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Efficacy of Nurse Case-Managed Intervention for Latent Tuberculosis Among Homeless Subsamples

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Abstract

Background—The efficacy of a nurse case-managed intervention was evaluated in subsamples of participants with one of the following characteristics: female gender, African American ethnicity, recruited from a homeless shelter, a history of military service, lifetime injection drug use, daily alcohol and drug use, poor physical health, and a history of poor mental health.

Objective—To determine whether a validated nurse case-managed intervention with incentives and tracking would improve adherence to latent tuberculosis infection treatment in subsamples of homeless persons with characteristics previously identified in the literature as predictive of nonadherence.

Methods—A prospective 2-group site-randomized design was conducted with 520 homeless adults residing in 12 homeless shelters and residential recovery sites in the Skid Row region of Los Angeles from 1998 to 2003.

Results—Daily drug users, participants with a history of injection drug use, daily alcohol users, and persons who were not of African American race or ethnicity had particularly poor completion rates, even in the nurse case-managed intervention program (48%, 55%, 54%, and 50%, respectively). However, the intervention achieved a 91% completion rate for homeless shelter residents and significantly improved latent tuberculosis infection treatment adherence in 9 of 12 subgroups tested (odds ratios = 2.51–10.41), including daily alcohol and drug users, when potential confounders were controlled using logistic regression analysis.

Discussion—Nurse case management with incentives appears to be a good foundation for increasing adherence to 6-month isoniazid treatment in a variety of homeless subgroups and, in particular, for sheltered homeless populations. However, additional social-structural and environmental strategies are needed to address those at greatest risk of nonadherence.

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Keywords

homeless; latent tuberculosis; nurse case management

As active tuberculosis (TB) rates in the United States have declined in the last 10 years, attention has shifted to the identification and treatment of those with latent tuberculosis infection (LTBI) to prevent future increases (Blumberg, Leonard, & Jasmer, 2005). Certain groups have been designated to be at high risk of TB exposure and of development of latent disease. These groups require vigorous scrutiny and innovative treatment strategies. Homeless individuals, immigrants, alcohol and drug abusers, those living with human immunodeficiency virus (HIV) and other immune disorders, and those who are incarcerated, among others, have been identified to be at high risk of LTBI (American Thoracic Society and Centers for Disease Control and Prevention, 2000). Unfortunately, such groups are also at high risk of failure to complete LTBI treatment.

Homeless persons, particularly those who abuse alcohol and drugs or have major medical illnesses, are at significant risk of poor adherence to TB treatment (Jasmer et al., 2004; Tulskey et al., 2004). In addition, persons who suffer from mental illness or consider themselves to be in poor health are more likely to suffer from low treatment completion for a number of chronic illnesses (Berg, Nyamathi, Christiani, Morisky, & Leake, 2005). Several approaches to improve adherence have been studied, including financial and other incentives, disease education, and directly observed therapy; the latter requires monitoring of participants for ingestion of each dose of medication (Jasmer et al., 2004; Malotte, Hollingshead, & Larro, 2001). In a recent study of 520 homeless persons with latent TB, a comprehensive intervention program produced higher treatment completion rates than a control program (62% vs. 39%, respectively; $p = .001$; Nyamathi, Christiani, Nahid, Gregerson, & Leake, 2006). However, the efficacy of the intervention in important subgroups of homeless adults at high-risk of nonadherence was not delineated until additional data had been collected and additional analysis completed.

The purpose of this study is to examine the impact of a nurse case-managed program on LTBI treatment completion among homeless subsamples with a variety of behavioral determinants previously identified in the literature as predictive of nonadherence. These behavioral determinants include lifetime injection drug use (IDU), daily drug, and daily alcohol use. Subsamples with other characteristics that might impact adherence, such as ethnicity, gender, veteran status, homeless history, and physical and mental health problems, were examined also. Many of these characteristics and behaviors have been associated with increased risk of both LTBI and extremely poor adherence to medical treatment regimens, often despite incentives (Brassard, Bruneau, Schwartzman, Senecal, & Menzies, 2004; Tulskey et al., 2000, 2004). Consequently, these subgroups of homeless adults may represent important high-risk clusters that may benefit from novel intervention programs.

