DOI: 10.1111/j.1475-6773.2009.00986.x
RESEARCH ARTICLE

Does Deinstitutionalization Increase Suicide?

Jangho Yoon and Tim A. Bruckner

Objectives. (1) To test whether public psychiatric bed reduction may increase suicide rates; (2) to investigate whether the supply of private hospital psychiatric beds—separately for not-for-profit and for-profit—can substitute for public bed reduction without increasing suicides; and (3) to examine whether the level of community mental health resources moderates the relationship between public bed reduction and suicide rates.
Methods. We examined state-level variation in suicide rates in relation to psychiatric beds and community mental health spending in the United States for the years 1982–1998. We categorize psychiatric beds separately for public, not-for-profit, and for-profit hospitals.
Principal Findings. Reduced public psychiatric bed supply was found to increase suicide rates. We found no evidence that not-for-profit or for-profit bed supply compensates for public bed reductions. However, greater community mental health spending buffers the adverse effect of public bed reductions on suicide. We estimate that in 2008, an additional decline in public psychiatric hospital beds would raise suicide rates for almost all states.
Conclusions. Downsizing of public inpatient mental health services may increase suicide rates. Nevertheless, an increase in community mental health funding may be promising.

Key Words. Deinstitutionalization, suicide, community mental health, privatization, psychiatric beds

Deinstitutionalization represents one of the most widespread changes in mental health policy. This process has led to the massive transfer of severely mentally ill persons out of institutional care in favor of community treatment (Grob 1994). A crucial aspect of deinstitutionalization involves significant structural changes in the public mental health system. From 1970 to 2000, public psychiatric hospital beds dropped from 207 to 21 beds per 100,000 persons (Manderscheid et al. 2004). This reduction concerns mental health professionals and policy makers because the declining capacity of public psychiatric hospitals may jeopardize care for indigent, severely mentally ill patients that require treatment but lack sufficient economic resources.

Decreasing public psychiatric hospital beds (hereinafter public beds) would be efficient if the demand for beds similarly declined. However, the literature does not support this notion of efficiency; deinstitutionalization rarely, if at all, followed reduced demand for inpatient psychiatric care. Instead, ideological rhetoric, welfare programs, and fiscal considerations by states initiated and accelerated the process of deinstitutionalization (Cameron 1978; Gronfein 1985a; Mechanic and Rochefort 1990; Grob and Goldman 2006). Moreover, deinstitutionalization represents a rare social policy that was implemented faster and more extensively than anticipated (Mechanic and Rochefort 1990). Thus, public bed availability may have dropped below the level of demand. In this circumstance, public bed reductions may adversely affect mental health for persons with severe mental illness in a community.

The last decades have also experienced rapid privatization of the inpatient psychiatric market and proliferation of public community-based mental health programs (Manderscheid et al. 2004). It is unclear whether these augmented services could substitute for the reduction in public inpatient supply. If privatization does not influence the availability and quality of care, it should not, ceteris paribus, alter mental health of severely mentally ill patients. However, compared with public psychiatric hospitals, private psychiatric hospitals, particularly for-profit hospitals, preferentially treat insured patients and those with less severe, acute symptoms (Schlesinger et al. 1997; Mechanic 1999). The clear distinction of service clientele across different ownership types implies that private bed supply may not substitute for public bed supply. Moreover, due to its voluntary nature and chronic underfunding, community mental health care may not adequately treat severely mentally ill patients with a history of dangerousness, co-occurring disorders or arrests (Lamb, Weinberger, and Gross 2004). Nevertheless, increased supply of public community mental health resources provides free goods to the economically disadvantaged and may therefore buffer adverse effects of public bed reductions, improving community mental health.

Our main objective is to examine the relationship between the supply of public beds, as a proxy for deinstitutionalization, and population mental health. We focus on suicide rates as a measure of population mental health. Despite recent declines in national prevalence (McKeown, Cuffe, and Schulz

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2006), suicide rates serve as a useful indicator of population mental health because of their strong association with severe psychiatric episodes (Black and Fisher 1992; Simpson and Tsuang 1996; Colton and Manderscheid 2006; Miller, Paschall, and Svendsen 2006; Saha, Chant, and McGrath 2007). We test whether private hospital psychiatric beds, separately for not-for-profit and for-profit hospital psychiatric beds (hereinafter, not-for-profit beds and for-profit beds, respectively), can replace public beds without increasing suicides. We also analyze whether the relationship between public bed reduction and suicide rates varies with the availability of public community-based mental health resources.

Prior Studies and Limitations

Deinstitutionalization has also taken place, and been researched, outside the United States. In Sweden, mortality due to suicides among patients with schizophrenia increased when the number of psychiatric hospital beds declined (Salokangas et al. 2002). In Denmark, a significant negative association was found between the number of psychiatric beds and suicide mortality (Ösby et al. 2000). A Norway study reported an increase in suicide mortality after psychiatric bed reductions (Hansen, Jacobsen, and Arnesen 2001). In the United States, Haugland et al. (1983) examined the mortality rate of 1,033 deinstitutionalized patients. The authors found that during a $3\frac{1}{2}$-year follow-up period, patients were approximately eight times more likely to die of suicide or accident than persons in the general population. This finding is in line with a greater risk of suicide among young deinstitutionalized patients served in a community mental health center (Pepper, Kirshner, and Ryglewicz 1981). In contrast, Bachrach (1996) and McGrew et al. (1999) reported general improvements in the quality of life and functioning among patients discharged and treated in community settings due to the closure of state psychiatric hospitals.

