

E.M.C.D.D.A.

**European Monitoring Centre
for Drugs and Drug Addiction**

EMCDDA Recommended Draft Technical Tools and Guidelines

**Key Epidemiological Indicator:
Prevalence of problem drug use**

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Status of the guidelines

These guidelines are based on a series of seminars and projects, organised by the EMCDDA and the IFT, to improve quality and comparability of national estimates of problem drug use prevalence. The projects brought together experts from EU countries and the EMCDDA to discuss possible methods, data availability and target definitions. Several estimation methods emerged that have subsequently been tested in the countries. Results have been reported in the 1999 to 2003 EMCDDA Annual Reports. Additional, supporting documents on local prevalence estimation, incidence estimation and patterns and careers of problem drug use have been included in the list below. This document is an updated version of the original guidelines as they were published in 2000.

Supporting documents

- European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). Study to Obtain Comparable National Estimates of Problem Drug Use Prevalence for all EU Member States. (CT.97.EP.04) Lisbon: EMCDDA, October 1999.
- European Monitoring Centre for Drugs and Drug Addiction. Work Report; Methods of national prevalence estimation (CT.99.RTX.05). Lisbon: EMCDDA, September 2000.
- European Monitoring Centre for Drugs and Drug Addiction / Pompidou Group of the Council of Europe. Estimating the Prevalence of Problem Drug Use in Europe. EMCDDA Scientific Monograph Nr 1. Lisbon: EMCDDA, 1997.
- European Monitoring Centre for Drugs and Drug Addiction. Methodological Pilot Study of Local Level Prevalence Estimates. (CT.96.EP.07) Lisbon: EMCDDA, December 1997.
- European Monitoring Centre for Drugs and Drug Addiction. Methodological Guidelines to Estimate the Prevalence of Problem Drug Use on the Local Level. (CT.97.EP.05) Lisbon: EMCDDA, December 1999.
- European Monitoring Centre for Drugs and Drug Addiction. Scientific Review of the Literature on Estimating the Prevalence of Drug Misuse on the Local Level. (CT.97.EP.05) Lisbon: EMCDDA, July 1999.
- European Monitoring Centre for Drugs and Drug Addiction. Study on Incidence of Problem Drug Use and Latency Time to Treatment in the European Union. (CT.99.EP.05) Lisbon: EMCDDA, December 2000.
- European Monitoring Centre for Drugs and Drug Addiction. Pilot Project to Estimate Time Trends and Incidence of Problem Drug Use in The European Union. (CT.98.EP.07) Lisbon: EMCDDA, March 1999.
- European Monitoring Centre for Drugs and Drug Addiction. Feasibility Study on the Implementation of Longitudinal Studies on Changing Patterns of Use, Health Risks,

Careers and Needs in Young Problem Drug Users (YPDUs) (CT.99.EP.02B) Lisbon: EMCDDA, December 2000.

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- European Monitoring Centre for Drugs and Drug Addiction. European Network to Develop Policy Relevant Models and Socio-Economic Analyses of Drug Use, Consequences and Interventions. (ERB 4141 PL 980030) Lisbon: EMCDDA, 2002.
- European Monitoring Centre for Drugs and Drug Addiction. National Prevalence Estimates of Problem Drug Use in the European Union, 1995-2000. (CT.00.RTX.23) Lisbon: EMCDDA, 2003.

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Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
BC	Back calculation method
DSM	Diagnostic and Statistical Manual of Mental Disorders
ENAADS	European Non-Aggregate AIDS Data Set
EMCDDA	European Monitoring Centre for Drugs and Drug Addiction, Lisbon, Portugal
EU	European Union
HIV	Human immunodeficiency virus
ICD	International Classification of Diseases
IDUs	Injecting drug users
IFT	Institute for Therapy Research, Munich, Germany
LADIS	Dutch National Alcohol and Drugs Information System
RELIS-LINDDA	Luxembourg Network on Drugs and Drug Addiction
UK	United Kingdom

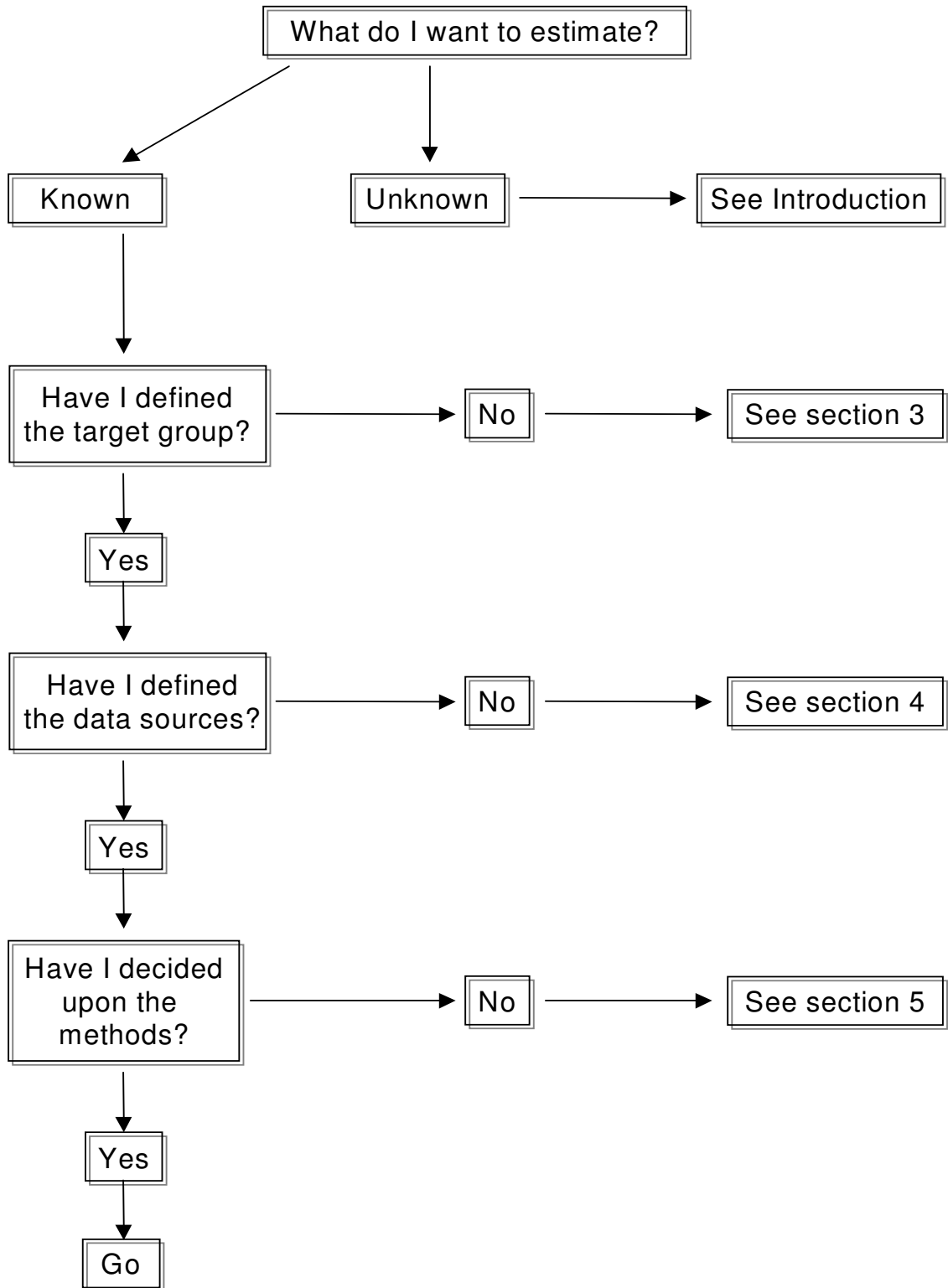
1. Introduction

It is acknowledged that accurate information on the prevalence of drug use and especially that of heroin and other opiate use is difficult to obtain. Evidence from national surveys and other sources indicate that the prevalence of heroin use in the general population is relatively low. However, most of the widespread drug-related health and social problems in EU countries are caused by the use of heroin and other opiates. Nevertheless, the substances causing health and social problems as well as the route of administration of these substances vary across Europe. In Sweden, for example, the drugs causing most of the problems are amphetamines, although like in Norway and Finland a new heroin wave is challenging the drug help system. On the other hand, the most common practice of using heroin in the UK is sniffing ("chasing the dragon") whereas in Germany, France and Italy intravenous use is the common way of administration.

