Evaluating the Impact of Dental Care on Housing Intervention Program Outcomes Among Homeless Veterans

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On a single night in January 2011, 640 000 people in the United States were estimated to be homeless; estimates are much higher for those experiencing homelessness in a given year.[1,2] The homeless population experiences more health problems than the general population, demonstrating high rates of acute and chronic medical illness.[3] Homeless adults report substantial unmet needs for multiple types of health care.[4] In a study involving 3000 people who were homeless, one fourth had not received needed medical care in the preceding year.[5] Multiple barriers make accessing health care, including dental care, difficult for individuals experiencing homelessness.

Dental care has been reported as one of the top unmet needs among homeless adults, 10% reporting it as their most needed service.[6] Clinically significant dental problems have been identified in two thirds of homeless individuals, with a 58% prevalence of untreated caries among adults.[7] Previous work shows that homeless veterans have poor oral health according to all measurable parameters, including missing and decayed teeth and oral pain.[8] Poor dental health and poor dental appearance can also be significant quality of life issues. Among homeless veterans in rehabilitation programs, provision of dental care (relative to a lack of care or only emergent care) has been found to significantly increase self-perceived quality of life with respect to oral health.[9] Such results clearly demonstrate the need for adequate access to oral health care among people who are homeless.

Questions remain however, as to how dental care affects more global outcomes of homeless intervention and rehabilitation programs. We attempted to address these uncertainties by examining the impact of dental care on outcomes among homeless veterans discharged from one of 538 Department of Veterans Affairs (VA) community-based transitional

Objectives. In this retrospective longitudinal cohort study, we examined the impact of dental care on outcomes among homeless veterans discharged from a Department of Veterans Affairs (VA) transitional housing intervention program.

Methods. Our sample consisted of 9870 veterans who were admitted into a VA homeless intervention program during 2008 and 2009, 4482 of whom received dental care during treatment and 5388 of whom did not. Primary outcomes of interest were program completion, employment or stable financial status on discharge, and transition to permanent housing. We calculated descriptive statistics and compared the 2 study groups with respect to demographic characteristics, medical and psychiatric history (including alcohol and substance use), work and financial support, and treatment outcomes.

Results. Veterans who received dental care were 30% more likely than those who did not to complete the program, 14% more likely to be employed or financially stable, and 15% more likely to have obtained residential housing.

Conclusions. Provision of dental care has a substantial positive impact on outcomes among homeless veterans participating in housing intervention programs. This suggests that homeless programs need to weigh the benefits and cost of dental care in program planning and implementation. (*Am J Public Health.* 2013;103:S368–S373. doi:10.2105/AJPH.2012.301064)

housing intervention programs. These programs provide housing for up to 2 years and are designed as transitional rehabilitation interventions leading to permanent housing. Our primary outcomes of interest were program completion, employment or stable financial status on program discharge, and transition to permanent housing. We specifically addressed differences in characteristics and outcomes between veterans who did and did not receive dental treatment, the impact on outcomes of self-perceived dental status at the time of program admission, and the relative importance of demographic characteristics, housing and occupational history, health and mental health status, and dental care with respect to all 3 primary outcomes.

METHODS

Data for this longitudinal retrospective study were provided by the VA Northeast Program

Evaluation Center and the VA Office of Dentistry. The data set consisted of the records of 18 744 veterans who were admitted into VA housing intervention programs from August 1, 2008, through September 30, 2009. Of these veterans, those who participated in the intervention program for 60 days qualified for dental care under the VA Homeless Veteran Dental Program. In this program, dental care generally includes but is not limited to a comprehensive examination with x-rays, cleanings, fillings, extractions, and full or partial dentures. Veterans in transitional housing programs are typically not eligible for VA-provided dental care outside of the Homeless Veteran Dental Program. A course of dental care under the program can continue to treatment plan completion after a veteran has been discharged from a housing intervention program.

Data Sources

Our data set was derived from 3 sources of information. The first was VA Form X,

a structured interview administered by program staff to veterans entering specialized VA homeless programs that captures sociodemographic, psychosocial, health, housing, and employment information, as well as staff diagnostic impressions based on interview findings and client presentation.

The second source was VA Form D, which captures information at the point of program discharge (e.g., reason for discharge, length of stay, work status). Form D provided data on the 3 primary outcomes: completion of the housing intervention plan (which may include completing therapies or skill training), obtaining a residence, and obtaining employment, entering a training program, or achieving stable financial status (e.g., qualifying for disability). A secondary outcome measure was length of stay, which was examined because previous research had shown it to be related to the other outcomes of interest. Data from Forms X and D are contained in the VA Northeast Program Evaluation Center database.

