Ireland and Italy this is not the case, as the estimates of IDUs are higher than the estimates for problem opiate users.

Comparing the figures within a country, great differences can only be seen for the Finnish estimates. The extrapolation from treatment data is much lower than the estimates derived by mortality multiplier probably due to the fact that the treatment data do not include data on addiction treatment but only medical health problems that can be directly related to drug use. The estimate is therefore an underestimate of problematic opiate use prevalence. The figure for the capture-recapture method is far higher than the others, as this method includes the police-register on driving under the influence of psychoactive substances, and therefore might include people not being regular or long duration users.

The prevalence rates of Italy, Luxembourg, and the United Kingdom are highest (about 8 problem opiate users per 1000 inhabitants), followed by France with about 5 problem opiate users per 1000 inhabitants, whereas the rates for Finland and Sweden are at the lower end (1 to 2 problem opiate users per 1000 inhabitants). Denmark, Germany, Ireland, the Netherlands, and Norway are ranked between France, Finland and Sweden, and show quite comparable prevalence rates with about 3 problem opiate users per 1000 inhabitants.

For column-wise comparisons across countries, it has to be kept in mind that the target group may to some degree vary between methods since indicators, benchmarks or multipliers are not

always identical. While most estimates refer to annual prevalence of problem opiate use, the back calculation method estimates lifetime prevalence of intravenous drug use (IDU).

As can be seen in the summary table, there is no single method providing estimates for all countries. There are still many empty cells in the table indicating that this report is not the end point of the aim to improve comparability of national prevalence estimates. The discussion, however, has to go beyond the methodological issues. The data itself have been identified as the most crucial part in this project. The information given in the reports on how data are collated in each of the participating countries makes clear that estimating drug prevalence is apparently an issue of data collection.

1 Introduction

The project CT.97.EP.04 to improve comparability of national prevalence estimates of addiction in all EU member states including Norway is a follow-up study of the pilot project CT.96.EP.06 (EMCDDA 1997a). The project CT.97.EP.04 is designed to extend the methods recommended in the final report of the pilot project to estimate prevalence of problem drug use in all EU member states. After it turned out that no single method recommended by the participants of the pilot study could be applied across all countries, it was decided that each country should apply the methods where data would be available and give upper and lower limits of problem drug use prevalence.

The objectives of this project are to discuss and fine-tune the methods that are applicable in the participating countries. The outcome of the project is evaluated and discussed with regard to quality and comparability of the calculated results and their applicability in different countries.

1.1 Pilot Project

The pilot project was aimed at supporting the development of methods for the estimation of the extent of problematic drug use on a national level. The partners for the pilot project have been chosen due to their experience with national estimates of addiction (or problematic drug use/opiate use). Apart from Germany as the co-ordinator of this project, experts from France, Italy, the Netherlands and Sweden participated.

The main goal of the project was to select, describe, apply and recommend those methods that built a lowest common denominator for later use in all EU member states. The outcome of the project is documented in a final report (EMCDDA 1997a).

1.1.1 Definition of Target Group

To arrive at comparable estimates of the extent of problem drug use in different countries it is most important to use the same methods, equivalent data sources and, as a consequence, the same definition of problem drug use in all countries. Due to differences in demographic structures, it is also necessary to use the same age group when prevalence rates, i.e., prevalence per 1000 inhabitants, are compared. In the pilot project we agreed upon the age group 15-54.

The definition of problem drug use that first comes to mind is harmful use or dependence of psychoactive substances according to ICD-10 criteria. The tenth revision of the International Classification of Diseases (ICD-10) characterises harmful use as “ A pattern of psychoactive substance use that is causing damage to health. The damage may be physical or mental”. The dependence syndrome is defined as “A cluster of behavioural, cognitive and physiological phenomena that develop after repeated substance use and that typically include a strong desire to take the drug, difficulties in controlling its use, persisting in its use despite harmful consequences, a higher priority given to drug use than other activities and obligations, increased tolerance and sometimes a physical withdrawal state. The dependence syndrome may be present for a specific psychoactive substance, for a class of substances or for a wider range of pharmacologically different psychoactive substances”.

Unfortunately, most of the available data bases do not allow for the application of these or similar criteria. The police, for example, only record the number of individuals caught in possession of illicit drugs. Of course, not all offenders will show symptoms of harmful use or dependence on illicit drugs. In some countries it is even not clear if the offender is a dealer or a user. Obviously a different definition of problem drug use is needed.

Defining problem drug use is associated with two problems: What is problem drug use compared to non-problem drug use and what drugs should be included? It is apparent that different drugs cause different problems and the inclusion of all illicit drugs leads to a heterogeneous target group. In addition, some of the already available estimation methods can be applied to only some types of drugs: The mortality multiplier method, for instance, is not appropriate for estimating the extent of problem cannabis or ecstasy use as there are no reliable estimates for mortality rates up to now or the mortality rates are too low. In accordance with the local estimation prevalence project (EMCDDA 1997b), we defined problem drug use as intravenous drug use (IDU) or long duration/regular use of opiates, cocaine and/or amphetamines. Ecstasy and cannabis are not included. Mode of administration, frequency of use or duration of use cannot be identified from some data sources, e.g., from police data.

A further problem may emerge when individuals appear twice in the same data base, e.g., as opiate user and as cocaine user. To avoid serious biases due to double-counting, it is necessary to classify this individual either as opiate user or as cocaine user. As most of the data bases do not indicate the main drug, we introduced the following classification:

- If a person uses heroin or other opiates, he is always categorised as opiate user regardless of whether he or she also takes other drugs.
- If no opiates are used, then the person is a non-opiate user. He or she can then be classified as cocaine user (disregarding other drugs) or, if no cocaine is used, as amphetamine user.

As a first step, the participants in the pilot project concentrated on the estimation of the extent of problem opiate use. We decided to do this because some estimation methods use information which up to now has only been available for opiate users, e.g., mean duration of problem use. As in most of the countries of the EU heroin is still causing the biggest drug problems, the majority of problematic drug users is covered by this definition.

1.1.2 Selection of Methods

In a first step, estimation methods that had been used before in France, Italy, Germany, the Netherlands and Sweden were collected and described. A total of nine different methods was found, which are listed in Table 1-1. The label ⊗ indicates the country which has specific experiences for one method and therefore produced a detailed description of the method for the pilot project. Countries marked by “x” have either used these methods before or within the pilot project.

Table 1-1: Data and methods to estimate prevalence estimates that have been used in different countries in the preceding pilot study

	Data	Method	France	Italy	Germany	Netherlands	Sweden
1	Police Death Treatment AIDS Jail	Multivariate indicator method		Ä	x		
2	Police data	Different multipliers	x	x	Ä	x	
3	Treatment	Demographic multiplier method	Ä	x	x	x	
4	Treatment	In-treatment rate multiplier	x	x	x	Ä	
5	Population surveys				Ä		
6	School surveys	Multiplier		x			
7	Conscripts urine tests	Multiplier		x			
8	General practitioners	Multiplier			Ä		
9	Case finding study	Capture-recapture					Ä

In the pilot project we restricted ourselves to methods 1 to 5. Methods 6 to 9 were no longer followed in this project as in most countries these data were not available (e.g., conscript tests), data collection seemed to be too expensive for a routine method (e.g., case-finding) or covered only parts of the critical age group (e.g., school surveys). Methods 2 to 4 were selected because we assumed that police data and treatment data are available in nearly all EU countries and that these methods could therefore be applied in the follow-up project by most of the EU countries. The multivariate indicator method was seen as especially interesting as it is based on a combination of several drug-related indicators.

1.1.3 Results

For each of the methods 1 to 5 the contributors of the country indicated by Ä in Table 1-1 gave a detailed description of how they had applied it and what sources they had used. The other members of the group tried to apply the same method using available data and procedures for their country.

Table 1-2: Estimation results of the preceding Pilot Study per 1000 inhabitants

	Data	Method	France	Italy	Germany	Netherlands	Sweden[1)]
1	Police, death, treatment, AIDS, jail	Multivariate indicator method		8.7	3.9		
2	Police	Different multipliers	5.3	8.1	4.9 – 6.0	2.8	
3	Treatment	Demographic multiplier	6.6	12.4	4.4		
4	Treatment	In-treatment rate multiplier	5.4	7.6	1.9-2.8	3.0-3.3	
5	Population surveys				0.9-1.3[2)]		
6	case finding study	Capture-recapture					0.3-0.7

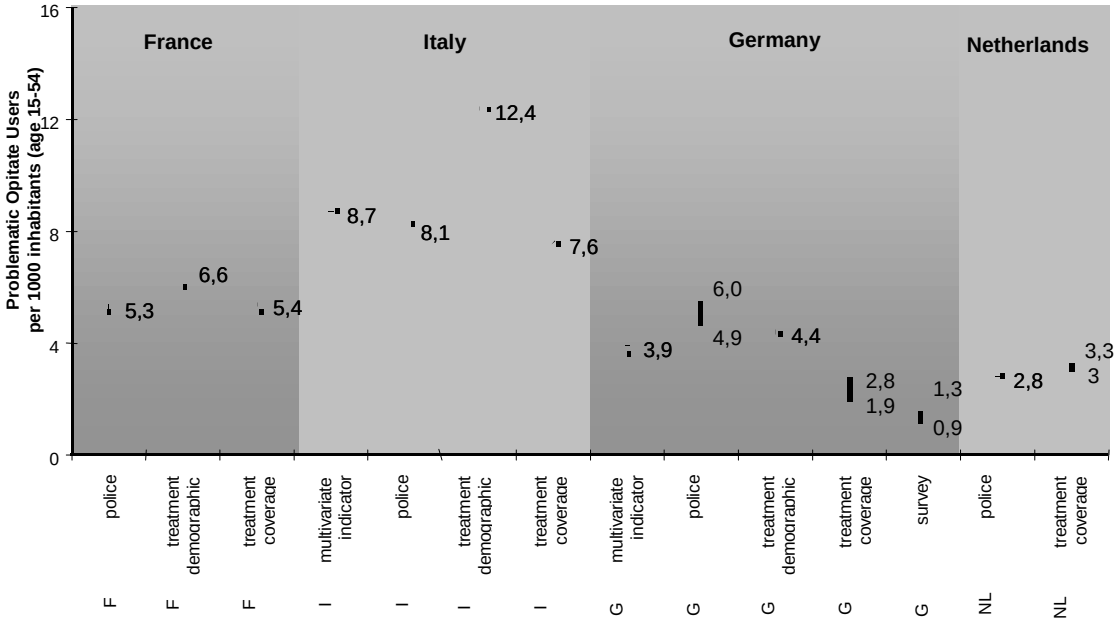
1) none of the methods 1-5 could be applied in Sweden, where a case finding study was conducted in 19922)

2) data refer to the age group 18-59 years

Comparing the results from the different methods used in this project, it appears that most of the figures for each country are rather close to one another. Rather high estimates compared to others resulted from the treatment demographic multiplier method for Italy and the extrapolation from police data for Germany. Given the small base rates, however, the relative range is considerably high.