These differences in substances and routes of administration make a common definition of the target group rather difficult, since different substances and practices of use are related to different health problems. Nevertheless, comparisons across countries with regard to the extent of drug use call for a common definition of the target group, the use of equivalent data sources, and the application of the same methodology. In an attempt to find a common definition in spite of the differences between the EU countries we use the term *problem drug use* which includes all different forms of problems due to the use of opiates, cocaine, and amphetamines irrespective of the route of administration.

Since most of the methods which are commonly used in EU countries to estimate the national prevalence of problem drug use are rather simple in terms of the mathematics required, this guide will focus on the definition of the target group and data requirements rather than on the statistical properties of the methods.

2. Guide to the Guidelines



3. Target Group

The definition of the population targeted at by any prevalence estimation in the drug field is one of the most difficult tasks. The identification of substance users can only be derived from the known population, i.e., only when an individual comes into contact with the legal, medical or social system do we know that he or she is a user. Any definition of problematic drug use should therefore consider these three perspectives with their different interests, norms and values. In practice, however, the simultaneous consideration of these three perspectives is often not possible, may be e.g. due to the non-availability of data bases or lacking links between data bases. Thus, the researcher is very often left with a pragmatic definition of the target group.

Clinical System

The International Classification of Diseases (ICD) and the Diagnostic and Statistical Manual of Mental Disorders (DSM) give clear criteria for dependence on specific psychotropic substance groups, as well as for abuse. Consequently, all other use can be assumed as unproblematic.

DSM-IV disorders related to psychotropic substances include the following substance groups:

- Alcohol
- Opioids (e.g. heroin, morphine, codeine, methadone)
- Cocaine (e.g. cocaine, crack)
- Amphetamines (e.g. amphetamine, dextroamphetamine, methamphetamine, methylphenidate)
- Sedatives, hypnotics, anxiolytics (e.g. benzodiazepines, barbiturates)
- Hallucinogens (e.g. LSD, mescaline, ecstasy, psilocybin, DMT)
- Phencyclidine (e.g. PCP, ketamine)
- Inhalants
- Cannabis
- Nicotine
- Caffeine
- Multiple substance use is defined as use of substances of at least three substance groups in the last 12 months, without a clear preference for one main substance (except nicotine and caffeine)

The DSM-IV differentiates between dependence on substances and abuse of substances.

Criteria for Substance Dependence

A maladaptive pattern of substance use, leading to clinically significant impairment or distress, as manifested by three (or more) of the following, occurring at any time in the same 12-month period:

- (1) Tolerance, as defined by either of the following
 - a) a need for markedly increased amounts of the substance to achieve intoxication or desired effects
 - b) markedly diminished effect with continued use of the same amount of the substance
- (2) withdrawal, as manifested by either of the following:
 - a) the characteristic withdrawal syndrome for the substance

- b) the same (or a closely related) substance is taken to relieve or avoid withdrawal symptoms
- (3) the substance is often taken in larger amounts or over a longer period than was intended
- (4) there is a persistent desire or unsuccessful efforts to cut down or control substance use
- (5) a great deal of time is spent in activities necessary to obtain the substance (e.g., visiting multiple doctors or driving long distances), use the substance (e.g., chain-smoking), or recover from its effects
- (6) important social, occupational, or recreational activities are given up or reduced because of substance use
- (7) the substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance (e.g., current cocaine use despite recognition of cocaine-induced depression, or continued drinking despite recognition that an ulcer was made worse by alcohol consumption).

Criteria for Substance Abuse

- A. A maladaptive pattern of substance use leading to clinically significant impairment or distress, as manifested by one (or more) of the following, occurring within a 12-month period:
 - (1) Recurrent substance use resulting in a failure to fulfil major role obligations at work, school, or home (e.g., repeated absences or poor work performance related to substance use; substance-related absences, suspensions, or expulsions from school; neglect of children or household)
 - (2) Recurrent substance use in situations in which it is physically hazardous (e.g., driving an automobile or operating a machine when impaired by substance use)
 - (3) Recurrent substance-related legal problems (e.g., arrests for substance-related disorderly conduct)
 - (4) Continued substance use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the substance (e.g., arguments with spouse about consequences of intoxication, physical fights)
- B. The symptoms have never met the criteria for Substance Dependence for this class of substance.

The International Classification of Diseases (ICD-10) codes refer to the dependence syndrome 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.“ Harmful use is defined as a consumption pattern, that leads to health problems (e.g., a physical disorder like hepatitis or a psychological disorder like depressive episodes). The diagnosis demands an actual harm of the psychological and/or physical health of the user.

These coding systems also account for the social system, as persons seeking help because of their substance use are very likely to fulfil the clinical criteria of ICD or DSM for at least abuse or harmful use. This can be quite different for the medical system.

Medical System

Substance users can be treated purely medically, because of a variety of reasons, like e.g. regular medical examination, pregnancy, dental state, non-fatal accidents under the influence of psychotropic substances, long-term effects of drug use like hepatitis or HIV, or they may try to utilise also prescribed drugs. In all these cases, it may not be clear, whether an individual fulfils the diagnostic criteria, as no diagnose of drug problems will be made. It may furthermore not be clear, whether practitioners know the status of their patients, or whether they are indeed „unproblematic drug users“. If not very specific information of such a data source can be obtained, only „use“ of psychotropic substances can be estimated. In a German study, it has been estimated that 44% of the practitioners treat patients that are regular hard drug users (Kirschner & Kunert, 1995).

The data described above refers only to the health and social systems. Other data sources have never been meant to cover these medical and/or clinical definitions and must therefore be based on different definitions (e.g., data of the legal system). However, the legal status of the substances varies between countries, which leads to difficulties in determining what a „problematic use“ may be according to different legal systems.

Legal System

An operational definition of problematic use may be that any person having come into contact with the legal system, i.e., having been registered in any police data base, has indeed a problem with his consumption pattern, and is therefore a problematic user. This can furthermore be differentiated in use of illicit substances or use of licit substances, that were obtained illegally.

Demands on a Definition

Definitions of target group may combine a certain time period (e.g., a certain year), a specific substance group (e.g., opioids, amphetamines), the route of administration (e.g., intravenous injecting, smoking), frequency of use (e.g., experimental, occasional, habitual, regular, long duration), legal status (illicit, licit), and clinical diagnoses (dependence, abuse). As the utilised data bases, e.g. police data files or treatment monitoring systems, usually report data for a calendar year it is natural to use this time frame also for the prevalence estimation of problem drug use. Even when referring to the broadest possible target group, the „drug users“, any definition should include

- a time period
- an age group
- frequency of use
- and a definition of substances.

From an epidemiological point of view, the definition should include an age group. As in the age group of the 15-34 year olds substance use is most spread, prevalence rates in this age group will be higher than in the age group of the 15-64 year olds. This may furthermore be relevant, if “youth drugs” are examined. Studies on a national scale should consider if and how differences in the age structure of the general population distort comparisons. For comparisons of different national states prevalence rates per 1, 000 inhabitants of a certain age group should be calculated.

Pragmatic Definition

Not only does prevalence of substance use vary between countries, birth cohorts, and even gender, also route of administration differs greatly between substances, countries and cohorts. Even if route of administration and frequency of use could clearly be related to a more or less hazardous consumption pattern, this information may not be directly available. Furthermore, substances are used in quite mixed, often chaotic patterns. Only very few opiate users do not use other drugs as well. On the other hand opiates, especially heroin, are the drugs, which cause most of the problems. If the pattern of drug use has to be labelled and categorised in a simple way, it can be done on the basis of the drug which causes the highest risk. Complexity can be further reduced by omitting the notion of primary and secondary drugs, and not accounting for polydrug use.