The third source was the dental care data set derived from information entered in VA's Dental Record Manager, maintained in the Dental Encounter System and reported by the Dental Healthcare Analysis section of the Office of Dentistry. These data included dates, CPT (Current Procedural Terminology) codes for services, and other characteristics of services provided in each dental care encounter.

Inclusion and Exclusion Criteria

Several restrictions reduced the size of the data set. Records for veterans who were discharged from a housing intervention program because they required inpatient or specialized treatment of a deteriorating health or mental health disorder were excluded. We also excluded records of veterans who had a length of stay in the housing intervention program of fewer than 10 days or more than the limit of 2 years (5 cases).

Many veterans have multiple admissions to VA housing intervention programs. Dental care in some cases overlapped 2 or more admissions to housing intervention programs. To test most clearly the impact of the VA Homeless Veteran Dental Program on outcomes, we included only the records of veterans for whom dental services were initiated after their first housing intervention program admission or at least 60

days prior to their first program discharge. Our final data set consisted of the records of 9870 veterans.

Data Analyses

We calculated descriptive statistics and made group comparisons of the data of veterans receiving and not receiving dental care in the following domains: demographic characteristics, medical and psychiatric history (including alcohol and substance use), work and financial support, and treatment outcomes. We also examined characteristics and outcomes among veterans who had a complaint of dental problems on program admission versus those who did not. For these analyses, we calculated χ^2 statistics to determine significant differences between groups on categorical variables. We used the independent-sample t test to examine differences in continuous variables. When Levene's test for homogeneity of variances was significant, we adjusted our examination of mean differences accordingly.

Because of the large sample size, we anticipated that many of the univariate analyses would produce statistically significant results. To guide meaningful interpretation of findings, we calculated effect sizes for all analyses. We computed Cohen's d to provide an effect size for our t test results.[10] Following Cohen, we interpreted absolute d values of 0.2, 0.5, and 0.8 as indicating small, medium, and large effect sizes, respectively. Absolute values for d that were less than 0.2 were designated as meaningless, regardless of levels of statistical significance.

We calculated Cramer's φ (a measure of association between 2 binary variables that is similar to the Pearson correlation coefficient in its interpretation) to provide an effect size estimate for our χ^2 analyses.[11,12] Again following Cohen, we interpreted absolute values for φ of 0.1, 0.3, and 0.5 as indicating small, medium, and large effect sizes, respectively.[10] Absolute values for φ that were less than 0.10 were designated as meaningless, regardless of levels of statistical significance. Because we focused our interpretation of results primarily on effect sizes, we did not correct P values for the number of analyses we conducted.

We conducted regression analyses to examine predictors of treatment outcomes. Logistic regression was used in separate analyses of

program completion, obtaining a residence, and employment–financial stability. We used multiple linear regression to analyze length of stay. For each procedure, several models were examined to estimate the combined and unique contributions of all independent (predictor) variables to outcomes.

Initially, we conducted a regression analysis in which all predictors (dental care and the set of 16 variables reflecting demographic characteristics, housing and occupation, health, and mental health) were simultaneously entered in a single step. The resulting model (model 1, the full model) provided an estimate of the amount of variance in the dependent outcome variables that could be explained by all of the variables as a set.

We then conducted separate analyses in which either dental care or the set of non–dental care variables were the only variables entered into the analysis. These analyses produced estimates of the overall unique contribution of the variables and the contribution shared with the other variables (shared models 2 and 3).

Finally, we conducted 2 separate analyses in which we alternated entering either the dental care variable or the set of non–dental care variables in the first step of the hierarchical regression analysis, followed by the remaining variables in the second step. This allowed us to estimate the unique contribution of the dental care variable or the set of non–dental care variables to variance in outcome variables by examining the increase in variance explained in the second steps of the analyses. These analyses examined the unique variance models (models 4 and 5).

For the logistic regression analyses, we calculated the McKelvy–Zavoina index as a measure of effect size (per the recommendation of DeMaris[13]). For the multiple linear regression analysis, we used R^2 values as estimates of the amount of variance in outcomes explained by the study variables. We used a standard convention to set 2% of variance explained (in the dependent variable) as the lower boundary of a small meaningful effect.

RESULTS

Of the 9870 veterans in our data set, 4482 (45.4%) received care in 23 325 dental encounters (the mean number of visits per

veteran was 5.20, SD = 4.07). A total of 123 501 individual CPT-codable treatments were delivered (with a mean number of treatments per veteran of 27.55, SD = 22.10). The sample was predominantly non-Hispanic Caucasian (49.9%) and African American (39.9%) and comprised almost exclusively unmarried (95.2%) men (95.6%) with a mean age of 50.1 years (SD = 9.5). Table 1 provides descriptive statistics and the results of *t*-test and χ^2 analyses comparing the group of veterans receiving dental care and the group not receiving such care.

