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Alcohol and drug treatment systems in public health perspective: mediators and moderators of population effects

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Abstract
This article describes a public health approach to the study of service systems for people with substance use disorders. Such an approach is broadly conceived to include the consideration not only of specialized services for alcohol and drug dependence, but also of medical care and social welfare services that interact with and complement specialized drug and alcohol services. After describing a conceptual model of the substance abuse service system, we discuss how systems of care may contribute to population health and social welfare by reducing the societal burden of substance use disorders. The article then summarizes key systems issues pertaining to mediators and moderators of effective treatment systems. The potential benefits of systems thinking in relation to the management of substance use disorders are described. It is suggested that systems concepts and research may help to improve access, efficiency, economy, continuity of care, and effectiveness, thereby improving the population impact of treatment services. Copyright © 2008 John Wiley & Sons, Ltd.

Key words: alcohol, drugs, treatment, systems, public health

Introduction

During the past 50 years, there has been a steady growth in the provision of specialized medical, psychiatric and social services to individuals with substance use disorders. The number and variety of services has in parts of the industrialized world increased dramatically after World War II, when many countries with a high prevalence of alcohol and drug problems have invested in treatment services as part of a larger public health approach to reduce the burden of disease, disability and social problems that accompany substance use (Klingemann, Takala and Hunt, 1992; Klingemann and Hunt, 1998). For example, in the Netherlands, admissions to Consultation Bureaus for Alcohol and Drugs increased from 45,000 in 1988 to 55,000 in 1995 and residential treatment admissions almost doubled between 1980 and 1990 (Derks et al., 1998). In China, several hundred drug treatment centers were established in the 1990s after a pronounced increase in drug-related problems (Zhengyan et al., 1998). In other countries, such as Peru and Colombia, treatment resources are scarce and scattered in spite of increasing demand (Madrigal, 1998). As a consequence, treatment is obtained in primary care settings or through private practitioners. In the US, it is estimated that drug treatment services are delivered in over 5000 specialized facilities, such as hospitals, residential settings, methadone clinics, therapeutic communities and outpatient programs (Hunt and Dong Sun, 1998). These services employ more than 250,000 workers, and serve more than one million substance users per day.

Within the context of expanding services, or the likelihood of expanded services in the developing countries, questions arise regarding the allocation of

resources and the optimal mix of services for the management of substance use disorders. Should people with these conditions be managed within the general health care system, specialized addiction services, social welfare agencies, the criminal justice system, or a combination of these entities? To what extent are alcohol and drug services effective in reducing population rates of substance-related death, disease and disability? What is the optimal amount and best combination of services needed to serve the needs of a country or a geographic area? What kinds of treatment systems are best suited to prevent the marginalization of alcohol and drug users? How can treatment services best be organized to provide the most effective treatment at the lowest cost?

Other questions arise with respect to the kinds of research that will inform policy-makers and program administrators about the best way to configure or expand their treatment services. Although much treatment research has been conducted on treatment of substance use disorders, most of it deals with clinical issues, such as the efficacy of different psychotherapies, client factors that moderate treatment effects, and treatment process characteristics that mediate differential responses to treatment. Some studies have attempted to develop classification systems to facilitate treatment tailoring (Collins et al., 2008), whereas others have investigated genetic (McGue and Iacono, 2008) and neurobiological (Schütz, 2008) moderators of relapse proneness in an effort to improve prevention measures and treatment outcomes.

While this research may have relevance to the design of clinical programs, the search for mediators and moderators of treatment effects within the clinical 'technology model' of treatment efficacy and treatment matching has not proved useful for improving treatment effectiveness (Babor, 2008). One approach has been to advocate for an expanded search for mediators and moderators, such as the use of longitudinal and life course methods (Rehm, 2008; Scherbaum and Specka, 2008); another is to investigate a broader range of treatment options than psychotherapy, such as stepped-care, treatment allocation decisions, and help-seeking behavior itself (Grothues et al., 2008; Freyer-Adam et al., 2008; Berner et al., 2008; Bühringer, 2006). Although this new line of research and theory seems more likely to provide useful information about treatment allocation decisions, it does not speak to the larger issue of how treatment services should be configured to serve the needs of large population groups. In this article we discuss the theoretical constructs, data systems and research methods that would be needed to answer basic questions relevant to policy-makers and program administrators, particularly those interested in planning the quantity, type and organization of services for heterogeneous populations of problem drinkers and drug users.