A pragmatic definition for coding according to this concept can be summarised as follows:

- If a person uses heroin or other opiates he or she is always classified as opiate user regardless whether other drugs are taken as well.
- 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.

Although not all groups of problem drug users are covered by this definition (e.g. problematic users of cannabis), they are not included in the target group as the estimation methods described in these guidelines are in most cases not appropriate for these groups. For example, the mortality multiplier method can only be applied for groups of drug users who have a considerably high risk of dying because of their drug use. This applies in the first place to intravenous opiate users (most European countries) and amphetamine users (Sweden and Finland).

This logic of categorising patterns of drug use is summarised in table 1.

Table 1: **Groups of problem drug users**

	Groups	Opiates	Cocaine	Amphetamines
Opiate users	Problem Opiate user	Yes	Yes/No	Yes/No
Non-opiate users	Problem Cocaine user	No	Yes	Yes/No
	Problem Amphetamine user	No	No	Yes

As mentioned in the section “Demands on a Definition” above the definition of the target group should not be restricted to the substances but should also include a time period, an age group as well as consumption patterns. Clinical diagnoses would be preferred but are not available from most of the data bases. As time period a one year period is widely accepted to define a current status. Since many data bases do not include age, the age range of the target group should be wide enough to cover the majority of problem drug users. On the other hand reference to the total population does not make sense because different demographic structures in different countries would make cross-national comparisons unreliable. Within the EMCDDA project the age range 15-54 was chosen. To increase comparability with other indicators, the more often used age range 15-64 should be selected.

In summary, we arrived at the following:

An operational definition of a target group would be

- Intravenous drug use (IDU) or long duration/regular use of opiates, cocaine or amphetamines,
- During a one-year period,
- In the age group 15-64.

Literature

Kirschner, W. & Kunert, M. (1995). *Umfang und Struktur von i.v. Drogenabhängigen in Deutschland. Anonymes Monitoring in den Praxen niedergelassener Ärzte*. Empirie der Gesundheitswissenschaften, Bd. 1. München: Profil Verlag.

4. Data Sources

Clinical, Medical, and Social System

The clinical, medical and social systems collect the most detailed information on drug users. A drug user can come into contact with:

- Drug treatment agencies (inpatient versus outpatient, specialised on drug care versus general treatment agencies; e.g., drug counselling centres, general counselling centres, psychiatric hospitals, and specialised hospitals),
- Low threshold agencies (e.g., needle and syringe-exchange schemes, drop-in centres),
- Substitution services (dependent on the regulation in each country these may be general practitioners, substitution ambulances, hospitals, treatment agencies),
- General practitioners (medical reasons),
- Emergency ambulances (mobile or stationary),
- HIV/hepatitis related services,
- Clinical psychologists,
- Psychiatrists.

Problems associated with these data sources are:

- In general, treatment monitoring systems do not cover all treatment facilities of a country. To utilise treatment data for prevalence estimation an extrapolation of the treatment centres included in the monitoring system to all treatment centres is necessary. For an estimate of the coverage rate, the exact number of centres involved in treatment of drug addicts must be known. Besides, the treatment facilities represented in the treatment monitoring system may differ from others, e.g., with respect to the average number of treated drug users. Note, that the coverage rate should not be confused with the in-treatment rate which is the proportion of problem drug users in treatment.
- Agencies usually collect their data for themselves, and in rather few countries a general treatment monitoring system covering most of the treatment centres has been established. Furthermore, double counting cannot be excluded, as many drug users will come into contact with a variety of treatment facilities. Due to privacy laws utilising unique personal identifiers to prevent double counting is impossible in some European countries.
- Drug users in urban areas have more options for receiving treatment in comparison to rural areas. On the other hand, the latency period between onset of drug use and treatment admission seems to be shorter in less urbanised areas which might be related to stronger social cohesion in rural areas. Therefore, the probability of coming into contact with treatment facilities is nationwide not constant.
- Some treatment agencies are interrelated and send patients to certain other centres.
- The capacity of facilities is limited, drug users may be set on waiting lists. They might break off contact again, before any data can be collated, or they may leave incomplete, unreliable or even wrong data. There exists a population of drug users not covered by the drug-related social and medical system.
- It is very likely, that every drug user comes into contact with a general practitioner, but this rather seldom utilised data base has manifold problems. It is not clear, how many drug users will be recognised while visiting a doctor for medical reasons not

obviously related to drug-use. Furthermore, in case of a non-fatal accident under influence of psychotropic substances it is almost impossible to distinguish between regular, occasional or experimental users.

Legal System

Data of drug users can be found in registers

- on convictions because of offences against laws on consumption, possession or supply of illegal drugs,
- on convictions because of secondary crimes, i.e. offences associated with the obtaining of drugs (theft, shoplifting, prostitution, forgery),
- on convictions because of offences under the influence of psychotropic substances (e.g. driving, violence),
- on detainees in connection with the above mentioned categories,
- on mortality (e.g., all-cause deaths of registered drug users, drug-related deaths).

Problems associated with these data sources are:

- It is difficult to distinguish between consumers and dealers of drugs. Frequency of drug use cannot easily be obtained, in order to separate regular from experimental users. Police recordings do usually not distinguish between minor experimentation with drugs, severe drug problems, mere trade without consumption, and long or regular users.
- It is not clear if utilising data bases on offences tends to underestimate or to overestimate problem drug use prevalence as an offence can be committed by several offenders and on the other hand one individual can commit several offences.
- Secondary crimes may not be registered at all, and dependent on the drug policy of a country no special attention may be paid on detecting them as connected to drug use.

Mortality Data

Most European countries have national and/or regional mortality registers where deaths are coded using the International Classification of Diseases (ICD). However the definition of drug-related deaths and/or the registration strategies may vary across countries. While in the Netherlands and in Italy only deaths due to an overdose are registered as drug-related deaths in other countries a wider definition is adopted. In Germany a drug-related death includes deaths “following overdose, as a result of a long-term abuse, suicide resulting from despair about the circumstances of life or the effects of withdrawal symptoms, and fatal accidents under the influence of drugs”. In Denmark “deaths caused by accident or suicide due to: misuse of illegal drugs; misuse of other drugs if the deceased was a known drug addict; or misuse of intoxicating but not illegal drugs” are registered as drug-related deaths (EMCDDA, 1997). The applied definition and/or the registration strategies may vary to a great extent not only between different European countries, but also within one country between regions or urban in contrast to rural areas.

An overdose may be accidental, intentional or undetermined. Accidental overdoses include deaths after periods of abstinence when the tolerance has changed, as well as overdoses while using methadone or naltrexon. An overdose can also be held responsible when in fact the substance is contaminated. Regular as well as occasional users can die of an overdose. This death may be coded as a drug-related death or it may be coded alternatively as due to respiratory failure. The latter code will not be detected as a drug-related cause, if the deceased has not been known as a drug user before. Therefore, the number of deaths from any regional or national register will very likely be a lower limit of the actual figure.

Further types of drug-related deaths are fatal accidents under the influence of psychotropic substances (excluding alcohol) and suicides related to dependence on drugs. Deaths resulting from long-term abuse of psychotropic substances can be part of the definition as well as deaths due to violence under the influence of psychotropic substances. It is important to understand how the registration operates, who completes death certificates (pathologist or medical practitioner). Valuable information can also be gained from customary practices of coding primary and secondary causes of fatalities associated with drug overdoses. If it is not possible to establish the number of all-cause deaths, some subsets may be more clearly defined, e.g., drug overdoses.

Links Between Data Bases

When data bases are linked, definitions should be comparable between sources along several dimensions:

- Substances used
- Time period
- Age range
- Frequency of use
- Route of administration
- Geographical area

In most cases, data sources may not be comparable along all characteristics listed above, some may not even be explicitly recorded (e.g., route of administration, or frequency of use may not be recorded in a police register). For some properties of the selected data, it is possible to collate the data or clean them afterwards according to given definitions (e.g., age range). If this is not possible, at least a minimum definition covering substances used, time period and age group should be met. Data requirements for single methods are considered in the specific chapters.

Literature

EMCDDA (1997). *Annual Report of the State of the Drugs Problem in the European Union*. Lisbon: EMCDDA.