Group Characteristics

Examination of demographic characteristics revealed significant differences between the 2 groups of veterans (receiving vs not receiving dental care) with respect to age, gender, and marital status. However, none of the analyses of these variables revealed an effect size that could be considered meaningful. In terms of housing and employment variables, only the number of days worked in the 30 days preceding program admission differed significantly between groups; again, the effect size failed to reach the criterion for meaningfulness. With the exception of variables capturing number of days of alcohol and drug use prior to program admission among members of the 2 groups who reported using alcohol and drugs, all comparisons involving health, mental health, and substance abuse variables were significant.

Of these, only the variable measuring total number of medical problems achieved a small effect size. Veterans in the group receiving care had approximately 20% more medical problems than veterans in the group not receiving care.

Comparisons of outcomes between veterans in the 2 groups revealed significant and meaningful differences on all measures. Significant differences were found for the 3 primary outcome variables, with veterans in the group receiving care being more likely than those in the group not receiving care to complete the program, obtain a residence, and have a job or stable financial situation on discharge from the program. These differences all fell in the

TABLE 1—Characteristics and Outcomes of Homeless Veterans Who Did and Did Not Receive Dental Care: Department of Veterans Affairs Housing Intervention Program Participants, 2008–2009

Variable	Did Not Receive Dental Care (n = 5388), Mean ±SD or No. (%)	Received Dental Care (n = 4482), Mean ±SD or No. (%)	t or χ^{2a}	df	P	d or φ[b]
Demographic characteristics						
Age, y	49.35 ±10.37	50.82 ±9.50	7.46	9164	<.001	0.16
Male	4668 (96.3)	4255 (94.9)	10.20	1	<.001	0.03
Married	255 (5.3)	191 (4.3)	5.27	1	<.05	0.02
Caucasian	2407 (49.9)	2238 (50.0)	0.03	1	NS	0.00
Employment/housing						
No. of d worked in past 30 d	2.76 ±6.66	2.38 ±6.06	2.87	9276	<.001	0.06
Unemployed for past 3 y	1113 (23.0)	1025 (22.9)	0.01	1	NS	0.00
No. of d living on street in past 30 d	3.43 ±8.23	3.31 ±8.13	0.69	9311	NS	0.01
Homeless for > 30 d	2139 (46.8)	2041 (48.4)	2.15	1	NS	0.02
Health, mental health, and substance use						
Mean no. of medical problems	1.91 (1.9)	2.31 (1.89)	10.47	9868	<.001	0.21
Serious medical problem	2435 (50.7)	2502 (56.0)	26.51	1	<.001	0.05
Current psychiatric problem	2476 (51.4)	2502 (56.0)	19.87	1	<.001	0.05
Serious depression in past 30 d	2206 (45.7)	2179 (48.7)	8.32	1	<.01	0.03
No. of d of alcohol use in past 30 d among alcohol users	10.64 ±9.64	10.74 ±9.71	0.32	3236	NS	0.01
Current alcohol abuse	1426 (29.5)	1505 (33.7)	18.42	1	<.001	0.04
No. of d of drug use in past 30 d among drug users	9.95 ±9.46	10.34 ±9.58	0.87	1830	NS	0.01
Current drug abuse	1114 (23.1)	1242 (27.8)	27.05	1	<.001	0.05
Treatment outcomes						
Completed program	2577 (47.8)	2817 (62.9)	222.80	1	<.001	0.15
Had residence on discharge	3740 (72.0)	3608 (82.8)	156.40	1	<.001	0.13
Had job or financial stability on discharge	3384 (63.1)	3223 (72.1)	88.33	1	<.001	0.10
No. of d in program	137.62 ±139.23	236.73 ±182.62	33.14	9108	<.001	0.68

Note. NS = nonsignificant.
[a]*t* test for mean ±SD and χ^2 for no. (%).
[b]*d* for mean ±SD and φ for no. (%).

category of small effects. Length of stay was also found to be approximately 70% longer for the veterans receiving care. This difference was significant and met the criterion for a moderately large effect.

Dental Complaints on Program Admission

On program admission, 5100 veterans (54.7% of the sample) responded positively to a single yes–no question administered in the Form X interview asking whether they currently had any oral or dental problems. Of these veterans, 2837 (55.6%) received dental care, whereas 2263 did not receive care at any time during the program. Overall, 1645 of the 4770 veterans who did not have a dental complaint at the time of admission were identified as having a dental problem; these veterans subsequently received care during their tenure in the housing intervention program. Approximately two thirds (63.3%) of the 4482 veterans who received dental care had a dental complaint at the time of their admission to the housing intervention program.

