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Longitudinal Cost of Services in a Homeless Sample with Cocaine Use Disorder

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Abstract

Homeless people with cocaine use disorder have multiple comorbidities and costly service needs. This study examined service costs associated with cocaine use and substance service use in substance, psychiatric, and medical service sectors. 127 homeless participants with cocaine use disorder were interviewed annually. Self-report and agency-report service use and cost data were combined. Pairwise comparisons were made with cocaine abstinence and substance service use in relation to mean and yearly proportional service costs in 3 service sectors. Among substance service users, achievement of abstinence was not associated with decreased substance service costs. Cocaine abstinence was associated with proportional reduction of substance service costs over time. Substance service use was associated with proportional reduction of psychiatric service costs over time among the abstinent subgroup. Conversely, substance service use was associated with continuing higher medical service expenditures in the abstinent subgroup and higher psychiatric service expenditures in those not abstinent. Homeless individuals who achieved cocaine abstinence after using substance services had decreased substance service expenditures. Individuals with continued substance service use had greater medical and psychiatric service costs. Policy based on maximizing benefits while minimizing costs appears insufficiently complex to incorporate the multiple needs and associated with costs of treating homeless populations.

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Declaration of Interest Statement

The authors report no competing interests.

Availability of Data and Materials

Because the dataset includes identifiable patient information and relevant privacy regulations prohibit dissemination, data utilized in this study is not available for sharing.

Keywords

Cocaine use; homelessness; substance service use; service utilization; cost of health services

Introduction

Use of cocaine has been found to be highly prevalent in homeless populations, and because of the high addictive capacity of this drug, the prevalence of cocaine use disorder in homeless populations is also very high. There is evidence that the prevalence of cocaine use disorder in the homeless population has increased in recent decades (Childress et al., 2015; North, Eyrich, Pollio, & Spitznagel, 2004; Stringfellow et al., 2016). Established treatments for cocaine use disorders have been demonstrated to be beneficial in the general population (Crits-Christoph et al., 1999; McKay, Lynch, Shepard, & Pettinati, 2005; Weiss et al., 2005). Average costs of these treatments have been demonstrated to range from about \$1,400–1700 per episode for outpatient treatment to about \$11,000 for long term residential treatment (Cartwright, 2000; Flynn, Kristiansen, Porto, & Hubbard, 1999; McCollister, Yang, & McKay, 2016). A few studies of cocaine treatment for homeless populations specifically have also identified substantial treatment benefits at comparable costs to those cited in the general population study above (Kertesz, Crouch, Milby, Cusimano, & Schumacher, 2009; Mennemeyer, Schumacher, Milby, & Wallace, 2017; Milby et al., 2008; Schumacher, Mennemeyer, Milby, Wallace, & Nolan, 2002).

Many homeless people with cocaine use disorder have multiple comorbidities including other substance use disorders, psychiatric illness, and medical problems (Butler, Rehm, & Fischer, 2017). Therefore, treatment needs for most homeless people with cocaine use disorders requires not only drug treatment, but also psychiatric and medical treatment. The presence of multiple comorbidities has consequences for treatment needs for additional conditions, thus implying additional associated costs (Anderson et al., 2018; Latimer et al., 2017; Zaretzky, Flatau, Spicer, Conroy, & Burns, 2017). Research in homeless populations has yet to examine associations of substance abuse service use for cocaine use disorder and subsequent abstinence with psychiatric and medical treatment costs.

The purpose of this study was to address the above gaps in knowledge through exploration of relationships between service needs and costs in a homeless population with cocaine use disorder. This study will first investigate the costs of services in different years in the progression of homelessness over two years, and secondly the effects of substance abuse service use and subsequent cocaine abstinence on the cost of services and the proportional yearly costs in substance abuse, psychiatric, and medical service sectors. Specifically, the current study will further explore how active cocaine use and substance abuse service use intersect in their relationship with the cost of services in different service sectors over time. For example, do expenditures for substance abuse services result in desired outcomes (e.g., substance abstinence), and do they in turn reduce the contemporaneous costs of other services? Additionally, do expenditures for substance abuse services reduce later expenditures for this type of service and for other types of services? Answers to these

questions are relevant for planning and coordinating multiple sectors of care for substance abusing homeless populations with multimorbidities with optimal efficiency.