5. Methods

5.1. The Multiplier Method

In the context of problem drug use the total population of drug users T is unknown (partly hidden population). Given a sample of size B of the population in question (benchmark) and the probability c for someone of this unknown population to be member of the sample, the total population T can be estimated from

$$T = B / c$$

- B: the number of identified problem drug users (sample or benchmark)
- c: a parameter giving the probability of a problem drug user (unknown target population) to be member of the identified sample B

Note that dividing by c is equivalent to multiplying by $1/c$ (multiplier) (table 1).

The number of identified problem drug users (benchmark) is usually provided by or calculated from routine sources, e.g. by treatment centres, monitoring systems, police, drug death and/or HIV/AIDS registers. Generally, the value of the benchmark can be taken directly from a register or can be extrapolated by simply multiplying the given data with an appropriate factor. For instance, multiplying the number of treatment centres covered by a monitoring system with the coverage rate yields the benchmark for the treatment multiplier method.

The value for c must be estimated using independent external information and should be updated from time to time. This requires extensive research as expert ratings may be misleading. Appropriate estimation methods include capture-recapture (see chapter 5.2) or nomination techniques. Nomination techniques refer to sampling methods that collect data not just from the respondent but also from persons nominated by the respondent (Taylor, 1997; Korf, 1997). Sometimes, results of other projects can be used as well. For example, one spin-off of a project on drug-related deaths in five South German cities was an estimate of the in-treatment rate of opiate dependents (Augustin & Kraus, 2004)

Usually, multipliers are estimated from small-scale studies. A generalisation of this local estimate to the whole country may be problematic as e.g. the probability of an opiate user to get into contact with the police may vary over regions and cities due to law enforcement activities. Therefore it is recommended to use mean estimates from at least 3 to 4 different areas including cities and rural municipalities.

Benchmark and multiplier must fit each other and the target group. If e.g. the number of drug-related deaths is used to estimate the number of problem opiate users both benchmark (drug-related deaths) and multiplier (mortality rate) must be based on the same definition of drug-related deaths (overdoses vs. all-cause deaths). For the estimation of the prevalence of problem cocaine use based on treatment data an in-treatment rate derived from a sample of opiate dependents may be misleading.

Table 1: Data and sources for the multiplier method

Parameter	Data	Source of information	Section
B	Number of problem drug users who underwent treatment in a given year	Treatment centres, Monitoring systems	5.1.1
c	Probability for a problem drug user to be treated (in-treatment rate)		
B	Number of registered problem drug users in a given year	Police	5.1.2
c	Probability for a problem drug user to be registered by the police in that year		
B	Number of problem drug users registered by the police for the first time (over a period reflecting mean duration of addiction)	Police	5.1.3
c	Proportion of drug-related deaths that have previously been registered by the police as problem drug users (also over the same period)		
B	Number of drug-related deaths in a given year	Mortality register, Police	5.1.4
c	Probability of death among problem drug users in the same year		
B	Number of HIV infected drug injectors in a given year	HIV/AIDS register	5.1.5
c	Prevalence of HIV infections among drug injectors in the same year		

B=benchmark, c=multiplier

Literature

Augustin, R. & Kraus, L. (2004). Changes in prevalence of problem opiate use in Germany between 1990 and 2000. *European Addiction Research*, 10, 61-67.

Korf, D. J. (1997). The tip of the iceberg: Snowball sampling and Nomination Techniques, the experience of Dutch studies. In EMCDDA & Council of Europe (Eds.), *Estimating the Prevalence of Problem Drug Use in Europe* (Scientific Monograph Series Nr. 1, pp. 171-184). Lisbon: EMCDDA.

Taylor, C. (1997). Estimating the prevalence of drug use using Nomination Technique. In EMCDDA & Council of Europe (Eds.), *Estimating the Prevalence of Problem Drug Use in Europe* (Scientific Monograph Series No. 1, pp. 157-170). Lisbon: EMCDDA.

5.1.1 Multiplier Method Using Treatment Data

The number of problematic drug users registered in treatment-centres serves as benchmark. If the treatment monitoring system does not cover all treatment centres an estimate of the treatment coverage-rate should be used to extrapolate to all treatment centres. The in-treatment-rate of problematic drug users has to be estimated, e.g. by applying snowball-sampling and other nomination-techniques as described in Taylor (1997).

Example: The Netherlands

The benchmark is the total number of opiate users (including poly-drug users) in outpatient treatment centres registered in the Dutch National Alcohol and Drugs Information System (LADIS) which has a comparatively high coverage. Only 2,777 methadone clients of the Municipal Health System in Amsterdam and 1,334 methadone clients of the Symbion Foundation in Rotterdam are not included in LADIS. Adding those clients to the 14,748 problematic opiate users registered in LADIS yields a total of 18,859 problematic opiate users in 1996. Any presumable overlap between the clients in LADIS and those added from Rotterdam and Amsterdam could not be excluded.

The multiplier was based on research in two regions, namely in Amsterdam and in Rotterdam (Buster & Reurs, 1997; Toet, 1995). In both regions the in-treatment rate estimate was 0.70. Because of a lack of information about in-treatment rates outside Amsterdam and Rotterdam a range of 0.65-0.75 seems to be reasonable. Given that the care agencies reached on average 65% of the total number of users nationally, there are $18,859/0.65=29,014$ estimated problem opiate users in the Netherlands: If 75% is taken as an average percentage nationally, there are $18,859/0.75=25,145$ estimated problem opiate users in the Netherlands (Toet, 1999).

Data Demands

The treatment monitoring system should not only provide figures of drug users seeking treatment categorised by main substance groups, but should also be able to avoid double counting. Furthermore, it is important to consider the coverage rate of the monitoring system.

An estimate of the treatment coverage rate cannot be obtained easily as treatment centres can include inpatient and outpatient treatment facilities, e.g., specialised drug care centres, low- and high threshold agencies, general psychiatric hospitals, doctors' surgeries and substitution programmes as well as smaller substitution facilities. Thus simply extrapolating the treatment centres included in the monitoring system to all the treatment centres may give a wrong picture. In Germany, for instance, extrapolating the number of treatment centres yields a much smaller coverage rate than extrapolating the number of staff of the treatment centres as bigger treatment centres are more likely to be included in the treatment monitoring system. Besides, drug users can be treated because of a variety of other reasons connected to problematic drug use, like e.g., hepatitis. It is necessary to define the extent of treatment that will be taken into account for the treatment monitoring system: shall only treatment because of dependence and abuse be taken into account or shall also data on other health

problems connected with problem drug use be utilised? How can the problem of double counting be minimised, if e.g. country-specific laws on privacy make an individual identifier impossible?

The question of specific target groups should be considered carefully when collecting data. On the basis of the following characteristics any target group could be estimated:

- Differentiation between polydrug and monodrug use.
- Categorisation of main problem drug according to a clearly defined hierarchical scheme.
- Differentiation between dependence and abuse or known frequency and duration of use.

The main problem of this method of estimation is the „in-treatment-rate“, i.e. the rate of problem drug users seeking help in a given year. The calculation of this rate is closely connected to the definition of treatment facilities utilised. A very narrow definition of the in-treatment-rate would cover only persons seeking help in order to give up drug use and would therefore consider only inpatient and outpatient treatment facilities. In order to include also drug users who do not intend to quit, low threshold-agencies should be taken into account as well. The broadest possible definition of the in-treatment-rate would include also general practitioners. Of course, the definition of the in-treatment rate must suit to the definition of the benchmark. The broadest definition must be chosen if and only if the benchmark includes general practitioners. On the other hand side, if the benchmark includes only inpatient and outpatient treatment facilities the narrowest definition of the in-treatment rate must be used. There is no relationship between the narrowness of the definition and the estimate: An estimate based on the narrowest definition may be higher or lower than an estimate based on a wider definition.

Limitations

Dependent on the national monitoring system, not all treatment facilities may be covered, or not even the exact number of treatment facilities dealing with drug problems may be known. If a coverage rate is known, the estimate can be improved. Users not in contact with the treatment system are not taken into account. The figures obtained with this method have to be considered as lower bounds.