Methods

Setting and Participants

Between 1998 and 2003, 520 homeless adults with LTBI participated in a study, approved by the University of California Internal Review Board, that assessed adherence to 6-month isoniazid (INH) treatment (Nyamathi et al., 2006). Homeless adults, recruited from 1 of 8 homeless shelters and 4 residential recovery programs in the Skid Row area of Los Angeles, were eligible for the study if they (a) had spent the previous night in 1 of the 12 selected sites; (b) had no self-reported history of completing LTBI therapy; (c) were between the ages of 18 and 55 years, or over the age of 55 years and reported risk activation factors for

active TB, such as IDU or taking immunosuppressing medications; and (d) were Tuberculin Skin Test (TST) positive via the Mantoux method, with at least 10 mm of induration (5 mm if HIV positive). The INH treatment was offered in a nearby community clinic by trained study nurses in consultation with the clinic physician. Full details of the parent study are presented in a previous publication (Nyamathi et al., 2006).

The framework used for the study was the Comprehensive Health Seeking and Coping Paradigm (Nyamathi, 1989); this health model is focused on the implementation of strategies relating to coping, communication skills, and promotion of health-seeking behavior. Completing LTBI treatment, increasing TB knowledge, and reducing risky substance use were health-seeking strategies that were emphasized in the intervention group via health education, psychosocial support, and linkage to medical and social services by nurses prepared for homeless patient care.

Procedure

Homeless adults were advised of the study by means of flyers posted in the 12 sites. These sites were randomized into the intervention and control programs based on size and length of stay. Interested persons called or visited the research nurses, who were located at the neighborhood clinic a few blocks from their shelters. Research nurses then provided potential participants with a detailed description of the study. After the initial informed consent was obtained, the homeless adults were asked to complete a brief screener; those who were eligible then received a TST administered by the research nurses via the Mantoux method (read within 48 to 72 hours). All eligible TST-positive (and chest x-ray and symptom negative) persons then underwent a second informed consent process followed by program assignment (based on recruitment site); those who presented with symptoms or had positive chest x-ray findings were referred to treatment of active TB. Over the subsequent 6 months, participants received either the intervention or control program, with a follow-up interview conducted at 6 months. The research nurses and outreach workers who delivered the intervention were not involved in the baseline or follow-up assessments.

Measures

Most of the instruments utilized have been tested previously and validated for impoverished Black, Latino, and White subjects (Nyamathi, Flaskerud, Leake, Dixon, & Lu, 2001; Nyamathi, Leake, Keenan, & Gelberg, 2000).

Dependent Variable—Treatment completion was measured by direct observation of 52 doses of INH, recorded twice weekly by the directly observed therapy nurse.

Independent Variables—Drug use and alcohol use were assessed with a revised version of the Texas Christian University Drug History Form (Simpson & Chatham, 1995). This instrument has been validated with men and women with a history of drug addiction, prostitution, and homelessness and revealed 2-week test–retest reliabilities in an acceptable range of .63 to .71 (Anglin et al., 1996). The frequency of use of 16 drugs taken by injection or other means for the past 6 months and lifetime was assessed. Drugs assessed were heroin, street methadone, other opiates, cocaine, crack, methamphetamine and other amphetamines, inhalants, marijuana or hashish, hallucinogens, tranquilizers, barbiturates, other sedatives, designer drugs, alcohol, and nicotine.

Injection drug use was defined as use of any drugs by injection, regardless of frequency, during the last 6 months and over the respondent's lifetime. In a prior study, the research team found reasonable concordance between self-report and objective evidence (through

hair sampling) of cocaine use in homeless women (Nyamathi, Leake, Longshore, & Gelberg, 2001).

Emotional well-being was assessed with the five-item Mental Health Index (Stewart, Hays, & Ware, 1988). The five-item Mental Health Index has well-demonstrated reliability and has been shown to detect significant psychological disorders including major depression, general affective disorders, and anxiety disorders (Berwick et al., 1991). A cut-point of 66 was used to identify emotionally distressed participants (Rubenstein et al., 1989). Reliability in the overall sample was .76.