The sequential order of countries is the same for each of the methods used: the highest prevalence figures were found for Italy, followed by France and Germany. Unfortunately, no data from Sweden were available for the methods under examination (see Figure 1-1).

Figure 1-1: Overview on results of the preceding pilot study



1.1.4 Evaluation

1. The treatment demographic multiplier method was considered problematic as increasing or decreasing incidence leads to a considerable bias. Therefore, it was not recommended by the participants of the pilot project.
2. Only Germany was able to utilise general population surveys for the estimation of problem drug use prevalence as in the other participating countries recent surveys or information on patterns of use, e.g., frequency, was lacking. Furthermore, due to underreporting and other non-sampling errors, the figures from general population surveys with respect to problematic heroin use are usually too low. Therefore this method was no longer seen as a good choice for a European standard estimation method.

3. The best results were found for the multiplier method using police and treatment data. It resulted in rather stable estimates, which did not differ very much within the countries. The police multiplier method is based on the number of individuals registered as drug offenders for the first time; the multiplier is based on the ratio of drug-related deaths previously known by the police as drug users to the total number of all drug-related deaths. The treatment multiplier is based on the number of individuals treated for opiate problems divided by the estimated percentage of opiate users in contact with treatment services in a given year. In some countries as, for instance, in Germany, the in-treatment rate is only an expert rating. Here additional small-scale studies are needed to reduce the uncertainty concerning the multiplier. Finally, studies on the duration of problem drug use in different countries of the EU should be conducted as the figures on duration of problem opiate use utilised in the police multiplier method are based on rather old studies.
4. In the long run, the most promising method seemed to be the multivariate indicator method, which integrates information from different sources. It requires a breakdown of this information (offences, drug-related deaths, treatment demands, etc.) by region. This causes problems because the administrative structures in a country do not always support this type of breakdown. Additionally, for two or three regions reliable prevalence estimates are necessary.

1.2 Follow-up: Application to all EU Member States

The aim of the follow-up project is to apply the methods recommended in the pilot study in all EU member states, including Norway. The application of the same methods should lead to comparable estimates and thus improve exchange of data and information between EU member states. A future aim may be to establish standardised estimation methods based on equivalent data leading to comparable prevalence estimates in Europe.

In the course of the planning meeting for the follow-up project (CT.97.EP.04), the EMCDDA and the project team agreed to include a method proposed by the EMCDDA project to develop dynamic models (CT.96.EP.05). The back calculation method uses data of AIDS incidence to make inferences on the dynamics of HIV incidence in the past years. It was decided that this method should be applied to the total of IDUs infected with AIDS or HIV. The result should then be combined with the prevalence of HIV or AIDS among IDUs to get an estimate of IDU prevalence. For the application of this model, Carla Rossi, an expert both in the field of AIDS/HIV and modelling, agreed to participate in the follow-up project.

Experts from all EU countries and Norway were asked to take part in the study. With the exception of Spain, experts from all EU countries were interested and confirmed their participation. Experts were either recommended by the national Focal Point or were working at the Focal Point.

In the first meeting of experts from the participating countries it turned out that, due to the available data bases, no method recommended in the preceding pilot project would be applicable across all countries. For few countries, e.g., Norway, none of the recommended methods seemed applicable. To avoid the exclusion of these countries methods which were not used in the pilot work, e.g., capture-recapture and mortality multiplier method, were also included. Since most countries would not be comparable across one single method it was hoped to get a range of different estimates for each country for which cross-national comparisons could be made under the assumption that all estimates reflect either problem drug use (PDU), problem opiate use (POU) or intravenous drug use (IDU). It should be kept in mind that although the same methods would be applied, data sources could still be different.

2 Methods

2.1 Introduction

This chapter describes all the methods having been applied in the participating countries. These methods are the demographic method (section 2.2), the multiplier method using treatment data, police data or mortality data (section 2.3), the capture-recapture method (section 2.4), the multivariate indicator method (section 2.5) and the back calculation method (section 2.6). Extrapolation from treatment and police data as well as mortality data are benchmark-multiplier methods. The benchmark is the total of a subgroup of the drug-using population. This benchmark has to be multiplied by an appropriate multiplier to estimate the total of the whole drug-using population (Taylor 1997). Strictly speaking the demographic method is also a multiplier method, but is treated separately because of its background of demographic theory. Both the capture-recapture approach and the multivariate indicator method combine information from different data sources. In this chapter, the properties and caveats of the methods are discussed. We restrict ourselves, however, to the general properties. Country-specific problems with the application of the methods are described in detail in the country reports (see appendix).

2.2 Demographic Method

The methodological framework of this method is the theory of stationary populations in demography. A population is defined as stationary if its size as well as its entry and exit flows (births and deaths) remain constant. Entry and exit flows balance each other out. The size of the stationary population is equal to the number of births on an annual basis (entry flow), multiplied by the life expectancy rate at birth (average length of life). In analogy to the demographic model, onset of problem drug use and termination of drug use are considered as "birth" and "death". Onset of problem drug use is operationally defined as first appearance in the health system.

Accordingly, the prevalence estimate is the number of new users, that is the incidence (entry flow) multiplied by the mean duration of problem drug use.

T Prevalence of problematic drug users

B Incidence of problematic drug use (annual flow of new users in treatments)

c Mean duration of problematic drug use

$\Rightarrow$ $T \approx B * c$

General Remarks

The presented method assumes the drug-using population to be stationary. Recent trends in incidence, however, indicate an increase in most countries which contradicts the assumption and causes an overestimate of the number of problematic drug users in these countries. Drug

users who have never been and will never be treated are not taken into account in the estimate. The estimate could be improved if an estimate for the in-treatment rate was available.

The required multiplier for the demographic method is mean duration of problematic drug use. The heterogeneity of drug use restricts estimates to rather defined categories of substances and drug-related problems. At present estimates are only available for abuse and dependence of opiates, defining the results of the demographic approach as problematic opiate use.

The estimation of the mean duration of problem opiate use, however, needs further exploration and reliable data. In the application of the demographic method, obviously an overestimate of mean duration of problem opiate use results in an overestimate of problem drug use, an underestimate of mean duration of drug use in an underestimate of problem drug use.

2.3 Multiplier methods

Method

The benchmark is the total of a subgroup of the drug-using population. This benchmark has to be multiplied by an appropriate multiplier to estimate the total of the whole drug-using population (Taylor 1997). The unknown population size can then be calculated following the basic formula:

$N = n * f$

N Unknown size of the population of problematic drug users

n Size of observed sample

f Unknown parameter to be estimated (the so-called "multiplier")

Sources of Data

Although benchmark multiplier methods are simple methods of prevalence estimation, that can very often be done on a relatively small amount of information and without extensive field studies, Frischer (1997) warns about using it for inappropriate samples. The basic assumptions met should include a cautious consideration of the sort of multiplier used (e.g., annual mortality rate, standardised mortality rate, in-treatment rate), as these fraction rates could very well be arbitrary (e.g., specific for certain regions or changing over time).

Most data sources will rather be available for problematic opiate use than for problematic drug use. For instance, mortality data are well documented for opiate use, but not available for a variety of other substances (e.g., amphetamines, cocaine). Police data very likely refer to opiates as well, whereas treatment data could very well be available for different substance groups.

2.3.1 Treatment Data

This estimation method extrapolates the number of problematic opiate users who underwent treatment in a given year. The extrapolation factor is the estimated in-treatment rate and should be based on surveys in drug using populations. This method can be stated as follows:

T Estimated total of problematic opiate users

B Total number of problematic opiate users who underwent treatment in a given year

c Estimated in-treatment rate

$\Rightarrow$ $T = B / c$

General Remarks

Two problems may arise with this method: In most cases, not all treatment centres (inpatient and outpatient facilities) are covered by the national monitoring systems. Thus, the total number of treated cases in a given year has to be calculated using an estimate of the treatment coverage rate. The second problem relates to the in-treatment rate, which is the multiplier in this method. This may be estimated by applying snowball sampling or other nomination techniques as described in detail in Taylor (1997).

2.3.2 Police Data

2.3.2.1 Using the Ratio of the Number of Drug-related Deaths to the Number of Drug-related Death Previously Known to the Police as Drug Users

The multiplier method using police data is based on two data sources, namely the data base of first registered opiate users and the data base of drug-related deaths. As according to the literature (Robins 1979; Bschor 1987; Marks 1990) the estimated mean duration of dependence amounts to ten years, the number of first-time registered opiate users in the previous ten years is taken as the benchmark. The correction term assumed to reflect the extent of the unknown cases is the ratio of the total number of drug-related deaths to the number of those deceased previously registered by the police as opiate users. Again, this comparison is made over a ten-year period. It is assumed that the ratio of the total number of problematic drug users to the number of those cases that have been registered by the police (over a ten-year period) is equal to the ratio of the total number of drug-related deaths to those that have previously been registered by the police as problematic opiate users (also over a ten-year period).

In summary, the following calculations are applied:

T Estimated total of problematic opiate users

B Number of first-time registered opiate users in the past ten years

c Dt/Dn, ratio of the number of drug-related deaths and the number of drug-related deaths previously known to the police as drug users,

where

Dt Number of drug-related deaths in the past ten years

Dn Number of drug-related deaths in the past ten years having been registered as drug users before

$\Rightarrow$ $T = B * c$

The proportion of all previously known users among drug-related deaths varies over time. Thus, using just one multiplier might be problematic. Therefore, as a variant this proportion is calculated for each of the past ten years and multiplied with the number of first-time registered opiate users in that year. To arrive at an estimate of the total prevalence the estimated incidence is again cumulated over ten years (assuming a duration of problematic opiate use of ten years).