What are treatment systems?

There is no generally accepted definition of the word 'system' as it applies to treatment services for people with substance use disorders. Nevertheless, definitional and conceptual work in this area (Klingemann et al., 1992; Hunt and Dong Sun, 1998) has identified several key components that could serve as the basis for a working definition. These include resources (facilities, personnel, programs), tasks (provide care, cure illness and control deviant behavior) and linking elements that make it possible to coordinate resources to accomplish key tasks. Thus, treatment systems can be defined by linkages between different facilities and levels of specialized care, and by the extent of their integration with other types of services, such as mental health, criminal justice, and mutual help organizations (Klingemann *et al.*, 1993; Klingemann and Klingemann, 1999). The following section expands on this definition and places it in the context of treatment policies designed to maximize the public health impact of treatment systems.

Toward a conceptual model of treatment systems

Figure 1 presents a public health model of the structural resources and qualities of alcohol and drug treatment systems. The model includes the policy determinants of treatment systems, on the one hand, and the population impact of treatment systems, on the other hand. Treatment policies are authoritative decisions made by governmental agencies and legislative bodies that affect the planning, financing, and monitoring of drug and alcohol services, as well as the development of a professional workforce to operate them. Regulatory and allocative policies are major determinants of the structural resources available to treat persons with substance use disorders, including the number of facilities, the types of programs (e.g. detoxification, Twelve Step, methadone maintenance, Therapeutic Communities), the settings where programs operate (e.g. hospitals, social service agencies, specialized drug and alcohol facilities)

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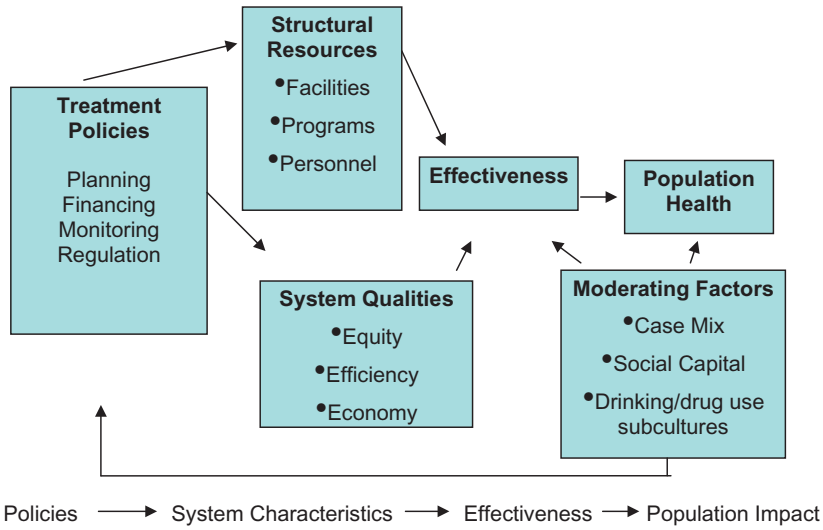

Figure 1. Conceptual model of population impact of treatment systems.

and the personnel who work there (e.g. drug and alcohol counselors, social workers, psychiatrists, psychologists). Treatment policies may also affect system qualities, specifying not only where services are located, but also how they are organized and integrated. System qualities include equity (the extent to which services are equally available and accessible to all population groups), efficiency (the most appropriate mix of services) and economy (the most cost-effective services). These qualities can be considered as mediators of system effectiveness, to the extent that they transmit the effects of system structures and programs. In this conceptual model, it is postulated that structural resources and system qualities contribute significantly to the effectiveness of services.