Depression was assessed with the Center for Epidemiological Studies Depression (CES-D) scale (Radloff, 1977). This 20-item self-report instrument was designed to measure depressive symptomatology in the general population and has been validated for use in homeless populations (Ritchey, La Gory, Fitzpatrick, & Mullis, 1990). Each item was used to measure the frequency of symptoms on a 4-point response scale from 0 = *rarely or none of the time (less than 1 day)* to 3 = *most of the time (5–7 days)*. Examples of CES-D items are “I felt depressed” and “I felt fearful.” Cronbach's α for the scale in this sample of homeless persons was .85. The standard cut-point of 16 was used as a marker for depression.

Tuberculosis knowledge was measured with a modified 13-item instrument (Morisky et al., 1990). Cronbach's α for this instrument in the sample was .77. Correct responses were summed for a score of 0 to 13. Social support was assessed using a validated 18-item scale (Sherbourne & Stewart, 1991); respondents were asked also whether they received support from drug users, non-drug users, or both. Cronbach's α for the social support scale in this sample was .97. Perceived health status was measured on a 5-point scale (Aday, 1994) ranging from *excellent to poor* and a dichotomous (yes–no) item about recent hospitalization.

Intention to comply with the treatment regimen was assessed by asking respondents to indicate how committed they were to taking INH for 6 months and how likely they were to do so using 5-point response sets that were subsequently dichotomized into *definitely would* and *other* for analysis. Desire to take treatment medication was measured by asking participants how much they would want to take INH; responses ranged from 1 = *definitely would* to 5 = *definitely would not* and were dichotomized into *definitely would* and *other* based on the distribution. An additional item was used to elicit agreement about the importance of taking INH, scored on a 4-point scale; responses were dichotomized as *strongly agree* and *other* for analyses.

Demographic Factors—A structured instrument was used to assess self-reported age, gender, ethnicity, education, lifetime length of time homeless, veteran status, marital and partnership status, history of incarceration, having a drug-using partner, history of sexually transmitted diseases, receipt of Supplemental Security Income benefits, and receipt of money from friends or family.

Intervention

In both the intervention and control programs, homeless adults were required to present to the clinic twice a week over a period of 6 months to receive directly observed treatments of 900 mg of INH with 50 mg Vitamin B6. Incentives of \$5 were paid to the participants for each dose. All participants were also given a detailed directory of community resources and services of local agencies.

Participants in the intervention program attended eight comprehensive educational and skills training modules over the 6-month study period in small groups of four to five at a time. The

program was delivered directly before the treatment dose by research nurses and outreach workers in a culturally competent and tailored manner. Information was provided on TB and HIV infection and risk reduction; strategies to improve self-esteem, coping, self-management, and communication skills; and training in problem solving to implement behavior change and to develop relationships and social networks to maintain behavior change. Content was delivered by means of factual presentations, group discussions, role playing, and presentations of culturally sensitive pictorial coping scenarios (Nyamathi & Bennett, 1997), as well as behavioral exercises and demonstrations. Intervention participants who missed appointments for their INH dose or educational session were tracked actively and reengaged into the program by the outreach staff using a detailed locator guide. A total of 78% of the intervention participants completed all eight sessions. Participants were not reimbursed for attending the educational sessions.

For the control program, one 20-minute TB and HIV education session was delivered, and tracking was not conducted for receipt of INH treatment. However, both groups were tracked for completion of the 6-month questionnaire.

Data Analysis

Frequencies on the characteristics and behaviors of participants in the experimental and control programs were examined. Differences in treatment completion for experimental and control participants in 12 subgroups of theoretical interest were tested with chi-square statistics. Relative risks rather than unadjusted odds ratios (ORs) were calculated to provide the most conservative picture of the magnitudes of program differences in treatment completion for each subgroup.