General Remarks

It is important to keep in mind that in some EU member states the statistics on drug-related deaths do not only consist of deaths due to an overdose. Suicides, fatal accidents under the influence of drugs, and deaths resulting from long-term abuse are also included. A drug-related death which is not caused by an overdose will often not be classified as a drug-related death if the drug user has not been registered before. This leads to an underestimation of the multiplier. The fact that the police normally do not distinguish between occasional and regular users contributes to an overestimation of the benchmark. Moreover, delays in data entry may also cause methodological problems. As it is not clear which of the above mentioned problems has a higher influence, it is not evident if this method tends to overestimate or underestimate prevalence of problem drug use.

The estimate for the mean duration of dependence is taken from the literature. It is, however, not clear if this figure reflects the situation at present in the EU member states as changing consumption patterns and methadone programmes may have influenced mean length of dependence. In some member states, e.g., in France, the mean duration of dependence is estimated to amount to eight years. The existing data bases do not allow for a proper estimation of mean length of dependence as usually all observations are right-censored: Only the beginning of dependence but not its end is known. Since the mean duration of problem opiate use is utilised both in the benchmark and the multiplier, the direction of the bias resulting from a probably incorrect mean length of dependence is not clear.

2.3.2.2 Estimating the Proportion of Drug Users that Have Come into Contact With the Police

As an alternative, the number of drug users registered by the police in a given year is used as a benchmark. To account for the hidden population, this figure is divided by the estimated proportion of drug users that have come into contact with the police. In summary, the following calculations are performed:

T Estimated total of current problematic opiate users

B Number of registered opiate users in a given year

c Proportion of opiate users that have come into contact with the police

$\Rightarrow$ $T = B / c$

General Remarks

For estimating the proportion of problematic opiate users that have come into contact with the police, a small-scale study is needed. This study will probably be conducted on a regional basis, for example, in a larger city. A generalisation of this local estimate to the whole country may be problematic. The probability of an opiate user having contact with the police may vary over regions and cities due to law enforcement activities. This makes estimates rather unreliable. If law enforcement bodies in the examined region are more efficient than on average, this will result in an underestimation and vice versa. Techniques that may be used to estimate the multiplier are, for example, nomination techniques, which are described in Taylor (1997) and Korf (1997).

2.3.3 Mortality Data

This estimation method is based on the total of drug-related deaths and the mortality rate of problem drug users. To get an estimate for the past year prevalence of problem drug use, the total of drug-related deaths is divided by the mortality rate.

T Estimated total of current problematic opiate users

B Number of registered drug-related deaths

c Mortality rate

$\Rightarrow$ $T = B / c$

General Remarks

Due to changing circumstances like improving treatment facilities for AIDS, the emergence of new drugs or the introduction of methadone programmes, mortality rates are not constant and have to be re-estimated periodically. How these circumstances affect mortality rates is, however, not clear. Studies in several countries on the impact of HIV on non-AIDS-related mortality and on the impact of methadone on mortality report very different results (Frischer 1997). The existing mortality rate estimates are based almost exclusively on studies on drug users in treatment. The mortality rate of non-treated drug users is probably different. Moreover, mortality rates normally are estimated only for certain types of drug users or types of drugs, and contain all-cause deaths. It is important to recall that the registers on drug-related deaths may not contain all deaths of drug addicts (usually overdose). Thus, the benchmark of the mortality multiplier method is obviously too low.

2.4 Capture-Recapture

The capture-recapture method combines data from different sources, e.g., the health system and the criminal system. Being recorded in one system is assumed to be independent of being recorded in the other system. In the simple case of two independent data sources the extent of the hidden population d is estimated as $d=b*c/a$ with a, b, c as defined in Table 2-1:

Table 2-1: Example of the simplest form of a capture-recapture analysis

		Sample 1		
		Present	Absent	
Sample 2	Present	a	b	a+b
	Absent	c	d	
		a+c		

Accordingly, the total number of problematic drug users is estimated as N=a+b+c+(b*c/a).

General Remarks

Positive dependence, i.e., being in one sample, increases the probability of being in the other sample, leads to an underestimate of the hidden population, negative dependence to an overestimate (Domingo-Salvany 1997). The capture-recapture approach can be derived from the framework of loglinear models. If there are more than two data sources available, fitting a loglinear model allows for accounting for dependence. In the 1997 local estimation project this method was examined further by fitting several loglinear models to data from six European cities (EMCDDA 1997b). The properties of this method have been studied intensively on city levels. Not much is known yet about the extension to regions or nations. The problems are manifold, e.g., false positives, false negatives, double counting, identification problems of individuals. National estimates may be even more sensitive to the impact of these factors.

2.5 Multivariate Indicator Method

The method introduced by Person, Retka and Woodward (1976, 1977) estimates drug use by combining several indicators directly corresponding to problematic drug use. It is assumed that a single latent variable, namely the true prevalence underlies the drug-related indicators. This single latent variable is extracted using principal component analysis.

Principal Component Analysis

Principal component analysis is a technique used to simplify the complex information contained within a multidimensional space by transforming it in a more comprehensible representation. It is a descriptive and explanatory model of multivariate analysis, that can be used with a **n x q** matrix where **n** represents the rows and **q** the columns (i.e., the quantitative variables measured on **n** observations). Therefore, each row of the matrix represents the individual profile of an observation. From a geometrical point of view, the set of the observations refers to a **q** dimensional space **($\mathbf{R^q}$)** generated by **q** axes made up by **q** variables: a single observation is represented, in the $\mathbf{R^q}$ multidimensional space, by a point, whose coordinates are the measures of the **q** variables. Within this space, the observations form a cloud of points that can be displayed by a projection on proper planes. The principal component analysis is used to define the shape and the dispersion of this cloud around a gravity centre and to determine the planes (factorial planes) on which the points can provide a satisfactory layout of the cloud of observations.

The main objective is to reduce the **q** original variables to **p (p<q)** new variables, that will explain as much as possible of the variance of the original variables and to characterise the extracted principal components on the basis of the original variables. The aim is to define a new reference system for the observations, i.e., new variables (principal components) characterised by a decreasing information content whose values represent the new coordinates of the observations. In other words, when variables are synthesised, the problem is to find the direction of the highest variance of the cloud of the observations (first principal component) and subsequently to find a second direction (second principal component) uncorrelated that represents the maximum of the residual variability, and so on.

The method of the principal components is often applied in order to obtain a reduced number of orthogonal variables to be used in further statistical analysis (e.g., regression). Therefore, it is important to find a compromise between the requirement of reducing the number of necessary variables for the description of the observation and the requirement of taking into account as much information as possible.

Application

The application of the multiplier method requires a breakdown of national states by regions or provinces and data indicating the prevalence of drug use. For an application, using data from Italy, see Mariani, Guaiana and Di Fiandra (1994). Data must be available for each of the regions. Furthermore, the data indicating the prevalence of drug use must be collected for the same time period. For example, the following variables can be utilised as indicators:

A	Number of offenders against drug laws
B	Drug-related deaths
C	Clients in treatment
D	Cases of AIDS related to IDU
E	Number of imprisoned addicts

In addition, the population size F of the age group at risk in each region is needed. For each of the variables A to E and for each region the figure per 100,000 inhabitants is calculated by

$A_F=A*100,000/F$

he variables A_F to E_F have to be standardised (i.e., the difference between value and mean has to be divided by the standard deviation), before a principal component analysis of A_F to E_F is run. In a second step, the first principal component is linked to prevalence estimates for at least two regions via linear regression. The prevalence estimates G for these regions which are called anchor points also have to be calculated per 100,000 inhabitants

$G_F=G*100,000/F$

and standardised.

The linear regression with G_F as dependent variable and the coefficients of the first principal component as independent variable results in the estimated prevalence rates per 100,000 inhabitants for each region. Finally, these estimates have to be transformed to prevalence estimates for the regions. Summation of the regional prevalence estimates yields the national prevalence estimate.

General Remarks

In each region data should be collected in the same way. If, for instance, a variable is person-based in some regions and event-based in other regions, a bias might emerge. Ideally, all variables should be person-based. As regression analysis with more independent variables than measurements for the dependent variable is not possible (the number of indicators exceeds the number of anchor points), principal component analysis is applied. The estimated factor scores serve as measurements for one independent variable in the regression analysis. The idea behind the principal components analysis is that the unobserved prevalence influences the observed indicators and that no other common factor has an effect on the indicators.

Moreover, using principal component analysis we indirectly assume a linear relationship between the unobserved prevalence and the observed indicators. This is criticised in Person, Retka and Woodward (1976). They emphasise that only a monotone relationship can be assumed. The indicators need not be linear functions of the prevalence. For example, an increase in prevalence will lead to an increasing number of addicts in treatment. The relationship, however, will not be linear as in practice the number of addicts in treatment is restricted by the capacity of treatment services. The change in treatment admissions due to an increase in prevalence will be smaller if treatment capacity is already nearly fully used. As a consequence Person and colleagues (1976, 1977) replace the population adjusted indicator values with their ranks in the principal component analysis. They claim that the information contained in the ranks suffices. Besides, studies of the principal component analysis method with rank-ordered data yielded excellent results. In addition, the ranked indicator values are robust against measurement errors.

The regression analysis is based upon the assumption of a linear relationship between the estimated factor scores and at least two anchor points. This is a very sensitive assumption: If the real relationship is non-linear, the prevalence estimates depend heavily on the choice of the anchor points. Furthermore these anchor points are somewhat chosen to define the linear regression line and are therefore of absolute critical importance in deriving reasonable prevalence rate estimates (Person, Retka & Woodward 1977; Wickens 1993).

Obviously, the indicator A (offenders against drug laws) does not only contain problem drug users, but all drug users who came into contact with the police. It is, however, not clear how this affects the prevalence estimate of problem drug use. There are two reasons for this: First, the influence of this indicator on the results of the principal component analysis cannot be predicted. Second, the prevalence estimate depends heavily on the anchor points. The linear regression step may correct possible biases due to the indicators.

2.6 Estimating the Prevalence of Injecting Drug Use by Means of Mathematical Models of the HIV/AIDS Epidemic (by Carla Rossi and Lucilla Ravà)

2.6.1 Models for the Analysis of Observational Data Related to the HIV/AIDS Epidemic

To monitor drug related phenomena, the extent of drug use and abuse must be estimated. As the use of substances is considered illicit in most countries, the number of drug users can only be estimated by indirect methods based on the observable consequences of drug use, for example, infectious diseases (hepatitis, HIV/AIDS), which provide observational data, easy available and comparable in the various countries, or other observable phenomena as reported

in the previous sections dealing with the various estimation methods.