Table 2 presents the results of analyses of outcomes based on the presence of a dental complaint at the time of program admission. Veterans who received dental care had significantly improved outcomes ($P<.001$) with respect to program completion, obtaining a residence, and achieving employment–financial stability. The improvements in outcomes on these measures met the criteria for meaningful effects.

Among veterans without a dental complaint on admission, those who subsequently received dental care had a longer mean length of stay (240.38 days; SD = 155.84) than those who did not (141.78 days; SD = 140.24). The pattern was similar among veterans who did

have a dental complaint on admission. Among those who received dental care, the mean length of stay was 234.62 days (SD = 154.25); among those who did not, the mean was 128.60 days (SD = 135.75). We conducted a 2×2 analysis of variance to examine the impact of dental complaints on admission (complaint vs no complaint) and dental care (care vs no care) on length of stay. The interaction of the 2 independent variables was not significant ($F_{1,9322} = 1.44$; $P>.05$). Presence or absence of a dental complaint at the time of admission did significantly affect length of stay ($F_{1,9322} = 9.35$; $P<.01$), but the effect size ($\eta^2 = 0.001$) indicated that the impact was not meaningful. By contrast, receipt of dental care had a significant impact ($F_{1,9322} = 1090.27$; $P<.001$) that was meaningful ($\eta^2 = 0.105$).

Among veterans who received dental care, those with a dental complaint on program admission had a greater mean number of visits (5.55; SD = 4.16) than those without a complaint (4.61; SD = 3.83; $t_{3665} = 7.69$; $P<.001$) as well as a greater mean number of procedures (29.77; SD = 22.96 vs 23.71; SD = 19.96; $t_{4479} = 8.93$, $P<.001$). These findings were primarily a result of differences in the mean number of removal or repair procedures (veterans with a complaint: 1.76; SD = 2.68; veterans without a complaint: 1.07; SD = 2.29; $t_{3883} = 9.07$; $P<.001$) and the mean number of surgical procedures (veterans with a complaint: 4.04; SD = 6.27; veterans without a complaint: 2.15; SD = 4.78; $t_{4156} = 11.34$; $P<.001$). All of these differences were found to meet the criterion for a meaningful effect size, with d values in the range of 0.23 to 0.33.

Table 3 presents the results of the regression analyses. Examination of the regression findings showed similar results for the program

completion and residence on discharge outcomes. In both cases, 4.1% of the variance in outcomes was explained by the full set of predictor variables (dental care and lack of care). Dental care accounted for the majority of the explained variance for each variable (2.6% for program completion and 2.2% for residence on discharge; see model 5). For the employment–financial stability on discharge variable, the full set of variables explained 4.4% of the variance in outcomes. In this case, however, the set of non–dental care variables made a substantially greater unique contribution (model 4, 2.9%; model 5, 0.9%). The unique contribution of dental care to employment–financial stability outcomes fell short of meeting the criterion of being meaningful.

Examination of the full model revealed that more than 12% of the variance in length of stay could be explained by the full set of variables. This was largely attributable to dental care, which explained 10.9% of the variance in length of stay. There was no shared variance component between the dental care variable and the set of noncare variables (model 2 estimate = model 4 estimate; model 3 estimate = model 5 estimate).

DISCUSSION

In this study of global outcomes in a national VA homeless rehabilitation program, veterans who received dental care were found to stay in the program significantly longer than veterans who did not receive dental care and to be significantly more likely to complete the program, obtain a residence, and secure financial stability. Even after adjustment for the impact of non–dental care variables in our regression analyses, dental care still had a significant effect in explaining length of stay, rate of program completion, and obtaining a residence.

Program completion is important from a policy perspective. In 2009, President Barack Obama and VA Secretary Eric Shinseki announced their 5-year plan to end homelessness among veterans. This plan has led to the expansion of many homeless rehabilitation programs. Efficient provision of care includes evaluating ways to increase the success rates of such programs and reduce the percentage of recidivism by enhancing program success. Our

TABLE 2—Comparisons of Outcomes of Homeless Veterans With Dental Complaints on Admission Who Did and Did Not Receive Dental Care: Department of Veterans Affairs Housing Intervention Program Participants, 2008–2009

Variable	Did Not Receive Dental Care (n = 2263), No. (%)	Received Dental Care (n = 2837), No. (%)	χ^2_1	P	φ
Completed program	1044 (44.8)	1814 (63.9)	186.55	.001	0.19
Had residence on discharge	1543 (70.6)	2313 (83.9)	125.95	.001	0.16
Had job or financial stability on discharge	1363 (60.4)	2052 (72.5)	83.56	.001	0.13