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5.1.2 Police Multiplier Method

In analogy to the extrapolation of treatment data (chapter 5.1.1), the number of drug users registered by the police in a given year can be extrapolated. The number of registered problematic drug users in a given time period is taken as a benchmark. If there is no nationwide police registration system but only regional registers an estimate of the coverage-rate should be used to extrapolate to the whole country. 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. For that estimate a small scale study is needed, that will very likely be conducted on a regional basis. Nomination techniques as described in Taylor (1997) and Korf (1997) or capture-recapture methods (see chapter 5.2) may be used.

Example: France

In France 8,720 individuals were arrested for using or using and selling heroin or cocaine in France in 1999. The multiplier was estimated by combining two different results: the prevalence of opiate or cocaine users for Lens, Marseille or Toulouse, provided by the capture-recapture method (10,117 individuals), and individuals living in Lens, Marseille or Toulouse who were arrested for heroin or cocaine use in 1999 (590 individuals). The result is: $590/10,117 = 0.058$.

Altogether, the 1999 national prevalence estimate of problem opiate or cocaine use is $T = B / c = 8,720 / 0.058 = 150\ 000$.

Data Demands

The utilised data bases should be person-based, distinguish between dealers and consumers of drugs and register the offenders by type of drug. If only data bases on offences but not on offenders are available (i.e. event-based instead of person-based) it is even not clear if prevalence is under-estimated or over-estimated as an offence can be committed by several offenders and on the other hand one individual can commit several offences.

Limitations

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 to get into 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. Therefore it is recommended to include at least 3 to 4 different cities and a rural area town at once in the small-scale study.

Techniques that may be used to estimate the multiplier are, for example, nomination techniques, which are described in Taylor (1997) and Korf (1997) or the capture-recapture method as described in chapter 5.2.

Literature

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5.1.3 Police/Deaths Multiplier Method

This multiplier method 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 drug users (also over a ten-year period).

In summary, the following calculations are applied:

- T Estimated total of problematic drug users
- B Number of first-time registered drug users in the past ten years
- c D_t/D_n , ratio of the number of drug-related deaths and the number of drug-related deaths previously known by the police as drug users,

where

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

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

⇒ $T = B * c$

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).

Example: Germany

In Germany, law enforcement data collected on the number of drug offenders include information on the substance consumed by an individual. However, drug offenders are only included in the data the first time they are charged and no distinction is made between drug-addicts and episodic users. Additionally, the regular comparison of national drug-related deaths and the registered drug user data allows to keep a record of previously unknown individuals. To estimate the number of first registered hard drug users the number of cases known by the police over the last 10 years are counted. This ten-year period reflects the mean duration of an individual's drug use.

The number of heroin users registered by the police for the first time serves as a benchmark. According to the literature (Robins, 1979; Bschor, 1987; Marks, 1990) the estimated mean duration of heroin addiction is ten years. To estimate prevalence, the

number of first-time offenders against drug laws in the previous ten years are summed up.

The correction term assuming to reflect the extent of the dark-field is the ratio of the total number of drug-related deaths to the number of these deceased individuals previously registered by the police as hard drug users. Again, this comparison is made over a ten-year period. As the proportion of all known users among drug related deaths varies over time, and using just one multiplier might be problematic, a variant of this method was calculated: In a first step the required proportion is calculated for each year between 1986 and 1995. This information, however, has only been available since 1992. For the years 1986 and 1991 this proportion varies between 30% and 55%. To get an estimate of the total prevalence the estimated incidence is again cumulated over ten years (assuming a duration of problematic drug use of ten years). Note, that the statistics on drug-related deaths also include deaths of non-opiate users. It is, however, reasonable to assume that most of the registered drug-related deaths are heroin-related in Germany as deaths due to suicides, fatal accidents and long-term use of other substances than opiates are often not recognised as drug-related death. In fact, in 1995 nearly two thirds of the drug-related deaths were due to heroin overdoses. It is estimated that in 1995 altogether more than 70% of the registered drug-related deaths were related to heroin use (Bühringer et al., 1997). In Table 2 the calculations for the estimate are summarised (Bühringer et al., 1997; EMCDDA, 1997a).

Table 2: **Extrapolation from police data for Germany**

Year	N of offenders first registered by police	Correction term	Year-specific estimate
	B	$c=Dt/Dn$	T
1986-1991	33,677	1.43 – 2.22	48,158 – 74,763
1992	10,452	2.23	23,308
1993	8,384	1.92	16,097
1994	8,501	2.40	20,402
1995	6,970	2.57	17,913
Total			125,878 – 152,483

Data Demands

The two registers utilised for the estimation method are the data base of registered opiate users by the police and the data base of drug-related death.

Data of the first data base have some limitations that cannot easily be overcome:

- Problems with a clear definition of target groups: In some countries it is often not possible to decide whether a person registered for the first time as an offender is consuming drugs himself or if he is trafficking drugs. Furthermore, if a person is registered as an user, it is not possible to distinguish between occasional and regular user, i.e., no information is available whether he or she is a problematic user or not. In some cases misclassifications of the main substance are possible and poly drug use is not accounted for.
- Because of privacy laws, cases have to be deleted from the police data so that double counting cannot be fully excluded.

- Data may be biased because of delays in data entry and variations in recording of data across police services.

National register on drug-related deaths:

These problems have already been considered in chapter 4 on data sources. The greatest problem may be to establish a definition of drug-related deaths that covers the registration praxis of the register. Attention should be paid on regional differences in the registration and/or definition, e.g., differences between urban and rural areas, where it might be more likely to “cover” a drug-related death in order to protect the privacy of a family. Valuable information can be gained from customary practices of coding primary and secondary causes of fatalities associated with drug overdoses. Where it is not possible to establish the number of all-cause deaths, a subset may be more clearly defined, e.g., drug overdoses.

The link between the two data bases is of importance in identifying deceased that have been registered as drug users before. As no established figures on the duration of drug use are available at the moment, the time period over which the calculations should be summarised are somewhat unclear.

Limitations

Usually, drug-related deaths are based on different definitions in different countries. In Germany, for instance, the statistics on drug related deaths do not only cover deaths due to an overdose, but also suicides, fatal accidents under the influence of psychotropic substances, and deaths resulting from long-term abuse. In Italy, offenders first registered by the police include all types of users (first user, user, addict, etc.), and all types of substances used (cannabis, ecstasy, cocaine, heroine, etc.). Different offences against drug laws may also be available. In Germany only the offence „possession for personal use“ is used for the estimation of the benchmark. In Italy there are three paragraphs, 72, 74 and 75, of which the last one is ‘possession for personal use’. In France four categories exist, two refer to ‘simple use’ and ‘use and resell’ and two to trafficking definitions. The first two comprise about 70% of all offences. In the Netherlands not possession of drugs is used but drug users are identified from other offences (burglary etc.) as possession is registered very rarely.

Drug-related deaths are very likely due to intravenous opiate use, which is in most cases exclusively use of heroin, or polydrug use. Fatal accidents under influence of psychotropic substances might be very difficult to separate for substance groups, and the same can be said for suicides.

On the other hand, opiate users in contact with the police may to some extent also include other drug users, e.g. cocaine users. In most cases, however, it will be very difficult to decide whether the registered first offender is a cocaine or cannabis user if caught with cocaine or cannabis, or if he will also take opiates at other times, as it is very unlikely that a drug user will state freely his consume behaviour at the police-station. Therefore, the population covered by a police register will mostly consist of opiate users, but can also include users of other psychotropic substances.

In summary, because of the problems of separating deaths for substance groups and of categorising first offenders in terms of substances prevalence estimates of problem use for certain substances may be biased.