Several statistical methods and mathematical models may be utilised to make projections on various drug related phenomena. In particular, the back calculation (BC) methodology (Brookmeyer & Gail, 1986) can be used to model the spread of the HIV/AIDS epidemic among injecting drug users (IDUs) and to make inferences on the number (prevalence) of IDUs based on HIV/AIDS surveillance data.

In this section a BC based method, developed to investigate the extent and the dynamics of the population of IDUs, is presented on the basis of Italian data from a methodological point of view. The application to the other EU countries is reported in the last section.

The method is based on the following points:

- Use external information to model the relation between injecting use of drugs (mostly heroin or opiates but also other drugs, as CNS stimulants in Sweden) and HIV infection in order to estimate the prevalence of IDUs from the estimated prevalence of HIV/AIDS;
- compare the results to those obtained using other methods or using different data sets to validate the estimates and to increase accuracy and robustness.

Some similar approaches can be found in Kaplan and Soloshatz (1993).

2.6.2 Estimating the Prevalence of Injecting Drug Users Using Data from and Models of the HIV/AIDS Epidemic

The size and the dynamic of IDU's population can be studied on the basis of the overall prevalence of HIV infections and/or AIDS cases as estimated through some suitable statistical methods.

By using external information on the proportion of HIV-infected individuals among IDUs, denoted by *P(HIV/IDU)* provided by various sources (sample surveys among incarcerated IDUs or IDUs in treatment), an estimate of the total number of IDUs, denoted by *N(IDU)*, can be obtained by applying the following simple calibration formula to the prevalence of IDUs who are HIV-infected, which is denoted by *N(IDU|HIV)*:

$$N(IDU) = \frac{N(IDU \mid HIV)}{P(HIV \mid IDU)}$$

where *N(IDU/HIV)* denotes the number of HIV-infected who are intravenous drug users.

Similarly, AIDS prevalence can be used in place of HIV prevalence:

$$N(IDU) = \frac{N(IDU \mid AIDS)}{P(AIDS \mid IDU)}$$

Unfortunately, the denominators *P(HIV|IDU)* and *P(AIDS|IDU)* (i.e., the estimated proportions of HIV-infected and of AIDS affected individuals among IDUs) are not always

available from routine statistics. For example, neither of the sources available in Italy (i.e., sample surveys of IDUs in the health care services and surveys of those in prison) distinguishes between cases of HIV and AIDS in their official published reports. Thus only the denominator *P(HIVÈ AIDS|IDU),* i.e., the proportion of HIV or AIDS individuals among IDUs, can be used, modifying the above formulas as follows:

$$N(IDU) = \frac{N(IDU \mid HIV \cup AIDS)}{P(HIV \cup AIDS \mid IDU)} \qquad (1)$$

where *N(HIVÈ AIDS|IDU)* denotes the number of IDUs who are HIV-infected or AIDS-affected. In simple words, the formula divides the current numbers of HIV-infected life-time IDUs, obtained by an epidemic model of the HIV/AIDS epidemic based on AIDS cases, by the estimated current rate of infection in IDUs. It must be noted that the results of the estimation method are based only on the projections of the absolute prevalences (number of cases) of HIV and AIDS, obtained by some suitable estimation methods (numerator of the calibration formula), and on the estimate of the proportion of individuals with HIV or AIDS among IDUs (denominator of the calibration formula), coming from official statistics, which are easily obtainable.

The prevalences *N(IDU|HIV), N(IDU|AIDS)* or *N(IDU|HIVÈ AIDS)* (numerator) might be estimated by the BC, which is a general class of deconvolution methods originally proposed as a means to determine the minimum number of HIV-infected individuals, and to make short-term projections of AIDS incidence (Brookmeyer & Gail, 1986). Nevertheless, as the HIV/AIDS epidemic developed, the increasing knowledge of its elements, particularly of the incubation period distribution, made it possible to implement more and more sophisticated BC methods to be used as a tool to estimate the HIV-infection curve, too (Brookmeyer & Gail, 1988; Rosemberg et al., 1991; Brookmeyer, 1991).

The basic idea of each BC method is to reconstruct, from a deconvolution procedure, and by using an estimate of the incubation period distribution, the numbers of individuals who must have been previously infected in order to yield the observed AIDS incidence cases. Then, by applying the assumed incubation distribution to the estimated HIV infection curve, and making some assumptions on future HIV infection rates, the AIDS incidence is projected forward.

Let *A(t)* be the expected cumulative number of AIDS cases diagnosed by calendar time *t*, *h(s)* the HIV infection transmission rate at calendar time *s*, and *F(t)* the incubation period distribution, then the convolution equation:

$$A(t) = \int_0^t h(s)F(t-s)ds \qquad (2)$$

links, through the incubation period distribution, the HIV infection rate to the AIDS incidence. In fact an individual results in diagnosed with AIDS at calendar time *t* only if he has been previously infected at a calendar time *s*, $s \leq t$ and has an incubation period less then *t - s.* By differentiating the equation (2) the following equation is obtained:

$$a(t) = \int_0^t h(s)\, f\,(t-s)ds \qquad (3)$$

were *a(t)* is the expected AIDS incidence, *h(s)* is the HIV infection curve and *f(t - s)* is the incubation density function. In discrete time the equation (3) is:

$$E\,(a_k) = \sum_{j=0}^{k} h_j\, p_{k-j} \qquad (4)$$

were a_k is the number of AIDS cases diagnosed in the interval *k*, h_j the incidence of HIV infection in the interval *j*, and p_{k-j} the probability for an individual to be diagnosed with AIDS *k-j* time intervals after the infection. Therefore the basic idea of the BC is to use a realisation of *A(t)*, or of *a(t)*, the AIDS incidence data, an estimate of *F(t)*, usually external, and to use one among the equations (2), (3), or (4) in order to gain information about the past infection rates *h(s)*, $s \leq t$.

Though the several BC methods proposed share the same underlying concept, they differ in terms of the statistical and epidemiological key assumptions about the shape of the HIV infection curve, which is needed to assure the identifiability of the estimation problem; they also differ in terms of AIDS incidence and incubation period distribution.

To date, the most appealing BC methods appear those based on step functions or splines being those retaining the maximum flexibility for the infection curve. The calibration formula (1) could be based, for example, on the Empirical Bayesian Back Calculation (EB-BC, Heisterkamp et al. 1995; Downs et al. 1997), a method developed within the EU Concerted Action (PL 931723) "Multinational scenario analysis concerning epidemiological, social and economic aspects of HIV-AIDS on society". In the EB-BC, a method implemented in a discrete framework, the HIV infection curve is represented by a step function, and a Poisson process is postulated for the occurrence of the infections in one time interval. The AIDS incidence in each interval of diagnosis is assumed to be independently Poisson distributed, and as estimation method a PL (Penalized Likelihood) approach is adopted, using a log link function in order to obtain non-negative estimates of the HIV infection curve parameters. Without any constrain the estimated HIV incidences corresponding to consecutive years could result highly variable, therefore a smoothness restriction is adopted, in an Empirical Bayesian framework, by placing a prior distribution for the infection parameters to be estimated. Originally the neighbour, the linear and the quadratic priors have been proposed, but there are situations in which different types of priors are needed. The advantage of this BC method is that it provides the simultaneous estimation of the infection curve parameter and of the degree of smoothing by using the EM algorithm. The Akaike Bayesian Information Criterion is used to assess the EM convergence.

The penalty parameter of the penalised likelihood, which is directly linked to the degree of smoothing, determines the relative weights of data and of the prior distribution postulated for the parameter to be estimated: large values of penalty parameter give more weight to the prior information than to the data.

The implementation of the present method allows for the inclusion of covariates in the BC.

Various estimates of the incubation period distribution, each one in the form of a Markov

multistage model, have been used in this approach. Such incubation distribution models make it possible to calculate stage-specific estimation of prevalences, to easily incorporate in the BC the possible effect of treatments, changes of AIDS definition, or other events that could modify the length of the incubation period. Moreover the way in which this BC method was implemented allows to consider age-specific incubation period distributions, that means to incorporate the covariate "age" in the estimation method. Finally, differently from other methods aimed to investigate the spread of HIV/AIDS, the EB-BC allows to study the epidemical trends by transmission category. Therefore, in this context, the EB-BC has the advantage to provide, differently from other estimation methods, a straightforward estimate of numerators *N(IDU|HIV)*, *N(IDU|AIDS)*, or *N(IDU|HIVÈ AIDS)*, reducing the amount of uncertainty in the final estimate of *N(IDU)*.

Table 2-2 illustrates the results of the application of the calibration formula to the Italian data. The estimated number of HIV and AIDS individuals among IDUs was obtained by the EB-BC method, without the covariate "age", while the denominator of the calibration formula was obtained on the basis of sample surveys of addicts in jail or of IDUs attending the health care services for treatment. It must be considered that the EB-BC methods without covariates may provide lower bounds of HIV/AIDS prevalence (Ravà et al. 1998). Though the estimates are especially sensitive to the HIV rates in IDUs, which constitutes the denominator of the calibration formula, the results for Italy can be considered reliable and allow to analyse the time trend of the prevalence due to the fact that such denominators of (1), taken from the two available sources, even if different, show "parallel" trends. In particular, the estimates taken from the sample survey of IDUs in health care services are always higher; this is probably due to the fact that the IDUs in prison are generally younger and healthier than those in the health care services. It must be noticed that, even if the BC estimates of recent behaviour of the HIV incidence curve are sensitive to the prior hypotheses, the prevalence which is used in the numerator of the calibration formula is less sensitive as it is mostly composed of older HIV incidence.

Table 2-2: Prevalences of HIV and AIDS estimated by means of Empirical Bayesian Back Calculation method for Italy and prevalences of Injecting Drug Users (IDU) obtained by calibration with the two denominators reported in column 5 (estimated from prison sample survey) and column 6 (estimated from Health Care Services survey)

Year	HIV prev.	AIDS prev.	Total	Denominator (prison)	Denominator (health serv.)	N(IDU) (prison)	N(IDU) (health serv.)
1990	46,700	2,000	48,700	0.326	0.36	150,000	135,000
1991	47,300	2,600	49,900	0.275	0.29	181,000	172,000
1992	45,500	3,200	48,700	0.250	0.24	195,000	202,000
1993	42,400	3,600	46,000	0.215	0.23	214,000	201,000
1994	38,700	4,000	42,700	0.175	0.21	244,000	203,000
1995	35,200	4,100	39,300	0.145	0.19	271,000	202,000
1996	32,500	4,200	36,700	0.135	0.17	272,000	214,000

2.6.3 General Methodological Remarks and Further Developments

The main purpose of this contribution was to demonstrate how to use the knowledge of the HIV/AIDS epidemic and the recent improvements of the epidemic models, to estimate the number of IDUs. With respect to other methods, which can be applied to estimate the same hidden population, the method presented here allows for the use of data (AIDS incidence data) that are generally more accurate than other drug related data in most western countries. It also allows comparisons to be made between countries, since they correspond to the same or similar case definitions. In fact, all the other drug related data are influenced by different case definitions (e.g., drug related deaths) and different laws and policies; thus straightforward comparisons between countries and the use of the same estimation method in different countries are not possible.