TABLE 3—Percentages of Variance in Outcome Variables Explained by Dental Care and All Other Predictor Variables: Department of Veterans Affairs Housing Intervention Program Participants, 2008–2009

Outcome Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Length of stay	12.4	1.5	10.9	1.5	10.9
Completed program	4.1	1.5	2.9	1.6	2.6
Obtained residence	4.1	1.9	3.1	1.0	2.2
Had job or financial stability	4.4	3.5	1.5	2.9	0.9

Note. The entry of variables into the regression equation was as follows: model 1, all variables in step 1 (full model); model 2, all variables other than dental care; model 3, dental care only; model 4, R^2 for all other variables when dental care entered in step 1 and all other variables in step 2; and model 5, R^2 for dental care when all other variables other than dental care entered in step 1 followed by dental care in step 2.

study indicates that provision of dental care is one modifiable variable that can increase the likelihood of success in these rehabilitation programs. Results of analyses assessing the impact of dental care on program completion, obtaining a residence, and length of stay were significant, and effect sizes were small to medium. Thus, our findings indicate that the impact of provision of dental care on outcomes among homeless veterans is equivalent to the impact of psychological treatments for depression.[14]

Some veterans entered the homeless intervention program without dental complaints but were subsequently identified as having dental problems and received care. This finding probably reflects a failure by the veterans to identify and report incipient dental issues or problems that developed over time. Both dental caries (cavities) and periodontal disease are slowly progressing chronic diseases. Often by the time pain or obvious visual signs are present, dental caries and periodontal disease have progressed and require more extensive intervention. In addition, the offer of dental care during the program may have allowed for an earlier and possibly less costly intervention for the one third of the patients who did not have an initial complaint but subsequently benefited from needed dental care. Also important is the fact that, among those patients who did have a dental complaint, dental care was associated with significant improvements in all global outcomes.

Provision of dental care had the most significant effect on length of stay, which may be considered an intermediate outcome relative to the more global and final measurements of program completion, permanent housing, and employment or financial stability. Length of stay has previously been identified as a measure of the treatment process or service dosage. As such, this variable has had a positive relationship with housing outcomes. McGuire et al. found that increased length of stay was a significant predictor of housing and employment status as well as overall quality of life at discharge.[15] Similar to McGuire et al., we do not interpret increased length of stay as a final outcome but recognize the highly positive relationship between increasing length of stay and provision of dental care. This relationship may be part of the reason for the improved outcomes among recipients of dental care in homeless intervention programs.

Strengths and Limitations

This study had several strengths. To our knowledge, it is the first attempt to examine the effects of dental care on commonly accepted homeless rehabilitation outcomes (i.e., program completion, housing on completion, and stable finances). Another strength is its size; we analyzed data on nearly 10 000 homeless rehabilitation program participants. The large longitudinal VA databases allowed us to link information regarding need for and provision of dental care, program outcomes, and an extensive number of independent variables that had previously been linked to homeless rehabilitation outcomes.

A limitation of our study was the inclusion of only homeless veterans; as a result, our findings may not be generalizable to nonveterans, women, and homeless family units. Also, the study was retrospective and thus not

randomized with respect to provision of dental care. Given that there was no assessment of how dental care was introduced to those eligible veterans, there may have been a selection bias that cannot be accounted for. Finally, it is notable that approximately 45% of veterans who did complain of a dental problem on program admission did not receive dental care. We do not have data addressing the dental status of these veterans on discharge.

Conclusions

To better evaluate the impact of dental care as a viable part of homeless rehabilitation programs, an assessment of the estimated cost of the inclusion of dental care in such programs is needed. There are also multiple ways to deliver dental care, and comparisons regarding effectiveness and efficiency should be made. More sophisticated analyses should be aimed at determining the mechanisms of the dental care effect, examining both the direct (e.g., impact on self-confidence, reduction of chronic pain) and indirect (e.g., dental care leading to longer program stays and thus allowing for greater impact of other interventions) contributions of dental care to outcomes.

Previous work has noted the positive effects of dental care on the oral health–related quality of life of individuals in homeless rehabilitation programs. Our results reinforce and extend these earlier findings by showing that, among veterans in a homeless rehabilitation program, provision of dental care promotes program completion, transition to permanent housing, and, to a lesser degree, employment or financial stability on program discharge. ∎

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Human Participant Protection

This study was approved by the University of South Florida institutional review board, which provided an informed consent waiver.

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