Associations between potential confounders of program effect on LTBI treatment completion within each subgroup were examined using zero-order correlations. Logistic regression models were constructed for each of the 12 subgroups. The dependent variable for all 12 models was LTBI treatment completion (0/1); a dummy variable for treatment effect (experimental vs. control) was included as a predictor in each model. Due to the large number of characteristics associated with treatment completion and the relatively small sample sizes in each subgroup, variables significant at the .15 level in preliminary analyses were entered into a stepwise backward logistic regression analysis for treatment completion. A second dummy variable representing recruitment site type was included in all models, except the model for emergency shelter recruits, to control for lack of program balance on that important factor. Small sample sizes prohibited model fitting among drug recovery recruits. The .10 level was used for retention in the final model for each subgroup. Final models were tested for multicollinearity, which was not found to be a problem; goodness of fit was assessed with the Hosmer-Lemeshow test. Adjusted ORs for program effects in the 12 models were reported.

Results

The intervention arm consisted of 279 homeless adults; the control arm contained 241 homeless adults. Participants were primarily male (80%), Black (81%), and unemployed (90%). Their mean age was 42 years ($SD = 8.5$ years). Approximately three quarters had completed high school. One fifth of the sample reported lifetime use of injection drugs, with more than half of these reporting recent IDU. Daily drug use was reported by one quarter of the sample, whereas daily alcohol use was reported by slightly less (16%). A third of the sample also reported daily substance use. The demographic and behavioral data of the sample based on intervention versus control program are displayed in Table 1.

Unadjusted Results

Differences of 20 percentage points or more in treatment completion were found between the intervention and control programs among all subgroups of participants except daily drug users (Table 2). Among women, persons in fair or poor health, and those experiencing emotional distress or depression, intervention program participants were almost twice as likely to complete INH treatment as controls and their completion rates exceeded corresponding rates among control participants by 30 percentage points.

Adjusted Results

Logistic regression analyses controlling for potential confounders in each subgroup of interest revealed that the intervention program was most effective for daily alcohol users, women, and those in fair to poor health (Table 3). The intervention program also led to better LTBI treatment adherence than did the control program among men, African Americans, daily drug users, and those with emotional distress or depression. No significant program differences in treatment completion were found among homeless adults who self-identified as either White or Hispanic and those who reported military service or lifetime use of injection drugs.

Discussion

In this prospective site-randomized study, a nurse case-managed intervention program with education, tracking, and incentives effectively increased adherence to 6-month INH treatment in a variety of homeless subgroups, including most substance users and those with physical and mental health problems. Furthermore, compared with a usual care program with incentives, the intervention increased LTBI treatment completion among 9 of the 12 subsamples examined. When potential confounders were controlled, the lowest adjusted OR for treatment effect was 2.20. Although variations in adjusted ORs (2.2–10.4) support the assertion that one size does not fit all, ORs in 8 of the 12 subgroups were in the range of 2–4, implying a generally consistent positive effect. The intervention impact was particularly evident among shelter residents, with a 91% completion rate, and among persons who reported fair or poor health. These results are particularly encouraging because treatment completion required 6 months of twice-weekly visits for INH. Efficacy in multiple difficult-to-treat subgroups suggests that the intervention is portable and can improve LTBI treatment completion in many underserved populations. Given a modicum of financial resources, public health programs could also adapt the major intervention components to address compliance with other types of supervised preventive care. The finding that two thirds of homeless shelter residents assigned to the control program also completed treatment highlights the critical roles of relative stability and that most homeless adults will comply with structured preventive healthcare when it is offered.