The proposed method, synthesised by the calibration formula (1) (see 2.6.2), can be easily applied, but it requires good estimates of the numerator and the denominator. It must be noted that the estimates obtained through the calibration formula are sensitive to uncertainties both of the numerator *N(IDU|HIVÈ AIDS)* and of the denominator *P(HIVÈ AIDS|IDU)*. In particular, the last one is crucial as, for example, if we estimate the denominator to be 2% in a country where its real value is 4%, the error of the estimate of N(IDU) is 100%, as we obtain a value which is double the "true" value. Thus it is very important that the estimate of the denominator of the formula is accurate in order to obtain good results, especially for those countries where the HIV/AIDS epidemic is small. Therefore the calibration formula (1) (see 2.6.2) can be usefully applied in countries where the level of the HIV/AIDS epidemic, particularly among IDUs, is high enough to allow reliable estimates for the numerator and the denominator or for countries where the knowledge of the population of IDUs is good enough to allow obtaining reliable estimates anyway, whereas it cannot be reliably applied in countries where the HIV/AIDS epidemic is small and/or mostly restricted to homo-/bisexual men because of the wide uncertainties of the estimates of HIV and AIDS individuals among IDUs and of the proportion of IDUs affected by HIV/AIDS.

The various methods and models proposed to estimate the extent of the HIV/AIDS epidemic generally provide quite reliable and accurate estimates of the numerators, yet if it should be taken into account that the EB-BC provides, for the most recent time intervals, highly variable estimates of HIV infection rates. On the contrary, some problems may arise for the denominator. This latter usually comes from sample surveys of IDUs tested for HIV or AIDS positivity. This implies that the information used to estimate the denominator is based on the sub-population of IDUs already known to some social agency. Such sub-populations may provide biased estimates of the proportion needed.

The IDU prevalence obtained by the calibration formula counts individuals who where IDU when they became HIV infected and then stopped injecting, or even using, drugs, and therefore they exit from the IDU population. On the other hand, new individuals, recently entered into the IDUs population, may not appear immediately in the HIV or AIDS estimates. For these reasons the calibration formula might provide upper bounds of the IDUs prevalence estimates if the injecting drug use epidemic is decreasing during the period taken into account for back calculation, lower bounds otherwise. In other words, if the IDU population is characterized by an exit rate higher than the in-flow rate, i.e., by a decreasing size, the estimates provided by calibration formula are an upper bound of IDUs prevalence, a lower bound otherwise. Therefore the prevalence estimates are realistic if the size of the IDU population is stable during the period considered. In the present application the most recent HIV incidence trend is assumed to be constant and we can suppose reasonably that this is true for most EU countries. Nevertheless, to improve the results, the dynamic of the IDU

population and the drug user career needs to be studied in depth by appropriate dynamic models and by the study of the latency period of drug use. In particular the flows of exits and the entrances in the IDU population must be modelled by suitable tools. The exit rate from the IDU population can be studied, through survival analysis models; the entrance rate in the IDU population, i.e., incidence of problem drug use (in particular injecting drug use), can be estimated by a proper EB-BC model for problem drug use. In fact the EB-BC could be used to estimate the incidence of injecting use of drugs, by directly applying the fundamental BC equation to other incidence data, such as the incidence of first notifications to some social agency. In this case, if the latency period distribution related to the data generation process for that social agency is known or can be estimated, the deconvolution methods can be used to estimate the incidence curve of injecting drug use that replaces the HIV incidence curve in this application. It must be considered that the EB-BC can only be used to estimate the population of IDUs eventually observed by the social agency, when the appropriate latency period has been taken into account. Thus, the estimate is a lower bound for the total incidence of IDUs. To improve this estimate, different latency periods and different social agencies could be considered in the framework of a proper competing risk model.

In any case, due to the various uncertainties, related both to data and models, several models and methods should be applied whenever possible in order to obtain the best description of the hidden population of interest.

The calibration formula can be applied either at a national level, whenever national estimates of the denominator are available, or at a local level, when only local estimates of the denominator can be provided (the numerator can always be estimated at a local or a national level). In such a case, the local estimates of N(IDU) can be used as anchor points for other estimation methods applicable to obtain the national estimates. This possibility is particularly interesting for those countries where local prevalence estimates of problem drug use are not available or difficult or costly to obtain. It is also possible to use the method to calculate local estimates where the denominator can only be obtained on a local level, as, for example, in the Netherlands.

3 Results

3.1 Introduction

The results are reported following the same order as the description of the methods in chapter 2. The tables contain information on all EU countries and Norway except for Spain, which did not participate in the project.

The project started out to estimate problem drug use defined as intravenous drug use (IDU) or long duration/regular use of opiates, cocaine and/or amphetamines. This rather broad criterion of problem drug use could rarely be met. Available data sources almost always determined the definition of the target group. Instead of problematic drug use (PDU) in most cases prevalence of opiate use (POU) or intravenous drug use (IDU) was estimated. The headings of the result tables in chapter 3.2 to 3.6 reflect in most cases the appropriate target group (for further details see the respective country report).

The demographic and the other multiplier methods using different data (section 3.2 and 3.3.) in general estimate the extent of problem opiate use. With few exceptions the capture-recapture method as well was employed to estimate problem opiate use prevalence (section 3.4). The multivariate indicator method was only applicable in Italy and the UK. In Italy it was used to estimate intravenous heroin use whereas in the UK the prevalence of problematic drug use was estimated (section 3.5). The back calculation method uses the same data base in all countries and estimates refer to the prevalence of intravenous drug use (section 3.6).

3.2 Demographic Method

Table 3-1: Results for the demographic method

Country	Year	Target group	N(POU)
Austria			No treatment monitoring system
Belgium			No national treatment monitoring system with sufficient coverage
Denmark			Data not available
Finland			Data not available
France	1995	Problematic opiate users	176,000
Germany			Data not available
Greece			Data not available
Ireland			Data not available
Italy	1996	Problematic opiate users (mainly heroin IDUs)	239,987
Luxembourg	1996	Hard drug users [2)]	1900
The Netherlands			Data not available
Norway			Data not available
Portugal			Data not available
Spain			- [1)]
Sweden			Data not available
United Kingdom	1996	Problematic opiate users	262,633

1) No country report available

2) Including sedatives, hypnotics, and ecstacy

In the context of the project two methods using treatment data were applied. The demographic method basically calculates the size of a stationary population, i.e., a population with constant entry and exit flows which balance each other. The size of the entry flow multiplied by the expected length of life yields the population size. In the context of prevalence estimation of problem drug use, the entry flow refers to newcomers to treatment and an estimate of the mean duration of problem drug use serves as expected length of life. The assumptions of the method were already discussed in the pilot project stating that the population of problem drug users is not stationary and that the method does not account for drug users who will never get into contact with the help system in the course of their "drug career". Nevertheless, the demographic multiplier method was applied in France, Italy, Luxembourg and the United Kingdom (Table 3-1).

The basic information for the demographic method comes from treatment monitoring systems. Where this information is not available (Austria and Belgium) no estimate is possible. Other countries did not apply the demographic method for various reasons, mostly because they were applying the second method using treatment data (see section 3.3.1). In spite of an existing treatment monitoring system and an estimate of the mean length of problem opiate use, Greece was not able to apply the demographic multiplier method. In Sweden most treatment centres do not provide individual routine data on treated drug addicts. Furthermore, they often do not distinguish between alcoholics, problem drug users or drug-

using and criminal adolescents.

According to the majority of subjects treated in specialised centres the target group estimated in France and the UK is defined as problematic opiate users. While in Italy the majority of subjects in treatment are heroin addicts, the estimate in Luxembourg is based on opiate, sedatives, hypnotics and ecstasy users.

3.3 Multiplier Methods

3.3.1 Treatment Data

Table 3-2: Results for the multiplier method using treatment data

Country	Year	Target group	N(POU)
Austria			No treatment monitoring system
Belgium			No national treatment monitoring system
Denmark			No estimate for the in-treatment rate
Finland	1996	Problematic opiate and amphetamine users	1600-2400
France	1995	Problematic opiate users	156,000
Germany	1996	Problematic opiate users	94,350-140,600
Greece			No estimate for the in-treatment rate
Ireland			No estimate for in-treatment rate
Italy	1996	Problematic opiate users (mainly heroin drug users)	298,989
Luxembourg			No estimate for the in-treatment rate
The Netherlands	1996	Problematic opiate users	25,145-29,104
Norway			Data not available
Portugal			Data not available
Spain			-[1)]
Sweden			Alcoholics, problem drug user, non-problem drug user not distinguishable
United Kingdom	1996	Problematic opiate users	268,258-341,423

1) No country report available

The second method using treatment data utilises an estimate or an expert-rating for the in-treatment rate. The figures in Table 3-2 show the results.

Some countries failed in extrapolating treatment data as there is no treatment monitoring system up to date (Austria, Belgium); the treatment monitoring system was installed in the past years and there was not yet enough information on the in-treatment rate (Denmark, Greece, Ireland, Luxembourg). Other countries could not apply the method as no estimate for the mean length of problem drug use could be derived (Denmark); or the existing data bases cannot be linked (Norway, Portugal).

Two countries, Finland and France, utilised data from annual surveys in treatment centres. France extrapolated these data to one year; Finland combined both survey results and data on drug-related hospital treatment periods to get a rough estimate of the total of treated problem drug users. The remaining countries - Germany, Italy, the Netherlands and the United Kingdom - based their estimates on data from monitoring systems.

Some experts consider the estimated in-treatment rates as not very reliable as they are based on expert-ratings (Germany, Finland) or on accidental sampling (France). In the United Kingdom, in Italy as well as in the Netherlands, the in-treatment rates resulted from surveys among drug addicts in some cities or regions.