Two conceptual models are helpful for organizing explorations of service utilization costs in relation to needs in a homeless population with cocaine use disorder and multiple comorbidities. The first, an economic model, is based on a linear association between cost of services and achievement of outcomes. In this model, it would be expected that achieving outcomes would be associated with greater costs. This could involve either services solely directed toward substance treatment, or it could be generalized across multiple service sectors. The second conceptual model, based on the transtheoretical model (Prochaska & DiClemente, 1982), was developed from previous studies of the homeless population by this research team (Pollio, Spitznagel, North, Thompson, & Foster, 2000). This nonlinear model posits an association between readiness to change, service use over time, and achieving positive housing outcomes. In the transtheoretical model, individuals become motivated by successive stages to change and then act to achieve this change through accessing and utilizing appropriate services. As desired outcomes are achieved, substance abuse service use and hence costs of these services may decline, producing a nonlinear association. These two models provide a structure for exploring relationships between service needs and costs in this study of a homeless population with cocaine use disorder.

Methods

The longitudinal cross-sectional data used for the current study were collected from an epidemiologic sample of 400 homeless participants in a NIDA-funded homeless study entitled Service Use, Needs, Costs, and Outcomes of Drug Abuse (SUNCODA) which was designed to prospectively examine service utilization over time in relation to characteristics of the study sample. Data for this study were collected between 1999 and 2003 including self-report data obtained through 3 annual interviews, urine substance testing at every interview, and service use data linked to each study participant provided by local agencies serving this population. Extensive details of the methods in this study have been provided in a previous publication to supplement this methodological description (Fuehrlein et al., 2014b). Institutional Review Board of [University A] in [City B] approved the project, and all participants provided written informed consent to participate in the study. Homelessness was defined as having no fixed address during the time of the study and having spent the previous 14 nights in a public shelter or in some other unsheltered location such as a park, an abandoned building, a car, or the streets without a personal mailing address. Individuals who had stayed with friends or relatives for more than 6 of these 14 homeless nights and individuals who had stayed in inexpensive places such as flophouses or motels for the previous 14 days but not more than a month were also included in this study.

Nearly 80% of this sample was recruited randomly from 12 homeless shelters, and 20% of the sample was recruited systematically from 16 computer-randomized street locations where homeless people frequently travel. Of 435 eligible individuals, 400 (92%) agreed to participate in the study. Participants were interviewed at baseline and reassessed one and two years later. Of the 400 study participants, 29 were ineligible for follow-up reassessment because of incarceration, death, or severe illness. Of the remaining 371, 255 (68%) were

reassessed in both follow-up years with complete data. There were no significant differences in variables reflecting demographics, chronicity of homelessness, income, legal problems, substance use, or any lifetime or current psychiatric disorders as determined by baseline interviews (see details below) between the 255 with complete data and those without. Only 127 of 255 had a lifetime cocaine use disorder, and these 127 individuals constitute the sample for these analyses.

Structured interviews at baseline (at the time of screening of the participant for study eligibility), year one, and year two included the Diagnostic Interview Schedule (DIS) for DSM-IV, (Robins et al., 2000) the substance abuse sections of the Composite International Diagnostic Interview-Substance Abuse Module (CIDI-SAM), (Cottler & Compton, 1993) and the DIS Homeless Supplement (North, Eyrich, Pollio, Foster, et al., 2004) which provides information about demographics, residence, social support, life events, substance use, service use, employment, finances, and legal status. At each assessment, participants provided a urine sample for substance testing.