The most crucial point is the estimate of the mean duration of problem drug use. Obviously, the end of problematic drug use cannot be observed since a client who has finally terminated his drug use will never appear in the drug treatment system again. On the other hand, even if it is known from a follow-up study that somebody does no longer take drugs it is not clear if he later will take up drug use again. Though there are some estimates for the mean duration of dependence or problem drug use no estimation procedure can be recommended here as no estimation procedure is able to handle the above mentioned problems and the figure of ten years can thus not be validated. All the methods used to estimate the mean duration of problem drug use are based on assumptions which can not be corroborated. In France, e.g. where mean duration of problem heroin use is estimated at 8 years it is assumed that the number of forthcoming treatments of an individual equals the number of up to now observed treatments. The mean duration of problem heroin use is estimated as the time between onset of problem drug use and first treatment plus twice the up to now observed treatments multiplied with the average time span between two treatments (Costes, 1999). The effects of handling right-censoring by simply doubling observed figures are, however, not clear. For this method two assumptions are necessary, namely that the time of the survey is independent of the observed process (i.e., the number of treatments) and that the observed process does not change in time (e.g., due to legal changes the number of treatments per client will be restricted in the future) (Preisendörfer & Wallaschek, 1987). This method provided very bad results in an empirical comparison with the results of a panel analysis in an attempt to estimate the duration of being employed in a certain company (Preisendörfer & Wallaschek, 1987). This finding is not surprising since in this panel study not all observations are right-censored and therefore more information is provided. But even with a panel study the problems mentioned above will not disappear. A different estimation procedure is given in Marks (1990). He claims that each year 5% of the addicts gave up their drug use and that therefore within 10 years one half of the addicts terminated drug use. This figure is, however, rather an estimate of the median length of problem opiate use than of the mean length. Apart from difficulties in validating the termination rate a termination rate of 5% each year does not yield 50% in ten years as population size is decreasing from year to year and 5% of a smaller population is less than 5% of the original population. Here further research is needed. Even if it seems to be impossible to develop reasonable estimation procedures small scale studies could give hints if the figures on mean length of problem drug use are plausible.

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5.1.4 Multiplier Method Using 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.

Example: Germany

Each year about 1600 drug-related deaths are registered in all of Germany. As studies on emergency room episodes and others indicate an annual mortality rate of 1.5-2% for drug addicts in Germany, this can be used as multiplier for the calculation of the total number of drug addicts. As mortality is mostly linked to intravenous drug use, changing patterns of drug use can influence this estimation in a critical way. The sharp increase in methadone substitution programmes in Germany for example seems to reduce mortality for drug users - which is one of the intentions of the programme. This might effect the validity of this type of estimation. The estimation is 80,000 – 112,000 for this method (Kraus, Augustin & Simon, 1999).

Data Demands

The mortality rate being highly specific and clearly referring to a neatly defined target group may vary a great deal over time. For example, impurities of certain substances in an area may be responsible for substantial changes in proportions of drug-related deaths as well as the influence of substitution programmes, needle exchange programmes and other harm reduction approaches. In areas where annual data are available it may be advisable to use a moving average over several years (Frischer, 1997), i.e., to replace the mortality rate of a certain year by the average mortality rate of that year and one or two adjacent years. Instead of the 1996 mortality rate the average of the 1995 mortality rate, the 1996 mortality rate and the 1997 mortality rate is applied to the 1996 drug - related deaths data. Moving averages smooth the time series of mortality rates.

Limitations

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 almost exclusively based on studies on drug users in treatment (Davoli, 1997, Frischer, 1997). 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.

As mortality rates are normally rather low small changes in the estimated mortality rates will have a big influence on the prevalence estimate. If e.g. the mortality rate is estimated as 2% instead of 4% the prevalence estimate will be doubled.

Literature

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5.1.5 Multiplier Method Using HIV/AIDS Data

This estimation method is based on the number of HIV/AIDS infected IDUs and the proportion of HIV/AIDS among IDUs. Dividing the number of HIV/AIDS infected IDUs by an estimate of the proportion of AIDS among IDUs ($P(\text{AIDS}|\text{IDU})$) yields an estimate of the IDU prevalence $N(\text{IDU})$.

Example: Belgium

In Belgium, the number of HIV infected IDUs (benchmark) was estimated by multiplying the number of alive HIV cases by an estimate for the prevalence of IDU among HIV-positives. In 1997, 7,819 HIV and AIDS cases aged 15-64 years were registered in two integrated databases at the Scientific Institute of Public Health in Brussels. From the 4,505 individuals with known IDU status in these databases 360 were injecting drugs, yielding a prevalence rate of IDU among HIV-positives of 8.00%. In Summary, the benchmark was estimated at $7,819 \times 8.0 = 626$ HIV infected IDUs.

In a survey conducted in Flanders (1996-1997), 186 drug users reported to have been tested for HIV and 5 of them, i.e. 2.7% of the sample, reported to be HIV seropositive. During this survey, a HIV blood test was also performed on all IDUs ($n=225$) but no new case was detected, giving thus a more accurate estimate of the multiplier of 2.2%.

Altogether, the total of lifetime IDU cases is estimated at $626/2.2=28,400$.

Data Demands

This method requires the total of HIV/AIDS-positive IDUs (benchmark) and an estimate of the prevalence of HIV/AIDS among IDUs. In many countries, only AIDS cases may be registered. Estimating lifetime IDU prevalence based on registered AIDS cases among IDUs and on an estimate of the prevalence rate of AIDS cases among IDUs is, however, not recommended. As the multiplier will be very small, the result depends heavily on the multiplier. Small changes in the multiplier will result in big changes in the IDU prevalence estimate. Also employing the back-calculation method (Downs et al., 1997; Rossi & Ravà, 1999) to estimate the prevalence of HIV/AIDS cases from the AIDS cases is no longer recommended. New developments in AIDS therapies changed parameters used in the back-calculation method as e.g. latency time.

Limitations

- The AIDS epidemic among IDUs has to be comparable large to lessen the influence of a wrong estimate for the denominator. If the denominator is estimated as 2% instead of 4% the IDU prevalence estimate will be doubled. If, however, the “true” denominator is 15% and it is estimated to be 13% the prevalence estimate is multiplied only by the factor 1.15.
- The estimate of the denominator is normally derived from a local sample of a subgroup. This subgroup should be reasonably representative for the IDU population in a country. Samples, e.g., from anonymous AIDS testing facilities, give biased estimates as those testing facilities particularly attract clients which expect to be infected. Besides, in some countries local estimates of $P(\text{AIDS}|\text{IDU})$ or

$P(\text{AIDS} \cup \text{HIV} | \text{IDU})$ differ strongly from region to region but a plausible range might be used.

- This method provides rather an estimate of IDU lifetime prevalence as HIV infected or AIDS affected individuals may exit from the IDU population.

Literature

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5.2. Capture-Recapture Method

Statistical Background

The capture-recapture method combines data from different sources, e.g., the health system and the criminal system. Each problem drug user is either in both samples or only in the health data base or only in the criminal data base or in none of the two data bases. The number of problem drug users found in the data bases can be arranged in a table as can be seen in table 3 below. Obviously, the number of those being in none of the two data bases cannot be observed and has to be estimated from the remaining cells of the table. Without making any restrictions any figure could be inserted in cell d. As this would not make sense one has to introduce a reasonable restriction. This restriction is the assumption of independence: Being recorded in one system does not change the probability of being recorded in the other system. Or in more technical terms: The ratio of identified persons being in both samples to the total sample of the criminal system is assumed to be the same as the ratio of the sample of the health system to the whole population. Then the extent of the hidden population d is estimated as $d=b*c/a$ with a, b, c as defined in table 3:

Table 3: **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 $N=a+b+c+(b*c/a)$.

This method can also be embedded in the framework of loglinear models. These are models for the analysis of contingency tables. In the case of a two-way-table the natural log of the content of a certain cell is modelled as the sum of a mean effect and the effect of the row (e.g., being in the health data base) and the effect of the column (e.g. being not in the criminal data base) and the interaction effect between row and column. As in the capture-recapture situation the number of those being in none of the two data bases cannot be observed, the interaction effect cannot be estimated and has to be set to zero in advance. This corresponds with the independence assumption.

In the framework of loglinear models the generalisation to more than two data bases is straightforward. If for example three data bases are employed for the prevalence estimation, the corresponding table has seven known cells and one unknown. Then the interaction effect for the three-way-interaction in the loglinear model has to be omitted but two-way interactions are allowed. This means that dependencies between pairs of data bases can be handled. Therefore, in most cases, at least three data sources will be utilised, in order to account for possible relationships between data sources (see data demands and limitations).