3.3.2 Police Data

Table 3-3: Results for the multiplier method using police data

Country	Year	Target group	N(POU)
Austria			Trafficker and user not distinguishable
Belgium			Data not available
Denmark			Data available only for the past two years and trafficker and user not distinguishable
Finland			No data on first-time offenders
France	1997	Problematic opiate users	164,000
Germany	1996	Problematic heroin users	140,843-165,424
Greece			No data on first-time offenders
Ireland			No national police data
Italy	1996	Problematic opiate users (mainly heroin IDUs)	171,531
Luxembourg	1996	Hard drug users [2)]	1800
The Netherlands			No national police data
Norway			No data on first-time offenders
Portugal			No reliable distinction between trafficker and user
Spain			-[1)]
Sweden			No reliable data on individuals
United Kingdom			No individual information on drug users

1) No country report available

2) Including sedatives, hypnotives, and ecstacy

The method as applied in Germany cumulates the number of first-time offenders against drug laws over the past ten years. Ten years is seen as the mean duration of problematic opiate use in the literature. The extent of the hidden population was estimated using the data bases on drug-related deaths. Therefore, the method requires a link between the data base on (first-time) offenders against drug laws and the data base on drug-related deaths. Italy was the only EU member state apart from Germany which was able to apply the method (Table 3-3).

While in Ireland, as well as in the Netherlands, national police data bases do not exist, there were no reliable police data for individuals in Sweden. In the United Kingdom only data on convictions and on drug seizures were available. Other countries failed in applying this method because there was no reliable information on whether an offender was a trafficker or a user (Austria, Denmark, Portugal) or because it was not indicated whether this was a first-time offence (Greece, Finland, Norway). In Belgium, reliable data will be available in 2002.

France as well as Luxembourg utilised police data in a way different from Germany. Both

accounted for the hidden population by utilising an estimate for the proportion of drug users that did not come into contact with the police. In Denmark the necessary information was given only for the past two years. A simple extrapolation to the past ten years would yield a very high figure compared to the estimate from the mortality multiplier method.

3.3.3 Mortality Data

Table 3-4: Results for the multiplier method using mortality data

Country	Year	Target group	N(POU)
Austria			No reliable estimates of mortality rate
Belgium			No estimate of mortality rate
Denmark	1996	Problematic drug users	12,500
Finland	1996	Problematic opiate and amphetamine users	4000-8500
France			Not available
Germany	1996	Problematic opiate users	80,000-112,000
Greece			Not available
Ireland	1996	Problematic opiate users	4694-7884
Italy			Not available
Luxembourg			Not available
The Netherlands			Not available
Norway	1997	IDUs	7200-10,300
Portugal			Not available
Spain			-[1)]
Sweden			Not available
United Kingdom	1995	Problematic opiate users	88,900-177,800

1) No country report available

In the pilot project, Germany was the only country that had traditionally applied the mortality multiplier method. Due to the experiences with this method - in Germany estimates obtained with this method were decreasing with time while all other estimates were increasing - the participants of the pilot project agreed not to employ this method neither in the pilot project nor in the follow-up project. In the meeting of the participants of the follow-up project, Denmark and Norway turned out not to be able to apply any other method. Thus, the participants of the follow-up project decided to also include the mortality multiplier method.

Apart from Germany, Denmark and Norway also Finland, Ireland as well as the UK were able to employ this method. Ireland and Finland have never before conducted studies on mortality rates in their own countries. Finland used a rate of 1-2% which was found in other Scandinavian countries, while Ireland assumed a comparatively low mortality rate of 0.5% because the prevailing mode of administration of heroin in Dublin is smoking. The prevalence estimate for Dublin was extrapolated to all of Ireland. The estimated 1-2% for the mortality rate in Finland seems to be too high as in Finland there is also little intravenous use. The estimated mortality rates in Germany, the UK and Denmark do not exceed 2% whereas in Norway the mortality rate is 2.5-3.5%. This, however, is an estimate of IDU mortality (Table 3-4).

3.4 Capture-Recapture

Table 3-5: Results for the capture-recapture method

Country	Year	Target group	N(POU)
Austria			Only local estimates
Belgium			Not available
Denmark			Not available
Finland	1995	Problematic opiate and amphetamine users	8,700-14,500
France			Only local estimates
Germany			Only local estimates
Greece			Not available
Ireland	1996	Problematic opiate users Opiate users	6304 13,735
Italy	1996	Problematic opiate users (mainly heroin IDUs)	293,814
Luxembourg			Not available
The Netherlands			Only local estimates
Norway			Not available
Portugal			Only local estimates
Spain			-[1)]
Sweden	1992	Heroin users Amphetamine users	1700-3350 8900-12,450
United Kingdom			Estimate for Wales only

1) No country report available

The Capture-recapture method did not belong to the methods evaluated in the 1997 pilot project. Capture-recapture, however, was utilised in Italy with data from private and from public treatment services in 1995. Italy provided a 1996 update of this estimate.

Ireland and Finland were able to extrapolate local prevalence estimates to the whole country as problem opiate use is heavily concentrated in the capital cities. In Ireland capture-recapture data on methadone treatment and on hospital discharges as well as police records were available. To estimate the problem opiate use prevalence a two-sample capture-recapture with medical data alone was applied as the police record may contain also non-problematic opiate users. In Finland, however, the hospital admission register, the police register containing persons suspected of use or possession of opiates or amphetamines and the register of drunken driving offences were employed.

Furthermore, there were local prevalence estimates in Austria, France, Germany, the Netherlands and Portugal as well as a regional prevalence estimate for Wales.

Sweden conducted a case-finding study in 1992 with a sample of 100 communities. For this estimate, heroin addicts and other addicts (mostly amphetamines) were calculated separately. Where amphetamine use was also included, the estimates are three times as high. At present Sweden is conducting a case-finding study in about 50 communities which will also be analysed using capture-recapture methodology (Table 3-5).

3.5 Multivariate Indicator Method

Table 3-6: Results for the multivariate indicator method

Country	Year	Target group	N(POU)
Austria			No second anchor point
Belgium			No regional data
Denmark			No regional data
Finland			No regional data
France			No second anchor point
Germany			No reasonable second anchor point
Greece			No regional data
Ireland			No second anchor point
Italy	1996	Heroin IDUs	248,672
Luxembourg			No regional data
The Netherlands			No drug-related indicators
Norway			No regional data
Portugal			No second anchor point
Spain			-[1)]
Sweden			No anchor points
United Kingdom	1997	Problematic drug use	273,923-288,675

1) No country report available

The multivariate indicator method requires both data on a regional level and reliable estimates for at least two regions (from the higher and the lower range of prevalence rates) which are called anchor points. These requirements hindered the application of the method in most of the participating countries. In Belgium, Denmark, Finland, Greece, Norway, as well as in Luxembourg, data are not collected on a regional level, while in Sweden different administrative regional levels exist which make it difficult to compile a useful number of indicators. Concerning problems due to anchor points, some countries had reliable estimates for only one region (Austria) or only for big cities where problem drug use is heavily concentrated but not for the surrounding regions (Portugal, France, Ireland). Although independent estimates for three bigger cities were available in Germany, no estimate could be derived. Since all three cities had a comparably high prevalence, the resulting estimate was rather unreliable. Furthermore, some of the indicators were not person-based. At present in Portugal there is only one local estimate for the City of Setúbal, but in the near future the application of the multivariate indicator will be feasible.

The multivariate indicator method could be applied in Italy which had used this method before, and in the United Kingdom. The estimate for Italy was calculated using principal component analysis. Indicators used were offences against drug law, drug-related deaths, clients in treatment, cases of AIDS related to IDU and number of addicts in prison. In the UK both versions (principal component and regression analysis or solely regression analysis) of the multivariate indicator method yielded similar national prevalence estimates. Therefore both results are reported in Table 3-6. However, indicators used were not quite the same as for Italy. For the estimation in the UK besides convictions for drug offence, drug-related deaths and clients in treatment (same as for Italy) the cases of HIV (instead of AIDS) related to IDU

were utilised and also seizure of controlled drugs.

In the Netherlands the appropriate indicators were not available on a regional level. They had to be replaced by social indicators such as housing density, crimes against property and mobility. A prevalence estimate has been obtained by regression analysis with the indicators as independent variables. However, as it is yet not clear how the choice of indicators influences the obtained estimate and whether it is indeed comparable to estimates derived from drug-related indicators, the estimate is not reported here. For details see country report.

3.6 Back Calculation (by Carla Rossi and Lucilla Ravà)

3.6.1 Application to EU Countries

The calibration formula has been applied for investigating the extent of problem drug use in the EU countries. As pointed out in Section 2.5., there are limitations in the application of the calibration formula and these are mostly related to the size of the HIV/AIDS epidemic. In particular, it is necessary to be cautious in applying the formula where the epidemic is small both in numbers and in rates as the uncertainties may be very high both in the estimate of the numerator and of the denominator. In such a case it is even impossible to state whether the method may preferably produce overestimates of IDU prevalence or underestimates.

It can be observed that the different countries show quite different situations with respect to the epidemic. This suggests a cautious use of the calibration formula (1) (see 2.6.2). In particular, it is quite impossible to rely upon estimates of the denominator for countries where the epidemic is small, such as Finland, Greece and United Kingdom, where both, the incidence among the general population and the incidence among IDUs are very low (EMCDDA Annual Report 1997). Other countries, such as Denmark and Sweden, may cause problems for the same reason, even if the proportion of AIDS cases related to injecting is not too low. Estimates may also be unreliable in countries such as The Netherlands, Belgium and Germany where the estimates of the denominator are available only at local basis.

Table 3-7: Prevalence estimates of HIV or AIDS cases related to injecting drug use (numerator) in EU countries in the years 1991-1997, obtained by Empirical Bayesian Back Calculation with covariates.

Country	1991	1992	1993	1994	1995	1996	1997
Austria	1,030	1,089	1,142	1,190	1,217	1,230	1,246
Belgium	332	354	375	393	404	411	418
Denmark	312	341	368	393	408	417	427
Finland	21	22	23	23	23	23	23
France	30,017	28,873	2,7615	26,312	24,861	23,359	21,852
Germany	5,354	5,446	5,524	5,605	5,639	5,628	5,627
Greece	173	184	194	202	207	209	212
Ireland	564	599	630	658	676	686	697
Italy	65,462	65,623	64,770	63,552	62,023	60,160	58,281
Luxembourg	42	44	45	47	47	47	47
The Netherlands	934	1005	1,070	1,129	1,164	1,184	1,207
Portugal	5,387	7,156	8,962	10,750	12,230	13,469	14,731
Spain	87,152	92,013	96,369	100,369	103,029	104,694	106,426
Sweden	356	390	423	453	473	487	502
UK	2,398	2,659	2,900	3,122	3,276	3,383	3,495

Table 3-7 shows the results obtained by applying the Empirical Bayesian Back Calculation Method to the AIDS incidence data for the estimation of the numerator of the calibration formula (1) (see 2.6.2). The application of the empirical back calculation procedure to AIDS incidence data has been performed by Dr. Lucilla Ravà. The AIDS incidence data for the EU countries have been provided by Dr. Angela Downs of the European Centre for the Epidemiological Monitoring of AIDS.