Effectiveness means the extent to which a particular service is responsible for positive changes in substance use and substance-related problems. Effective services are expected to promote abstinence (or at least reduce substance use), prevent relapse, and address substance-related problems, such as mental disorder, marital conflict, employment problems, and criminal behavior. The term effectiveness applies to the impact of services as they are delivered in typical clinical settings, in contrast to efficacy, which refers to the impact of services when delivered under optimal circumstances, such as under the conditions of a randomized clinical trial. When applied to systems of services, the concept of effectiveness refers to the impact of particular services on individuals, including subgroups of substance users (e.g. women, adolescents, heroin users, alcoholics) as well as their families and communities. The impact can be conceived in terms of population rates of death (e.g. overdose, suicide), disease (e.g. cirrhosis, mental disorders, HIV infection), disability (e.g. disability-adjusted life years) and social problems.

As suggested in Figure 1, the cumulative impact of these services should translate into population health benefits, such as reduced mortality and morbidity, as well as benefits to social welfare, such as reduced unemployment, disability, crime, suicide and health care costs. The model also provides for the possibility that both the effectiveness and population impact of treatment systems are influenced by certain moderating factors, such as the socio-demographic characteristics of the population with substance use disorders (i.e. 'case mix'), the social capital possessed by (or lacking in) these population groups (e.g. civic participation and community integration) and the cultural factors that determine patterns of substance use, as well as societal reactions to it. These moderating factors can contribute to the outcome of treatment regardless of system qualities and types of treatment, and should be taken into account in the design and evaluation of any treatment system. For this reason we have included a feedback loop from the moderating factors to the treatment

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policy box to emphasize that for optimal performance, treatment systems need to be designed to fit the characteristics of the population and its treatment needs.

As a further elaboration of the conceptual model, Figure 2 describes 'system boundaries' for alcohol and drug treatment in relation to the interaction between specialized alcohol and drug services and the services provided by other sectors, including the medical, psychiatric, criminal justice and social service systems. The linkages and overlapping connections also include mutual help and other voluntary organizations; informal support provided by family and friends, churches and religious organizations; workplace programs; and programs for drinking drivers. Depending on the structural resources and system qualities, these sectors will be more or less integrated with specialized treatment, and will assume a greater or lesser amount of the responsibility for managing persons with substance use disorders. For example, in some countries (e.g. Ireland) the psychiatric sector plays a large role in alcohol and drug treatment, whereas in others (e.g. Sweden) many persons are managed in the social service sector. In some developing countries (e.g. Brazil, Thailand), drug and alcohol services may be distributed among psychiatric facilities, voluntary organizations, specialized programs and primary care.

Within the specialized system, the nature and extent of services may differ according to the relative importance of alcohol or drugs, the types of disorders that are treated, and the populations that are served. In some countries alcohol and drug treatments are administered separately, whereas in others they are part of the same system. In some countries (e.g. France) there is an emphasis on early intervention, whereas in others (e.g. Russia) services are primarily reserved for those with more serious alcohol and drug problems. Finally, some systems are designed to accommodate special populations, such as adolescents, pregnant and parenting women, and ethnic minorities (e.g. the US), whereas others do not have the resources to tailor their services to special population groups.

System requirements and qualities

A number of concepts, developed within the context of health services research as well as alcohol and drug treatment, are relevant to an understanding of the nature and organization of service systems for people with substance use disorders. We begin with definitions of several concepts that have been used extensively in mental health services research (Burke, 2002). These concepts are equity, efficiency and economy.

Figure 2. Conceptual model of alcohol/drug treatment system and its connections with other sectors.