Application

- Step 1 Collecting data of two (or better three) different data sources including exact identifiers able to determine the overlap between the samples.
- Step 2 Identifying the overlap
- Step 3 Conducting a log-linear analysis, as described in detail by Hay in the “Methodological guidelines to estimate the prevalence of problem drug use on the local level” (EMCDDA, 1998). In the case of two samples the loglinear analysis reduces to the formulas given in 5.5.1.

Example: Sweden

In 1992, an attempt was made to estimate the number of addicts in Sweden (Olsson, Byqvist & Gomer, 1994). Known addicts of 100 local communities were reported from sources such as social services, hospitals and other medical units, police, prisons, probation offices, drug treatment units, NGO's and a few other organisations. The target population consisted of persons who illegally had used narcotic drugs during the last 12 months and who either injected drugs (regardless of frequency), or who used drugs by other ways of administration on a daily or almost daily basis. Application of the capture-recapture technique and an enumeration for the whole of Sweden gave an estimate of 17,000 heavy drug addicts.

Data Demands

Different aspects of drug use should be covered by the method (e.g., data of the legal system and the health system). Furthermore, if only two samples are employed the data bases have to be mutually independent, i.e., the probability of being in one sample must be independent of the probability of being in the other sample. A violation of the independence assumption can be handled by employing three or more data sources. This is the case, if the severity of the drug problem makes it more likely to seek help at an inpatient treatment facility. Then the appearance in the police data base is less likely. Other variables that may change the probability of being in one sample can be the socio-economic status, geographical differences or the route of drug administration. In general terms: the examined target group should be homogenous and not contain hidden sub-groups.

Great care has to be taken with coding exact identifiers for linking the data bases. These identifiers must be reliable and unambiguous; e.g., using only one initial, sex and date of birth may not be enough.

On a more general level, all individuals must have the same probability of being selected. This premise could not be met, if e.g. not all files would be available. The samples should be representative for the target population and the target group definition should be equivalent for all data bases.

Limitations

In the two sample case, 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.

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5.3. Multivariate Indicator Method

Statistical Background

The Multivariate Indicator Method is a special case of synthetic estimation. Generally, synthetic estimation methods are methods which transfer information about a variable of interest, e.g. drug use prevalence, from a population in which it can be observed (calibration population) to a target population in which it cannot be observed (Rhodes, 1993; Wickens, 1993). From the calibration population, a functional relationship between some variables and the variable of interest is derived which is extended to the target population. Applied to the field of drugs, the prevalence of problem drug use in a country may be estimated by relating a set of drug use indicators, which are available in all regions of a country, to prevalence estimates in a few regions (calibration population). The indicators may be directly (e.g. mortality, morbidity, arrest) or indirectly related to drug use (e.g. population density, unemployment rate, housing density). Typically, analyses are based on prevalence rates and indicator rates per 100,000 inhabitants.

With regard to the MIM, two main variants of the method are common. One way is to estimate the relationship between drug use indicators and prevalence estimates in the anchor points via (linear) regression and to apply the regression coefficients to the drug use indicators in the target population. This yields prevalence estimates for the non-anchor points. Summing up all regional prevalence estimates yields the national prevalence estimate. Smit and colleagues (2003) used this method to estimate local and national problem drug use prevalence in the Netherlands, employing population density and housing density as indicators. Apart from linear regression they also employed non-linear regression models. The different regression models showed very similar results. In the US Hser and colleagues (1998) related the prevalence of poverty, unemployment, high school graduates and youths via logistic regression to the absolute numbers of drug using arrestees in several large and medium-size cities in order to estimate the prevalence of drug use among arrestees in 185 cities.

In the second approach, (linear) regression is not applied to the indicators but to the principal components of the indicators. Person and colleagues (1977, 1978) who introduced this method used the first principal component of the ranks of heroin use indicators and interpreted it as “heroin problem index” (HPI). They also proposed to create an HPI by summing up the ranks of the indicators. This approach was applied by Brugal and colleagues in their attempt to estimate the prevalence of addiction to opioids in Barcelona (Brugal et al., 1999). In recent years, MIM including PCA has been applied to estimate the prevalence of problem drug use on national level in several European countries using drug-related indicators such as drug-related deaths, addicts in treatment or drug-related arrests (Frischer et al., 2001; Kraus et al., 2003). If indicators from different domains are included in the PCA one may get more than one latent variable which may be interpreted as the best indicators that summarize the information provided by the indicators (Sartor & Walckiers, 2001).

Application

Step 1 Data indicating the prevalence of drug use must be collected for a defined time period for each region. The following variables are examples for indicators, but also other drug-related indicators can be

used, e.g., seizure of controlled drugs. Not all available indicators may be the same for all countries.

- A Number of drug-related offences (ideally person-based)
- B Drug-related deaths
- C Clients in treatment
- D HIV cases related to IDU
- E Imprisoned drug users

Step 2 In addition, the population size F of the population at risk is needed. Most likely an age range will be introduced, e.g., the population at risk can be defined as the 15-54 year olds in 1995.

Step 3 For at least two regions reliable independent estimates G (maybe resulting from a capture-recapture study) are necessary. These regions are called „anchor points“.

Step 4 For each of the variables A to E , G and for each region the figure per 100,000 inhabitants has to be calculated.

$$A_F = A * 100,000 / F$$

$$G_F = G * 100,000 / F$$

Step 5 Principal components analysis requires standardised values for A_F to G_F (subtracting the mean and dividing by the standard deviate).

Step 6 Principal components analysis of A_F to E_F with the extraction of the first factor, whose coefficients are saved. No rotational solution is needed, as any rotation only serves as an improvement for the fit of a set of indicators, and is therefore here redundant as only one indicator will be extracted.

Step 7 A linear regression (dependent variable: G_F , independent variable: coefficients of the first factor) results in estimated prevalence rates per 100,000 inhabitants. Finally, these have to be transformed to prevalence estimates for the regions (multiplying with F and dividing by 100,000).

Example: UK

The example is taken from the UK country report on national prevalence estimates for the year 1999 (Frischer & Hickman, 1999). The relevant data have been assembled for the UK and are shown in table 4 as well as the results.

As data for indicator E (emergency admissions) are only given for English regions this indicator was excluded from the analysis and calculations were based on the indicators A (convictions), B (seizures), C (treatments), D (cases of HIV related to IDU) as well as F (drug-related deaths).

For Northern Ireland and for the regions of Wales only indicators A (convictions for drug offences) and B (seizures) were available. However, the other indicators were given for all of Wales. Therefore it was decided to enter all of Wales in the analysis and to estimate the prevalence of Great Britain in a first step and to extrapolate to all of the UK afterwards.

As a prevalence estimate for all of Scotland was available also Scotland was taken as a whole in the analysis, increasing the proportion of anchor points from 35% to 50% (6 anchor points out of 17 regions compared to 5 anchor points out of 10 regions, 8 English regions + Wales + Scotland).