3.6.2 Results

In the following, the EU countries are considered separately and the calibration formula is applied on the basis of the estimates reported in Table 3-7 (numerator) and of the denominator coming either from tables reported in the EMCDDA Annual Report 1997 (EMCDDA 1997c) or, whenever available, from the updated figures provided by EMCDDA (EMCDDA 1998). Estimates were calculated only if the epidemic (denominator) is large enough and the prevalence of HIV/AIDS amongst IDUs is considered reliable. Table 3-8 shows the results obtained. It is important to note that the definition of IDU in the present framework is "drug user who has ever injected lifetime".

Table 3-8: Results for the back calculation method

Country	Year	Denominator	N(IDU) [1)]
Austria	1996	1.5-5	Unreliable
Belgium	1993/95	3-5	Unreliable
Denmark	1995	4.0	10,200
Finland	1995	0.1	Unreliable
France	1995	16-20	124,000-155,000
Germany	1996	4 –12	Unreliable
Greece	1994	1.2	Unreliable
Ireland	1993	8.0	8,600
Italy	1995	19	326,000
Luxembourg	1996	2-4	Unreliable
The Netherlands	1996	2-12	Unreliable
Portugal	1996	14	Not reported
Spain[2)]	1996	30	Not reported
Sweden	1996	3-4	Unreliable
UK	1995	1.4	Unreliable

1) Note that the lower figure for national HIV prevalence corresponds with the higher estimate of IDU prevalence and vice versa

2) No country report available

Austria. Some drug treatment services offer anonymous AIDS-testing or special services for HIV-infected persons. Therefore, they particularly attract clients who expect to be infected. Other treatment services offering oral substitution therapy give HIV-positive clients a much better chance to be accepted in the programme and automatically attract more HIV-positive clients as well. Commonly the HIV status is not assessed routinely in treatment facilities or is assessed unreliably; i.e., based on voluntary information by the clients only. Even if the HIV status of clients is known, many institutions hesitate to report these data, even in an aggregated form, because of the sensitive nature of the information. Based on these data it is possible to conclude that presently HIV prevalence among IDUs is very low in Austria. Haas et al. (1998) based on the above mentioned scarce data, some expert ratings concerning the magnitude of biases in these assessments and the fact, that the HIV-rate among persons classified as "Drug Related Death" has dropped from 3.1% in 1995 through 2.8% in 1996 to 1.5% in 1997, conclude that the HIV-rate among IDUs that used to be around 20% at the beginning of the decade has dropped beneath 5% nowadays.

Belgium. The denominator for Belgium comes from EMCDDA (1997c). The size of the epidemic is very small (EMCDDA 1997c). Two "local" estimates of the denominator are

provided for the years 1993 and 1995 respectively, thus N(IDU) could be calculated for both values, extrapolating to the national level, i.e., considering the local estimate of the denominator as a national one. The estimates for the denominator cannot be considered reliable. It should be noticed that the estimates obtained would be lower than the number of known drug users in treatment.

However, a different approach can be chosen by using the true numbers of HIV and AIDS cases registered in two integrated databases at the Scientific Institute of Public Health in Brussels (Sasse et al. 1999). Approximately 600,000 screening tests are yearly performed, excluding the tests related to blood donations. Eight reference laboratories are recognised by the Ministry of Public Health to confirm the results of positive ELISA tests. Since they are the only laboratories subsidised for these tests, their reporting on new HIV-positive individuals gives the number of newly diagnosed seropositives in the country. Applying the following formula, $p(HIV \mid IDU) = \frac{n_{HIV \cap IDU}}{n_{IDU}}$, the number of IDU aged 15-54 years in 1995 could be estimated to be:

$$(6{,}809 \times 0.089) / 0.03 \approx 20{,}200$$

which is equivalent to a prevalence rate of 0.36 % in the population aged 15-54 years. (see also appendix, country report of Belgium for further details).

Denmark. The EMCDDA (1997c) provides a unique value of the denominator for 1995 (4%) that produced the estimate reported in Table 3-8. The epidemic is rather small, therefore the estimate should be considered with caution.

Finland. Finland is a country where the AIDS epidemic is negligible, thus it is not feasible using the calibration formula for estimating N(IDU).

France. The AIDS epidemic in France is quite large and also the proportion of AIDS cases among IDUs is significant. The denominator *P(HIVÈ AIDS|IDU)* from the EMCDDA (1997c) is 16%-20%.

Germany. The epidemic among IDUs is not very large (EMCDDA 1997c). Different estimates were provided for the denominator, mainly on a local basis. Thus N(IDU) is calculated for the interval (4-12%). Compared to the prevalence in Western Germany the proportion of AIDS/HIV among IDUs is still small in Eastern Germany. Taking 4% for a national estimation results in 141,000 IDUs. On the other hand taking the proportion for Western Germany as the denominator resulted in an estimated 47,000 subjects with lifetime IDU experience. This is very low compared to existing estimates (150,000 IDUs). Taking a weighted average of approximately 9% would result in a substantial underestimate. It can be concluded that BC does not improve the already well established information on IDU in Germany (Bühringer et al. 1997).

Greece. Similar to Finland Greece has a negligible AIDS epidemic. Thus the calibration formula was not applied.

Ireland. The EMCDDA (1997c) reports 8% for *P(HIVÈ AIDS|IDU)* in 1993 and the epidemic is considerable. The application of the calibration formula gives the value in the table. Comiskey (1997) in a report for a charitable body called The AIDS Fund estimated that there were approximately 7,500 IV drug users at that time. In the light of this work the result derived by Rossi seems reasonable. However in more recent years the trend in opiate use has been to smoke rather than inject and Rossi's result would be of more use if it could be updated with more recent data.

Italy. Italy has been already considered in depth in the previous methodological sections. Table 3-8 reports the estimate obtained using the numerator from Empirical Bayesian Back Calculation with the covariate "age" (Table 3-7) and the denominator from the Health Care Survey (reported in EMCDDA 1997c).

Luxembourg. The EMCDDA (1998) provides 2%-4% for *P(HIVÈ AIDS|IDU)* in the years 1996-1997. The epidemic is rather small. Estimates are therefore considered unreliable.

The Netherlands. The epidemic is considerable. From EMCDDA (1997c; 1998) results for 1996 of *P(HIVÈ AIDS|IDU)* are reported in the range 2%-26%. Estimates, however, are on a local basis. The estimates of N(IDU) are therefore considered unreliable.

Portugal. The epidemic is considerable. The estimate of the denominator from the EMCDDA (1998) is 14% for 1996. Since the HIV incidence in Portugal was dramatically increasing (EMCDDA 1997c) the estimate is considered unreliable and is not reported.

Spain. The epidemic in Spain is very high, similar to Italy. From the EMCDDA (1997c) 30% are reported for *P(HIVÈ AIDS|IDU)* in 1996. Since no expert from Spain was participating results are not reported.

Sweden. The epidemic is small. The EMCDDA (1997c) reports 4% for *P(HIVÈ AIDS|IDU)* in 1996. Recent updated figures from the EMCDDA (1998) provide an estimate of 3% for the denominator. The estimates are considered unreliable and are not reported. It must be considered that IDUs in Sweden are mostly injectors of CNS stimulants and not of heroin as in the other EU countries (UNDCP 1997).

United Kingdom. The epidemic is small. The EMCDDA (1997c) reports 1.4% for *P(HIVÈ AIDS|IDU)* in 1995. Therefore, estimates for the UK are considered unreliable and are nor reported. See country report for further use of this method in the UK.

3.6.3 Conclusive Remarks

Problems have been encountered in the application of the method in the EU countries mostly due to the availability of reliable estimates of the denominator. In some country this is only available at local level, thus the method would be better applied to estimate anchor points. In The Netherlands, for example, the following local estimates are provided for *P(HIVÈ AIDS|IDU)*: Amsterdam (1996): 26%, Rotterdam (1997): 9%, Utrecht (1996): 5%, Maastricht/Heerlen (1996): 12%, Arnhem (1995): 2%. These figures do not allow to obtain any national estimate by averaging, but they would allow to estimate suitable anchor points, namely Amsterdam, Utrecht and Maastricht/Heerlen for 1996, to be used for regression estimation on the basis of other indicators widely available for The Netherlands. Unfortunately the numerator can presently not be estimated at local level due to lack of suitable AIDS data. Thus, the calibration formula cannot presently be used at local level. On the other hand, even if the denominator is available at national level no external information or national estimate from different sources help to assess the uncertainty and possible bias. Thus, it cannot be stated to what extent the results are uncertain and it is not possible to evaluate the possibility of underestimation or overestimation. Further data analysis is required within each EU country to extend the knowledge on the phenomena involved in this kind of estimation procedures in order to allow the reliable application of the method.

4 Discussion

Results

The summary tables show results for all methods. The ranges given refer to minimum and maximum estimates obtained by the application of different multipliers or in the case of the back calculation method to different denominators. For the capture-recapture method a confidence interval is given for Finland. For Ireland the upper and lower bounds refer to the point estimates of two different target groups. For Sweden the confidence intervals for two different estimates referring to different target groups are reported. With the exception of Austria, Portugal and Greece at least one estimate could be provided for each participating EU country. Since no country report was available for Spain no results are given for this country.

For Belgium, the Netherlands, Norway and Sweden only one estimate is provided. Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg and the UK were able to apply more than one method. It should be noted, however, that each estimate may be based on a slightly different target population and therefore may not be directly comparable to each other even within the same country. Table 4-1 indicates the number of problematic drug users, problematic opiate users or IDUs per thousand inhabitants; Table 4-2 shows the absolute numbers and Table 4-3 gives an overview of the population sizes used to obtain the prevalence rates of Table 4-1.