The findings that Hispanics and non-Hispanic Whites did not benefit as much from the intervention compared with African Americans and had poor treatment completion rates overall are noteworthy. In general, ethnicity has not predicted treatment adherence consistently in other TB intervention studies with homeless adults (Bock, Sales, Rogers, & DeVoe, 2001; Davidson et al., 2000; Tulskey et al., 2004). A number of factors may have contributed to the relatively poor adherence among Hispanics in this study. First, almost half (45%) of the Hispanic participants were foreign born, primarily in Mexico, so those who were not facile with English may have experienced language barriers. Recommendations to improve adherence might include offering bilingual education programs focused on enhancing homeless persons' understanding of the disease and treatment issues (Driver, Matus, Bayuga, Winters, & Munsiff, 2005). Second, previous studies have shown that immigrant Hispanics are far more mobile than other homeless ethnic or racial groups due to

changing employment locations and immigration issues (Wells et al., 1999). Finally, although non-Hispanic Whites have received little attention in the homeless literature, it may be that, as members of a more advantaged population, homeless Whites feel particularly stigmatized by lack of housing and use of illegal drugs. Such feelings discourage consistent help seeking and treatment adherence.

The lack of treatment effect among Veterans Administration participants reflects the fact that this study was not powered to detect program disparities in subgroups with small sample sizes. Similarly, no intervention effect was found for IDUs. As might be expected, treatment completion rates for IDUs and for daily substance users were poor in both programs. These very difficult-to-treat populations need to be targeted with innovative services that include substance abuse counseling and treatment (Batki, Gruber, Bradley, Bradley, & Delucchi, 2002) and provision of stable housing (Davidson et al., 2000; Tulskey et al., 2004) to determine whether their LTBI treatment completion rates can be improved. Integrating disease-specific care may also be critical for homeless persons with poor mental health.

Depressive symptomatology, emotional distress, and self-reported fair/poor physical health were prevalent in this sample, and individuals with these conditions appear to have benefited directly from the nurse case management that offered them emotional support, health education, encouragement to seek needed care, and referrals to appropriate services. The findings that LTBI treatment completion rates were over 60% among homeless persons with poor mental health and over 70% among those with poorer physical health underscore the positive impact of nurse case management on treatment adherence. Although tracking was part of the intervention, the fact that three quarters of the participants in the intervention group did not require it supports the importance of the remaining components. Overall, this intervention led to excellent rates of treatment completion among homeless adults in emergency shelters, but stronger interventions are needed to address LTBI treatment adherence among those in residential recovery shelters. Further research also needs to investigate treatment compliance among unsheltered homeless persons because they are much harder to track and less likely to use health services.

Homeless adults are more likely than those in the general population to be exposed to TB, and those with TB infection are more likely to be undetected and untreated than their housed counterparts (Haddad, Wilson, Ijaz, Marks, & Moore, 2005). This study suggests that nurse case management with incentives increases adherence to 6-month INH treatment in a number of homeless subgroups, particularly sheltered homeless persons. However, further research is needed to better delineate adherence to medication regimens among high-risk subgroups so that resources can be distributed to individuals in these subgroups who are at highest risk of treatment failure.

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TABLE 1

Sample Characteristics by Program at Baseline

Characteristic	Intervention (n = 279)	Control (n = 241)	Total (N = 520)
Age, mean (SD), years	41.8 (8.5)	41.1 (8.6)	41.5 (8.5)
Male **	87.8	70.3	79.6
Ethnicity			
Black	82.7	78.9	81.0
White	6.5	8.3	7.3
Hispanic	8.3	10.7	9.4
Other	2.5	2.1	2.3
High school graduate	74.5	70.3	72.5
Never married	54.7	56.6	55.6
Partnered	28.4	28.1	28.3
Employed	9.7	10.3	10.0
Insurance			
Medical	8.7	11.2	9.9
VA	9.0	8.7	8.9
Other	5.3	6.5	5.8
None	77.0	73.6	75.4
Recruitment site **			
Emergency shelter	91.0	66.5	79.6
Drug recovery shelter	9.0	33.5	20.4
Years homeless, median (range)	1 (0.003–20)	1.5 (0.04–24)	1 (0.003–24)
Treatment completion important	96.4	95.4	96.0
Completed INH treatment **	61.5	39.3	51.2
Lifetime IDU **	13.7	27.3	20.0
Recent IDU ^a	7.3	16.1	11.4
Daily alcohol use	15.5	16.5	16.0
Daily drug use *	23.0	29.8	26.2
Daily alcohol/drug use *	30.6	36.0	33.1

Note. Values are presented as %, unless otherwise noted. VA = Veterans Administration; IDU = injection drug use; INH = isoniazid. From “A randomized clinical trial of two treatment programs for homeless adults with latent tuberculosis infection,” by A. Nyamathi, A. Christiani, P. Nahid, P. Gregerson, and B. Leake, 2006, *International Journal of Tuberculosis and Lung Disease*, 10, pp. 775–782. Copyright 2006 by the International Union Against Tuberculosis and Lung Disease. Reprinted with permission.