Participants provided self-report information about service use during the each structured interview, and 23 agencies of a wide range of cost structures and of both publicly and privately funded types that served the members of the sample provided data on service utilization and costs for each individual over the two years of the study (see (Fuehrlein et al., 2014b) for full details). Both self-report and agency report service data included information about the amount and type of service that the participants used during the previous year. Additionally, agencies provided service unit cost data for each type of service sector. Substance Abuse Services Cost Analysis Program (SASCAP) (Zarkin, Dunlap, & Homs, 2004) methods were used prospectively to calculate services unit cost data. Data were collected directly from agencies regarding the types and amounts of services provided, direct cost of service provision such as employee wages, and other costs of conducting the business such as space rental or mortgage, and algorithms were used to calculate service unit costs per hour for each service type for each agency (see (Fuehrlein et al., 2014b) for full details).

The main service sectors used for this study were substance abuse services, psychiatric services, and medical services. Substance abuse services included inpatient substance use treatment, outpatient substance use individual and group psychotherapy, outpatient substance use case management, and residential substance use treatment. Psychiatric services included inpatient psychiatric treatment, outpatient psychiatric treatment, outpatient psychiatric medication management, outpatient psychiatric individual and group psychotherapy, and outpatient psychiatric case management. Medical services included primary care and specialty medical visits, medical hospital stay, and medical emergency care visits.

Creation of variables

Missing data were handled in a multiple imputation procedure as described in detail in a previous publication (Fuehrlein et al., 2014b). Self-reported and agency-reported service utilization data were combined by taking the larger amount in either self-report or agency data as the amount of service utilization. Because cost variables were available only for

agency service utilization data, cost of service utilization in self-report data was estimated by using the average cost value of the corresponding agency-reported service.

A lifetime cocaine use disorder variable was created from structured diagnostic interview data collected at any time in the study. To create a variable for cocaine use within the last year for each follow up year, urine substance testing and self-report substance use data were combined. A variable reflecting cocaine use or abstinence over time was created to reflect of achieving abstinence (defined as either no use of cocaine in both years or cessation of cocaine use in the second year) or not achieving abstinence (defined as either using cocaine in both years or commencement of cocaine use in the second year). Another variable was constructed to reflect 4 combinations resulted from cross-tabulation of the dichotomous two-year (achieved/did not achieve) cocaine abstinence variable by the dichotomous two-year (used/did not use) service use variable.

A variable for the proportional yearly cost was created by dividing cost of service in the second year with the combined cost of services over both years. The Consumer Price Index for urban consumers was used to adjust cost estimates to 2017 US dollars. For the purposes of creating illustrative figures, extreme outliers in the data had to be adjusted by capping the maximum value at the greatest non-outlier cost value (but this data adjustment was not needed for cost comparisons in this study's analysis which utilized non parametric Wilcoxon tests (see data analysis section below).

Data analysis

Data analysis was conducted using SAS 9.4 (SAS Institute, Cary, NC). Mean service cost over two years and proportional yearly cost were compared using pairwise combinations of the dichotomous two-year (achieve/did not achieve) cocaine abstinence variable and the dichotomous two-year (use/no use) service use variable. These analyses used nonparametric Wilcoxon-Mann-Whitney U tests (PROC NPAR1WAY WILCOXON) using a continuity correction of .5 to accommodate potentially non-normal data. Level of significance was set as $\alpha < .05$.

Results

The sample was predominantly male (80%), African-American (90%), relatively young (mean=42, SD=7 years of age), and unemployed (67%) with a mean of 11.9 (SD=1.6) years of education. Mean income was \$6592 (SD=\$5007) at baseline assessment. During the study, 57% (n=72) used cocaine in the first year and 45% (n=57) in the second year (with 34%, n=43 using both years). At the end of the second follow-up year, 55% (n=70) had achieved abstinence and the rest (n=57) had not achieved abstinence. More than half (59%, n=75) of participants used substance abuse services in the first year and fewer (43%, n=55) in the second year. Of those who used substance abuse services in either follow-up year, 34% used cocaine in both years, and of those who did not use substance abuse services in either follow-up year, 33% used cocaine in both years.