The demographic and the other multiplier methods using different data estimate in most cases the extent of problem opiate use. With few exceptions the capture-recapture method was as well employed to estimate problem opiate use prevalence. The multivariate indicator method was only applicable in Italy and the UK. In Italy it was used to estimate intravenous heroin use whereas in the UK the prevalence of problematic drug use was estimated. The back calculation method uses the same data base in all countries and estimates refer to the prevalence of intravenous drug use.

If the different methods are seen as targeting different (subordinate and superordinate) groups, figures derived by the back calculation method should be somewhat lower than figures derived by the multiplier methods and the capture-recapture studies, and those lower than the figures of the multivariate indicator method, as problematic opiate use should always exceed intravenous opiate use. This relationship is complicated by the fact that the back calculation method estimates rather lifetime intravenous drug use than past year prevalence. Nevertheless, in France the prevalence rates of the multiplier methods exceed the rates of the BC, as the back calculation method yield about 4 IDUs per 1000 inhabitants and the multiplier methods about 5 problem opiate users per 1000 inhabitants. The same result was obtained for Denmark with about 3 IDUs (back calculation method) and 4 problem opiate users (multiplier methods) per 1000 inhabitants. However, for Ireland and Italy this is not the case, as the estimates of IDUs are higher than the estimates for problem opiate users.

Comparing the figures within a country, great differences can only be seen for the Finnish estimates. The extrapolation from treatment data is much lower than the estimates derived by mortality multiplier probably due to the fact that the treatment data do not include data on addiction treatment but only medical health problems that can be directly related to drug use. The estimate is therefore an underestimate of problematic opiate use prevalence. The figure for the capture-recapture method is far higher than the others, as this method includes the police-register on driving under the influence of psychoactive substances, and therefore might include people not being regular or long duration users.

Table 4-1: Summary of results for the different methods used in the study: Prevalence rates per 1000 inhabitants in the age range 15-54

	Multiplier Treatment data	Multiplier Police data	Multiplier Mortality data	Capture-recapture	Multivariate Indicator	Back calculation (BC)	Other Methods
Target group	**Problematic opiate users**	**Problematic opiate users**	**Problematic opiate users**	**Problematic opiate users**	**Problematic drug users**	**Intravenous drug users**	
Austria							
Belgium							3.6[c)]
Denmark			4.1[7)]			3.4	
Finland[6)]	0.6-0.8		1.4-2.9	3.0-5.0			
France	4.8	5.1				3.8-4.8	5.4[d)]
Germany	2.1-3.1	3.1-3.7[3)]	1.8-2.5				
Greece							
Ireland			2.3-3.8	3.1-6.7[2)]		4.2	
Italy	9.3	5.3		9.1	7.7[5)]	10.1	7.4[d)]
Luxembourg		8.2[1)]					8.6[1,d)]
Netherlands	2.8-3.2						
Norway			2.9-4.2[8)]				
Portugal							
Spain[a)]							
Sweden				0,4-0,7[3,b)] 1,9-2,6[4,b)]			
UK	8.3-10.5		2.7-5.5		8.4-8.9		8.1[d)]

Table 4-2: Summary of results for the different methods used in the study: Absolute numbers for the age range 15-54

Country	Multiplier Treatment data	Multiplier Police data	Multiplier Mortality data	Capture-recapture	Multivariate Indicator	Back calculation (BC)	Other Methods
Austria							
Belgium							20,200[c)]
Denmark			12,500[7)]			10,200	
Finland[6)]	1,600-2,400		4,000-8,500	8,700-14,500			
France	156,000	164,000				124,000-155,000	176,000[d)]
Germany	94,350-140,600	140,843-165,424[3)]	80,000-112,000				
Greece							
Ireland			4,694-7,884	6,304-13,735[2)]		8,600	
Italy	298,989	171,531		293,814	248,672[5)]	326,000	239,987[d)]
Luxembourg		1,800[1)]					1,900[1,d)]
Netherlands	25,145-29,104						
Norway			7,200-10,300[8)]				
Portugal							
Spain[a)]							
Sweden				1,700-3,350[3,b)] 8,900-12,450[4,b)]			
UK	268,258-341,423		88,900-177,800		273,923-288,675		262,633[d)]

a) country report not available
b) 1992
c) estimate using HIV/AIDS register
d) demographic method (probl. opiate users)
1) hard drug users
2) opiate users - probl. opiate users
3) problematic heroin users
4) problematic amphetamine users
5) heroin IDUs
6) probl. opiate and amphetamine use
7) probl. drug users
8) IDUs

Table 4-3: Population size used to calculate the prevalence rates per 1000 inhabitants (age 15-54)

Country	Population size (15-54 years)
Austria	4,608,295
Belgium	5,602,499
Denmark	3,014,995
Finland	2,895,000
France	32,431,857
Germany	45,207,736
Greece	5,580,553
Ireland	2,061,028
Italy	32,315,499
Luxembourg	220,572
The Netherlands	9,117,319
Norway	2,462,300
Portugal	2,680,894
Sweden	4,765,656
UK	32,481,100

Population size has been obtained by the country reports, except for the UK and Norway

Source for UK and Norway: Recent demographic developments in Europe. Council of Europe: 1997

The prevalence rates of Italy, Luxembourg, and the United Kingdom are highest (about 8 problem opiate users per 1000 inhabitants), followed by France with about 5 problem opiate users per 1000 inhabitants, whereas the rates for Finland and Sweden are at the lower end (1 to 2 problem opiate users per 1000 inhabitants). Denmark, Germany, Ireland, the Netherlands, and Norway are ranked between France, Finland and Sweden, and show quite comparable prevalence rates with about 3 problem opiate users per 1000 inhabitants.

For column-wise comparisons across countries it has to be kept in mind that the target group may to some degree vary between methods since indicators, benchmarks or multipliers are not always identical. While most estimates refer to annual prevalence of problem opiate use, the back calculation method estimates lifetime prevalence of intravenous drug use (IDU).

Definition

With the exception of BC, which is clearly related to IDU, and the multivariate indicator method, which might cover problematic drug use, as it includes indicators from a variety of target groups, all other methods are more or less defined to estimate prevalence of problem opiate use. Apparently, problem opiate use prevalence should always exceed IDU prevalence. In this case, however, the relationship is not quite clear since the obtained IDU estimate from BC refers to lifetime IDU. Therefore, no systematic pattern can be observed. Italy, for example, shows higher rates for IDU derived from BC than for problem opiate use when estimated making extrapolations from police, treatment or mortality data. Apart from random variations, this may be due to an almost negligible proportion of non-intravenous problem drug use. This proportion, however, may vary substantially between countries. Similar estimates are to be expected in some cases, for example when the number of AIDS cases related to IDU is taken as an indicator in the multivariate model (Italy, UK). Drug-related deaths are also strongly related to intravenous use of opiates. Indicators that identify consequences of drug use such as deaths or AIDS are inherently more related to IDU than indicators such as treatment admissions or drug-related convictions.

Methods

Multiplier methods using treatment, police, or mortality data are ad hoc methods. They are not based on statistical theory and no formula for the variation of the estimator can be derived. Benchmarks are usually collated on a national level. The corresponding multipliers are derived from local samples or expert ratings. Their validity for the total population is questionable due to regional and temporal variations. These methods are easy to apply and give only point estimates.

The capture-recapture method is embedded in the framework of log-linear models. Confidence intervals are easily obtained indicating the precision of the estimate. The properties of this method have been studied intensively on city levels. Not much is known yet about the extension to regions or nations. The problems are manifold, e.g., false positives, false negatives, double counting, identification problems of individuals. National estimates may be even more sensitive to the impact of these factors. If the capture-recapture method were to be extended at local level within countries then we would probably have more reliable regional estimates for use in national prevalence estimation.

The requirements for the application of the multivariate indicator method are complex. Firstly, countries need to have a federal administrative structure. Secondly, each region has to collect the required drug-related indicators in the same way. Thirdly, reliable estimates for at least two regions to be used as anchor points are necessary. These conditions cannot be met by some EU countries, which completely rules out the application of this method. The comparability across EU countries along this dimension is therefore limited.

While the BC method performs quite well in estimating HIV incidence, the estimate of IDU prevalence is very sensitive to P(HIV∪AIDS/IDU). In most countries, different samples give fairly different proportions, which leads to rather wide intervals. Other problems emerge from low proportions of AIDS or HIV among IDUs and if the AIDS epidemic is very small as in Denmark. On the other hand, data on AIDS incidence are available for all EU countries in a central file and estimates can be calculated for almost all EU countries. Given reliable estimates for the denominator P(HIV∪AIDS/IDU) most countries would be comparable using this methodology.

Conclusions

From the discussion of results, definitions and methods it becomes clear that the enterprise of improving comparability of prevalence estimates of problem drug use in EU member states has not yet reached its final destination. There are still serious obstacles which could not be overcome within this project. Epidemiological data such as information of treatment systems or various indicators of problem drug use are still far from being gathered in a way which makes them completely comparable. Since these data systems and statistics were established long before they were used as a basis for prevalence estimates and in most cases have been collated for other reasons than the ones described here, most countries will probably have good reasons for being reluctant to change their way of data collection.

As can be seen in Table 4-1 there is no single method providing estimates for all countries. There are still too many empty cells in the table indicating that this report is not the end point of the discussion which surrounds the use of these methods. The discussion, however, has to go beyond the methodological issues. The data itself have been identified as the most crucial part in this context. The information given in the reports on how data are collated in each of

the participating countries makes clear that the issue of estimating drug prevalence is apparently an issue of data collection. As long as we do not have a uniquely-defined data set across all EU countries, comparative tables will not be free of footnotes indicating why comparisons should be done with caution. Furthermore, since indicators of drug use are indirect measures of IDU or problem drug use, the uncertainty of the relation between obtained estimates and the defined target group will always remain.

While the main problems remain unsolved, this report for the first time contains prevalence estimates attained with a number of methods, the same data definitions, over the same time period and for the same age group (15-54). The country reports in the annex give a full account of data collection procedures and data quality as well as problems connected with the application for each method in 14 EU countries and Norway. The epidemiological and methodological advances made within this project will be of help for future work in the context of national prevalence estimates. The next step would be a closer link between various working groups of experts within the network of the EMCDDA, namely, the local estimation group, the workgroup on geographic spread of drug use and the workgroup concerned with dynamic models.

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Annex - Country Reports

Austria

Belgium

Denmark

Finland

France

Germany

Greece

Ireland

Italy

Luxembourg

The Netherlands

Norway

Portugal

Sweden

United Kingdom