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Assuming that services for substance users are effective, the concept of equity refers to the extent to which population subgroups have equal access to these services. In many countries, access to health services is influenced by socio-economic status (SES), geographic location and cultural factors, such that disadvantaged groups location and rural populations generally have lower access to services than higher SES groups and urban populations. Ideally, service systems for substance use disorders should be equally accessible to all population groups; if they are not, the system can be assumed not to be functioning optimally at the population level. Acceptability is a related concept used in the UK National Health Service. According to Crombie and Davies (1996, p. 14), 'the intention is to move away from the paternalistic 'doctor knows best' approach to take account explicitly of the patient's views and preferences for treatment.' It also includes the recognition that patients themselves are capable of evaluating the quality of their care and treatment, using ratings of patient satisfaction, for example.

Equity also implies that services should be acceptable and culturally appropriate. This has contributed to the development of program design features that would make services more attractive to persons with special needs, such as women, the elderly, and members of ethnic minorities. Lehto (1998) notes that many countries, following the principle of equity, make special arrangements for certain groups to ensure that they use services intended for them. Examples include special programs for drug dependent women, and treatment of substance use disorders in prison settings.

Efficiency refers to the most appropriate mix and quality of services needed to address population needs. As noted earlier, treatment services for people with substance use disorders, particularly in countries at the lower developmental levels, are typically fragmented and lack integration. Key components, such as referral mechanisms, diagnostic evaluation, detoxification, rehabilitation services, and after care, may be unavailable, inaccessible or lack coordination. When any of these conditions obtain, it is likely to affect the societal costs and consequences of substance use disorders. Ideally, services should be integrated so that clients are assigned to the least intensive level of care that suits their needs, and there should be continuity of care from one type of specialized service (e.g. detoxification) to another (e.g. rehabilitation), and from the non-specialist sector (e.g. primary care) to specialized treatment (see Figure 2). Thus, services should be efficiently organized within the optimal system to maximize effectiveness and minimize cost.

Economy refers to the use of available resources to minimize the cost of substance use disorders for individuals, families, communities and nation-states. Systems that operate efficiently should be able to serve more people or to serve the same number of people at lower cost. By investing in services with the highest cost-effectiveness and cost-benefit ratios, the population impact of services should be greater than when alternative services are used. For example, there is evidence that for most persons with alcohol dependence, hospital-based medical detoxification is no more effective than less expensive social detoxification, which is typically operated in inexpensive community settings (Hayashida et al., 1989). By shifting resources to less expensive detoxification services, a greater investment can be made in other parts of the treatment system, which could translate into a greater impact at the population level.

From effectiveness to population effects

As noted earlier, most treatment is intended to provide services to individual patients or clients, with little attention to the population impact of the interventions. Reuter and Pollack (2006) have argued that while the justification for the expansion of drug treatment is strong in many parts of the world, treatment has key limitations in controlling a nation's drug problems. While noting that 'no nation has succeeded in treating its way out of a major cocaine or heroin problem' (p. 341), they argue that treatment has the potential to substantially reduce the health burden of drug-related crime and the quantity of drugs consumed.

During the past 25 years a significant amount of empirical research has been conducted on the effects of treatment on different kinds of substance users. The literature shows that treatment not only reduces a patient's alcohol and drug use, it also results in improved psychiatric, medical and employment outcomes, as well as reduced risk of overdose, crime, and HIV infection. (e.g. Babor et al., 2003; Institute of Medicine, 1990; Prendergast et al., 2002; Amato et al., 2005; Wittchen et al., 2005, 2008). Documented gains appear most striking in the treatment of alcohol and opiate use disorders.

Beyond these individual effects, treatment is likely to have a beneficial impact at the level of communities and populations. Treatment for heroin and cocaine use

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not only reduces demand for these substances, it may also bring significant supply-side effects because drug-users comprise a large share of all cocaine and heroin retailers (Reuter et al., 1999; Gossop et al., 2003). In the UK National Treatment Outcome Research Study (NTORS), the number of drug selling offenses after one year in treatment was only 13% of the entry level (Gossop et al., 2003). If broad treatment provision reduces the number of drug users engaged in the drug trade, Reuter and Pollack (2006) argue that it is possible that treatment can have substantial supply-side effects, without the large personal and social costs that come with incarcerating non-violent drug offenders. Unfortunately, no research has been conducted to study this possibility, nor has there been research on the effects of drug treatment on population rates of drug-related death, disability, HIV infection, and other kinds of disease. However, there has been research on the population impact of alcohol services, particularly formal treatment and Alcoholic Anonymous (AA) groups.