Figure 1 shows the mean adjusted U.S. dollar cost of services over two years among four subgroups created by cross-tabulation of the dichotomous two-year (achieved/did not

achieve) cocaine abstinence variable by the dichotomous two-year (use/no use) substance abuse service use variable. In terms of total service costs, both of the subgroups that used substance abuse services had significantly higher costs over the two-year period than the two subgroups that did not use substance abuse services. For medical service use costs, the subgroups that did not achieve abstinence had significantly higher costs in the subgroup that used substance abuse services compared to the subgroup that did not use substance abuse services. For substance abuse service costs, among those who used substance abuse services, those who did not achieve abstinence were not significantly different from those who achieved abstinence. For psychiatric service costs, both of the subgroups that used substance abuse services had significantly higher costs over the two-year period than the two subgroups that did not use substance abuse services.

Total service cost in year 1 for the entire sample was greater than the total service cost in year 2 (mean=25,148, SD=19,719 vs. mean=17,949, SD=10,395; Wilcoxon S=17809, $z=2.76$, $p=.006$). The costs for medical services did not differ by year. Total service cost in year 1 was greater than total service cost in year 2 for substance abuse services (mean=4,582, SD=9,455 vs. mean=2,575, SD=6,020; Wilcoxon S=18015, $z=3.31$, $p<.001$) and for psychiatric services (mean=6,990, SD=14,423 vs. mean=1,888, SD=5,368; Wilcoxon S=17274, $z=1.99$, $p=.047$). Figure 2 shows the mean proportional cost of services by year among four subgroups created by cross-tabulation of the two-year cocaine abstinence variable by the two-year substance abuse service use variable. For medical service costs, the subgroups that achieved abstinence had significantly higher yearly proportional costs in the subgroup that used substance abuse services compared to the subgroup that did not use substance abuse services. For substance abuse service costs, the subgroup that did not achieve abstinence had a significantly higher proportional yearly cost than the subgroup that achieved abstinence. For psychiatric service costs, both of the subgroups that used substance abuse services had significantly higher proportional yearly costs than the subgroups that did not use substance abuse services.

Discussion

This two-year longitudinal study of a homeless sample with cocaine use disorder examined the cost of services associated with cocaine use and substance abuse service use. This study had several major methodological strengths as described in greater detail in related publications (Ayvaci, Obiri, Pollio, & North, 2017; Fuehrlein et al., 2014b). These strengths include systematic recruitment of research participants from street locations and shelters, implementation of structured diagnostic interviews, longitudinal collection of data over two years, systematic data collection from agencies, and combination of self-report and agency-report service use and cost data.

Contrary to prediction of the economic model described in the Introduction section, this study found that greater expenditures for substance abuse services did not yield greater cocaine abstinence. Further, use of substance abuse services was associated with greater, not fewer, expenditures for all other service types. Therefore, expenditures for substance abuse services not only failed to achieve the desired cocaine abstinence outcome, but use of substance abuse services was also associated with greater expenditures in medical and

psychiatric service sectors as well. Thus, not only did the service expenditures fail to achieve their primary goal, but the use of substance abuse services involved additional costs in other service sectors. This study's findings clearly did not conform to linear economic modeling.

To examine these nonlinear effects over time in relation to the nonlinear transtheoretical model described earlier, the proportional yearly cost was used as an indicator of cost trajectory over time, and achievement of cocaine abstinence was significantly associated with the proportional reduction of substance abuse service costs over time and use of substance abuse services was significantly associated with proportional reduction of psychiatric service costs over time among the subgroup that achieved abstinence. Conversely, use of substance abuse services was significantly associated with continuing higher expenditures for medical services in the subgroup that achieved abstinence and with continuing higher expenditures for psychiatric services in the subgroup did not achieve abstinence. Therefore, complexities in relationships among service sector costs led to reduction of substance abuse service costs over time (fitting the transtheoretical model), but to relative expansion of other service costs over time (not consistent with the transtheoretical model). Previous studies in homeless population by this team (Asana, Ayvaci, Pollio, Hong, & North, 2018; Fuehrlein et al., 2014a) have found that as one of a set of comorbid problems is addressed, other existing needs become manifest. Thus, the findings of this study suggest that when homeless individuals achieve cocaine abstinence after using substance abuse services, substance abuse service expenditures may decline over time. However, if individuals continue to use substance abuse services, this would likely lead to greater medical and psychiatric service costs.