^aRefers to past 6-month period.

* $p < .05$, chi-square or t test.

** $p < .001$, chi-square or t test.

TABLE 2

Unadjusted Rates of Latent Tuberculosis Infection Treatment Completion for Each Program Among Key Subsamples ($n = 507$)

Subsample	Completed treatment		RR	95% CI
	Intervention, n (%)	Control, n (%)		
Males	149 (61)	71 (37)	1.46	1.21, 1.77
Females	22 (65)	24 (33)	1.94	1.26, 2.98
African Americans	148 (64)	84 (44)	1.45	1.22, 1.74
Non-African Americans	24 (50)	11 (22)	2.32	1.32, 4.06
Homeless shelter recruits	253 (91)	161 (66.5)	1.57	1.29, 1.90
Veteran	17 (68)	9 (43)	1.50	0.93, 2.71
Lifetime IDU	21 (55)	23 (35)	1.59	1.01, 2.48
Daily alcohol use	23 (54)	11 (28)	1.95	1.13, 3.36
Daily drug use	31 (48)	25 (35)	1.40	0.93, 2.09
Fair/poor health	32 (71)	20 (36)	1.96	1.34, 2.87
Emotionally distressed	130 (63)	128 (33)	1.92	1.48, 2.50
Depressed	132 (63)	133 (35)	1.82	1.41, 2.35

Note. RR = relative risk; CI = confidence interval; IDU = injection drug use.

TABLE 3

Efficacy of the Intervention in Selected Subgroups

	Adjusted odds ratio	95% CI
Males ^a	2.51	1.60, 3.93
Females ^b	5.80	1.72, 19.57
African Americans ^c	2.60	1.69, 4.02
Non-African Americans ^d	2.29	0.84, 6.30
Veteran ^e	4.34	0.87, 21.73
Lifetime IDU ^f	2.20	0.85, 5.67
Daily alcohol use ^g	10.41	2.48, 43.68
Daily drug use ^h	3.27	1.30, 8.25
Fair/poor health ⁱ	5.10	1.79, 14.52
Homeless shelter recruits ^j	2.76	1.80, 4.23
Emotionally distressed ^k	3.57	2.00, 6.37
Depressed ^l	2.98	1.67, 5.33

^aControlling for recruitment site type, age, high school education, African American ethnicity, marital status, medical coverage, intention to comply, daily substance use, having a drug-using partner, years homeless, recent emotional or mental health problems, and receiving help from family and friends.

^bControlling for recruitment site type, recent hospitalization, history of sexually transmitted diseases (STD), and being willing to get care for physical health problems.

^cControlling for recruitment type, high school education, intention to comply, importance of compliance, years homeless, and daily substance use.

^dControlling for recruitment site type, living with a partner, history of STD, tuberculosis knowledge, and daily substance use.

^eControlling for recruitment site type, education, and daily substance use.

^fControlling for recruitment site type, receiving Supplemental Security Income benefits, history of STD, and having a drug-using partner.

^gControlling for recruitment site type, high school education, years homeless, and depression.

^hControlling for recruitment site type, high school education, years homeless, and depression.

ⁱControlling for recruitment site type, desire to take isoniazid, recent hospitalization, and months homeless.

^jControlling for education, marital status, having a regular source of healthcare, intention to comply, and daily substance use.

^kControlling for recruitment site type, African American ethnicity, years homeless, lifetime injection drug use, weekly alcohol use, and receiving help from family and friends.

^lControlling for recruitment site type, high school education, years homeless, history of STD, lifetime injection drug use, and social support from non-substance-users.