An early observation by Romelsjö (1987) suggested that a decline in alcohol-related problems in Sweden during the 1970s and 1980s may have been related to both declining per capita alcohol consumption and to increasing use of disulfiram, an anti-oxidant drug that causes an unpleasant reaction when alcohol is consumed. In an analysis of data from Ontario, Canada (where the number of alcoholics in treatment increased 76% between 1976 and 1982), Mann et al. (1988) found that increases in the proportion of alcoholics in treatment were associated with decreases in liver cirrhosis morbidity. A similar association was found in Alberta (Smart et al., 1996) for liver cirrhosis mortality. And in a multivariate time series analysis of data from North Carolina, Holder and Parker (1992) found a short time lagged association between increases in treatment and declines in cirrhosis mortality three months later. Using time series data from Stockholm County (1980–1994), Leifman and Romelsjö (1997) found a positive association between alcohol sales and sales of the anti-alcoholic drugs (i.e. disulfiram and calcium carbimide), and a negative association for a time-lagged measure of anti-alcoholic drugs. They speculated that alcohol sales reflected the current level of severe alcohol problems in the population, and the lagged measure was an indication of treatment activity. Finally, Corrao et al. (1997) found an association between changes in alcohol sales and deaths from liver cirrhosis, and suggested that treatment was a possible explanation for this.

In an integrative review of this research, Smart and Mann (2000) concluded that: (1) in most studies, increases in AA membership and amount of treatment in a geographic area are associated with decreased rates of alcohol problems; (2) changes in the number of alcoholics in treatment and affiliating with AA may be large enough to have a considerable impact on hospital admissions and death from liver cirrhosis. Such changes could potentially account for all reductions in liver cirrhosis deaths in Ontario and the US, as well as all reductions in hospital discharges in Ontario and 40% of the reductions in the US.

Although there could be simultaneous changes in attitudes and policies that affect both the use of alcohol and funding for treatment, the most parsimonious explanation for these findings is that treatment and similar kinds of interventions reduce individual drinking and drug use, and these reductions are sufficiently numerous to be reflected in the population rates of alcohol-related and possibly drug-related problems.

Research on treatment systems

Most research of alcohol and drug treatment systems has been confined to single countries. Some studies have looked at the actors, events, new techniques or problem formulations behind major changes in treatment systems, including changes in (declared) target groups for treatment (for instance, Room, 1998; Blomqvist, 1998; Rosenqvist & Stenius, 1986). A general conclusion from these studies is that major changes in the organization, methods or even extent of treatment have been driven by circumstances other than scientific findings concerning the effectiveness of one or the other model of organizing treatment.

Some studies have attempted to evaluate the effects of different organizational models and treatment system qualities. A study of the national alcohol treatment system in Denmark (Pedersen et al., 2004) was based on a population survey that could estimate the alcohol consumption and number of heavy consumers in Denmark's 14 counties. The findings showed wide variation in both catchment (what proportion of heavy consumers were reached) and cost per patient visit. A few of the counties stood out as reaching more clients and one stood out as highly cost-efficient. Qualitative analyses of the successful and less successful counties identified certain internal characteristics of the treatment system (accessibility, relation to drug treatment, treatment for special groups and structured treatment)

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that were important for catchment, while certain external factors were relevant for rate of treatment (i.e. a referral guarantee and a general appreciation in surrounding systems of the nature of alcohol treatment).

In a study of almost 1900 clients and patients in different parts of the substance abuse treatment system in Stockholm county, Stenius et al. (2005) found that in contrast to an organizational model where residential treatment predominated, a system organized around outpatient services was better at recruiting vulnerable groups into treatment.