This study had several limitations. Although this study provided a systematic epidemiologic sample of people who were homeless at a given point in time, this methods likely over-represented people with greater homeless chronicity because people with a greater duration of homelessness are statistically more likely to be homeless at a given time. Service cost data did not include criminal service costs which is an important area of service use for homeless populations. The substance abuse service utilization variable in this study was unable to differentiate between services specifically for cocaine or for other substances, reflecting the reality that these conditions tend to be highly comorbid and thus differentiating the use of these services for different substances is inherently difficult if not impossible. The longitudinal follow up was limited to two years, and thus it could not assess more far-reaching effects of service costs and outcomes. Because cocaine abstinence outcome was measured as a single dichotomous variable covering an entire year's period and cocaine use severity data were not available, the data for this study lend themselves to abstinence models, but not to dosage effects entailed in harm reduction models. The dichotomous cocaine use/abstinence variable did not permit the comparison of heavier and lighter users on outcomes and other important variables. Although the data were collected a number of years ago, these analyses yielded new knowledge not previously examined in other studies, and these data provide a benchmark for further discussion and conceptualization and for comparison with data acquired more recently.

Future research needs to replicate the benchmark findings of this study using new data and collecting costs and outcomes across multiple treatments needs and sectors of care.

Additionally, research is needed to examine causal directionalities in observed relationships between multimorbidities and their outcomes in relation to treatment within their corresponding systems of care (North, Brown, & Pollio, 2016). Experimental studies such as randomized controlled trials can help to determine definitively how treatment of one type of morbidity such as mental illness or substance use disorders may have effects on outcomes of comorbidities such as medical illness and costs of their treatment. Such studies can identify expected sequential effects of treatment in one sector on the outcomes of comorbidities and their associated costs in other sectors of care that may ultimately guide decisions for fiscal investment in specific areas of treatment.

The findings from this study argue compellingly against a simple economic approach to services for homeless individuals using cocaine. Policy based on maximizing benefits while minimizing costs appears unlikely to be complex enough to incorporate the multiple needs and associated costs of treating homeless populations. Thus, policy needs to consider costs as they shift across sectors of care, understanding that concepts such as cost efficiency are unlikely to yield effective strategies for addressing multiple treatment needs simultaneously.

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Figure 1.

Mean cost of services over two years among participants with cocaine use disorder subgrouped by dichotomous cocaine use and substance service use, in adjusted U.S. dollars. Pairwise comparison of two-year costs of services: *p .05, **p .01, ***p .001. Year 1 is solid and year 2 is striped portion of the columns. ^aWilcoxon S=433, z=-4.00, p .001, ^bWilcoxon S=297, z=-4.29, p .001, ^cWilcoxon S=409, z=-2.40, p=.02, ^dWilcoxon S=543, z=-2.66, p=.01, ^eWilcoxon S=346, z=-3.62, p=.001

Figure 2.

Mean proportion of service costs by year among participants with cocaine use disorder subgrouped by dichotomous cocaine use and substance service use, in adjusted U.S. dollars. Pairwise comparison of proportional yearly costs of over two years: *p .05, **p .01, Year 1 is solid and year 2 is striped portion of the columns. ^aWilcoxon S=591, z=-2.00, p .05, ^bWilcoxon S=1972, z=-2.63, p .001, ^cWilcoxon S=601, z=-1.97, p=.05, ^dWilcoxon S=419, z=-2.61, p=.01