Table 4: UK data for the multiple indicator method

Regions	Population	A	B	C	D	E	F	G	H
England	47,055,204	83,553	92,075	51,850	788	11,711	2,371		215,574
1. Northern and Yorkshire	6,600,626	11,356	13,285	9,722	37	1,989	344		35,095
2. Trent	4,606,495	6,451	7,010	3,580	67	395	207		14,574
3. Anglia and Oxford	4,521,912	3,761	4,183	3,762	79	1,342	216		13,426
4. North Thames	7,190,479	17,696	21,168	7,842	334	1,089	352	44,410	40,825
5. South Thames	6,579,403	13,987	16,530	7,774	122	1,708	346	38,140	35,510
6. South West	6,131,705	10600	12,717	5,890	60	974	311		26,676
7. West Midlands	5,150,246	7125	5,398	4,322	26	823	193	13,130	11,524
8. North West	6,274,338	12,557	11,804	8,958	63	3,391	402		37,944
Wales	2,835,073	6,110	5,870	2,282	14		139	8,357	11,064
1. Dyfed Powys	474,009	1,323	1,510						
2. Gwent	452,650	1,262	1,044						
3. North Wales	658,790	1,315	1,218						
4. South Wales	1,331,086	2,210	2,098						
Scotland	5,120,000	3,008	13,452	8,614	687		267	38,000	39,307
1. Central	274,086	333	587	594	45		19		
2. Dumfries and Galloway	147,935	207	334	126	3		3		
3. Fife	351,390	213	499	232	14		10		
4. Grampian	532,770	673	1,393	829	12		31		
5. Lothian and borders	868,852	277	1,231	2,191	359		55	5,000	
6. Northern	280,092	88	465	89	3		6		
7. Strathclyde	2,283,671	943	7,989	4331	97		127	18,000	
8. Tayside	395,309	274	954	222	154		16		
Northern Ireland	1,600,000	772	1,291						
Total: Great Britain									265,945
Total: UK	56,610,277	95,010	121,718	62,746					273,923

- A Convictions for drug offences
- B Seizures of controlled drugs
- C People receiving treatment for drug misuse
- D Cases of HIV related to IDU
- E Emergency admissions for opioids
- F Drug related deaths
- G Estimated no of problematic drug users
- H Model Estimate

Data Demands

Data requirements are firstly the availability of data on drug-related indicators broken-down at a regional level, and secondly reliable prevalence estimates for at least two regions (anchor points).

The same decomposition of regions, the same time period, the same data bases and the same definitions (e.g. drug-related deaths defined as overdoses) should be used for all indicators. If the data bases utilised (e.g., health system, legal system) are based on different administrative regions it should be tried to merge or to split regions. Furthermore, data should be person-based and not event-based, that means that for example the number of drug-related offenders is to be preferred to the number of convictions what may lead to problems with privacy regulations. The indicators should refer to the age group that is employed in calculating the figures per 100,000 inhabitants.

As the anchor points have a great impact on the actual figures of the total prevalence by fixing the regression line, great care has to be taken in obtaining reliable and valid estimates with the same target group. Furthermore, the estimates should cover at least one area with an assumed high prevalence rate and at least one region at the lower end of prevalence rates, in order to improve the quality of the regression model. Using only estimates of regions with a high prevalence makes the method useless, and may even result in negative prevalence rates. Indicator values for the anchor points must be available. In practice, prevalence estimates are often available only on city level whereas indicators are collected on a regional level. If problem drug use is concentrated heavily in these cities they may be used as anchor points. Otherwise, the surrounding region should be split in the anchor point and the region without the anchor point and indicator values must be collected for both sub-regions. Note, however, that the relationship between indicators and drug use prevalence may be different for metropolitan and rural areas.

Properties of the method

A project funded by the European Community under the Targeted Socio-Economic Research (TSER) aimed at the exploration of the properties of the multivariate indicator method (EMCDDA, 2002). One of the main results was, that the method is relatively robust towards some systematic biases of the indicators, i.e. the use of event-based data instead of person-based data in some or all regions, the inclusion of previous drug users or report not by area of residence. Also the age-group has only a negligible impact on the prevalence estimates. The choice of the anchor point turned out to be crucial for the method but also the selection of indicators had an impact on the outcome. It was concluded that the method is appropriate for national, but not for regional prevalence estimation. The choices of different sets of anchor points or indicators seem to effect the regional prevalence rates more than the national ones. Sensitivity analyses and cross-validation with capture-recapture estimates showed that changes of anchor points or indicators lead to high variations of the regional estimates, although the national estimates remained rather similar.

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Summary and Overview

The definition of the target group is closely linked to the availability of data.

With data bases identifying

- a) the main drug consumed (e.g., polydrug use including opiates, monodrug use of opiates, monodrug use of cocaine),
 - b) the severity of the drug problem (e.g., dependence, abuse, non-problematic use according to ICD or DSM criteria),
 - c) route of administration (e.g., inhaling, injecting, oral)
- on an individual base all possible target groups can be estimated.

The validity of the estimate is dependent on

- a) Definition of target group and thus quality of data sources
- b) Quality of independent measurements like anchor points (Multivariate indicator method) or multipliers

An operational definition of a comparable target group is

- a) Intravenous drug use (IDU) or long duration/regular use of opiates, cocaine or amphetamines,
- b) During a one-year period,
- c) In the age group 15-64.

Multiplier method using treatment data

- a) Is there a treatment monitoring system of which the number of all registered drug users can be obtained for the specific target group?
- b) Does it cover all possible treatment centres or can a coverage rate be obtained?
- c) Is there a reasonable estimate for the in-treatment-rate for the specific target group?

Multiplier method using police data and the ratio of all drug-related deaths to those deceased previously been known as drug users

- a) Can the police data base of registered drug users be utilised for the specific target group?
- b) Are there ways of linking it to the data base of drug-related deaths?
- c) On which definition is the register of drug-related deaths based?
- d) Has the target group to be modified to fit to the second data base?

Multiplier method using police data

- a) Can the police data base of registered drug users be utilised for the specific target group?
- b) Is there a reasonable estimate for the proportion of drug users having come into contact with the police for the specific target group?

Multiplier method using mortality data

- a) On which definition is the register of drug-related deaths based? Does it contain all-cause deaths?
- b) Does it fit to the definition of the target group?
- c) Is there a reasonable estimate for the mortality rate for the specific target group?

Multiplier method using HIV/AIDS data

- a) This method has a clearly defined target group: prevalence of life-time intravenous drug use.
- b) The method is not advisable for countries with a small AIDS epidemic among the general population and the intravenous drug users.

Capture-recapture method

- a) Are different aspects of drug use covered?
- b) Is the target group homogenous?
- c) Are the target group definitions equivalent in all samples?
- d) Is the identifier unambiguous?

Multivariate indicator method

- a) Data demands are quite high: A variety of drug-related indicators on a regional basis is needed that should reflect the assumed target group.
- b) At least two already existing estimates for regions at the lower and higher end of prevalence are necessary.
- c) The target group is determined by the target group of the anchor point estimates.

Additional small scale studies can help to increase the quality of the described methods. Studies on the duration of drug use in different countries of the EU as well as the coverage of the drug using population by treatment services could reduce uncertainties concerning the multipliers used.

The age range 15-64 is perceived as a useful reference frame for the calculation of prevalence rates.

Regarding comparisons of results of different methods one should be aware of the respective target groups. As the back calculation method estimates IDU, for example, prevalence whereas extrapolation from police data is supposed to include also low-frequent user and non-IDUs, the police multiplier estimate should exceed the back calculation estimate. In practice, however, it is possible that the estimate from the back calculation method is higher than the police multiplier estimate. This may result from a comparatively

high proportion of AIDS affected or HIV infected having already exited the IDU population, from invalid multipliers or denominators in at least one of the methods, or simply from random errors.

Moreover, one should always be aware of weaknesses of the data. Multipliers based on small-scale studies may not be valid nationwide or certain subgroups may be over-represented in data files. For instance, it is supposed that in the German statistics on drug-related deaths IDUs are over-represented and non-IDUs that died at a fatal accident under the influence of illicit drugs are under-represented as those are less likely to be recognised as drug users.

At present, a recommendation for a certain method – given availability of all data bases – can not be given. The performance of the more elaborated methods – the multivariate indicator method and the capture-recapture method on a national level – is not investigated in detail up to now. Both methods seem to have in common that in spite of a reasonable national estimate regional estimates or estimates for subpopulations might be rather implausible (Rossi, meeting of the participants of the EMCDDA project "Study to obtain comparable national estimates of problem drug use prevalence for all EU member states" in Munich in April 1998; Uhl, IV EASAR congress in Rome, May 22-24, 1998). On the other hand side both methods seem to be promising because of their ability to combine information from different sources. The properties of the multivariate indicator method are studied in the EMCDDA project "Targeted Socioeconomic Research". One should be cautious if multipliers or denominators are rather small or rather big as small changes in the multiplier/denominator have an enormous impact on the prevalence estimates. This applies specifically to the back calculation and the mortality multiplier method. For the extrapolation from treatment data, the police multiplier method as well as the police/death multiplier method very small or very big multipliers have not been observed so far.