In addition to research on national or regional treatment services, several international studies have used historical and comparative perspectives to monitor developments in alcohol treatment systems. In a study of drug and alcohol treatment services in 23 countries, Gossop (1995) found that most countries have a scarcity of resources for these kinds of services, and many report an inadequate level of professional training. Another comparative study (Klingemann et al., 1992, 1993) conducted in 16 countries showed that the size, extent and character of the treatment system depended more on a given country's view of the importance of alcohol problems than on changes in alcohol consumption, the need for treatment or economic resources.

Mäkelä et al. (1996) surveyed the activities of AA and other mutual help organizations in eight countries, noting wide variation in the proportions of recovering persons who affiliate with these community-based organizations. Another international comparative study (Lehto, 1998) focused on the coordination of drug services in 18 countries. The study found that drug treatment is more fragmented than general health services; different countries give varying significance to cost effectiveness; regional variations in availability of services are related to the extent of marginalization of drug treatment from mainstream health care; and drug treatment responds to other interests than user demands because there are many different objectives (e.g. abstinence, reduced HIV infection, reduction in crime, and improvement of health of drug users).

In summary, this brief review of research on the organization of drug treatment services indicates that: (1) service system changes tend not to be driven by scientific findings; (2) there is great diversity across countries in the organization of services; (3) some organizational models may be more equitable, efficient and effective than others.

The need for systems research

From a systems perspective, there are at least four kinds of research that would help to address the key issues outlined in the conceptual model described in Figure 1. The first is systems mapping research (see, for example, Luger et al., 2001). This refers to the quantitative and qualitative description of treatment systems structures (e.g. facilities, programs, service capacity) and qualities (equity, efficiency, economy). The second area of research relevant to the planning and improvement of treatment systems is needs assessment, which refers to the qualitative and quantitative methods used to estimate the need for drug and alcohol treatment and prevention services within a nation or a smaller geographic area. A variety of approaches have been developed to facilitate needs assessment within a population perspective, including the review of mortality, morbidity and social problem statistics, the use of population surveys to estimate prevalence rates, measures of the supply and demand for treatment services, and expert opinion (see, for example, WHO, 2000, 2006). If these methods could be standardized and applied across national boundaries, it would be possible to compare nations in terms of the gap between treatment need and the array of current services as documented in system mapping research. Such an exercise of system analysis, guided by the concepts outlined in this article, should lead to recommendations regarding the optimal design of a service system to fit the needs of the population.

The third area of research is system monitoring, which consists of quantitative data on such performance indicators as service utilization, continuity of care, recidivism rates, cost of services, as well as data on crime and mortality. When this information is integrated with qualitative data on the organization and effectiveness of treatment systems, policy-makers and program administrators should be in a better position to determine whether the treatment system is meeting the needs of the population.

A final area for research is comparative analysis. When common research methods are employed, data collected at the local and national levels can be compared in order to answer some of the pressing policy questions outlined in the Introduction to this article. Comparative analyses, especially when combined with prospective monitoring of changes in system indicators over time, should be able to answer basic questions about the optimal amount, organization and

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integration of treatment services to serve the needs of a given population. It should also allow the investigation of mediators and moderators of population effects within different treatment systems.

Summary

Why is it important to conceptualize treatment services from a systems perspective? As suggested by the concepts, issues and research reviewed in this paper, the simple answer to this question is that, beyond the provision of individual services, different system designs (independent of total resources) and operational methods should influence service utilization, cost-effectiveness, patient outcomes, and population rates of alcohol and drug problems. There are enormous variations in the way alcohol and drug services are organized. They vary in terms of extent of centralization, mix of services, availability and capacity of services, access or barriers to services, as well as staffing, integration, linkages, continuity, effectiveness, efficiency, economy and equity. Most research and scientific evidence are component-based, focusing on a single intervention or episode of care. Little is known about the overall impact of treatment systems and multiple episodes of care on population health or welfare indicators, and whether different system designs are more efficient or effective than others. In summary, systems concepts and research may help to improve the efficiency, economy, equity and the effectiveness of treatment, thereby improving the public health impact of treatment services.

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