We believe that the deinstitutionalization process in the United States has been implemented without sufficient evaluation of possible health risks. Relatively few studies in this area appear in the published literature, and the extant work has several important limitations. We address the following limitations in the literature to inform policy in the era of community-based treatment.

First, the U.S. studies examined only subgroups of persons with severe mental illness such as patients discharged from psychiatric hospitals (Haugland et al. 1983) and former patients in state psychiatric hospitals who continued to receive treatment in the community after a discharge (Bachrach

1996; McGrew et al. 1999). However, a reduced supply of public beds, ceteris paribus, may also affect persons who did not use public psychiatric hospitals previously but require intensive care in restricted settings as well as those who did not access treatment after a hospital discharge.

Second, inpatient psychiatric care has become more privatized. In 2000, private psychiatric and general hospitals accounted for 24 and 46 percent of all inpatient treatment episodes, respectively, as compared with only 12 percent in state psychiatric hospitals (Manderscheid et al. 2004). In addition, evidence suggests that private hospitals may increasingly serve patients similar to those of public hospitals (Olfson and Mechanic 1996; Mechanic, McAlpine, and Olfson 1998). However, little research evaluates the increasing role of private entities in providing inpatient psychiatric care. To our knowledge, no research has explored whether an increased supply of private psychiatric beds could offset a reduction in public beds, with no adverse effect on population mental health.

Third, the interaction between public inpatient and community mental heath resources remains largely unexplored. A region with greater community mental health resources may be better positioned than other regions to absorb a shock from a public inpatient reduction. Given the significance of the public sector's provision of mental health services, policy makers may want to know the level of community resources required to mitigate the potential sequelae of reductions in public beds.

Conceptual Framework

A change in psychiatric bed supply may relate to suicide rates because it may influence whether an individual obtains services at the time of need. Bed supply may also influence substance abuse because persons with severe mental illness may self-medicate their symptoms when they experience limited access to services (Whitmer 1980; Pristach and Smith 1996; Harris and Edlund 2005). In this case, bed reductions may increase suicide rates because substance abuse reportedly predicts suicide risk among mentally ill persons (Hiroeh et al. 2001).

Although public psychiatric hospitals have historically served as a safety net provider for many severely mentally ill persons, it remains unclear whether a reduction in public beds leads to higher suicide rates. The development of psychopharmacology beginning in the 1950s enabled community treatment of severe mental illness and reduced the need for long hospitalization (Morrissey 1989; Mechanic and Rochefort 1990; Grob 2001). With continued advances of psychotropic medications and treatment, community

options might achieve similar or improved patient outcomes as suggested by Bachrach (1996) and McGrew et al. (1999). In addition to technological innovations, however, strong ideological consensus, regulations of welfare programs such as Medicaid rules, and financial considerations have reportedly served as catalysts for rapid and ongoing public bed reductions (Cameron 1978; Gronfein 1985a; Mechanic and Rochefort 1990; Frank, Goldman, and Hogan 2003; Grob and Goldman 2006). Current data suggest that this downsizing led to a shortage of psychiatric beds and increased waiting lists for psychiatric hospital admissions (National Association of State Mental Health Program Directors Research Institute [NRI] 2006a). Therefore, deinstitutionalization may have proceeded faster than the reduction in the demand for public beds. If this were the case, we would expect a negative relationship between public bed capacity and suicide rates.

Among private psychiatric facilities, ownership status may affect hospitals' treatment behavior. For-profit hospitals are more inclined than public and not-for-profit entities to maximize profits (Frank, Salkever, and Mullann 1990; Sloan 2000) and therefore may avoid indigent and high-cost patients usually served by public psychiatric hospitals (Schlesinger et al. 1997; Mechanic 1999). Moreover, due to the voluntary nature of community treatment, for-profit psychiatric facilities may not address needs of a subgroup of patients with severe mental illness, especially those who do not respond to treatment and lack affordable housing. Thus, ceteris paribus, increased for-profit beds may not offset public bed reductions.

We expect not-for-profit psychiatric hospitals to derive their utility in part from patient well-being and thus may improve overall access to mental health services, which could subsequently reduce suicide rates. However, not-for-profit hospitals serve those with less severe symptoms than do public psychiatric hospitals. Despite the evidence that the case mix difference across ownership types diminished in recent years particularly among general hospitals (Olfson and Mechanic 1996; Mechanic, McAlpine, and Olfson 1998), public hospitals appear most likely to treat indigent patients with severe psychiatric disorders (Schlesinger and Dorwart 1984; Manderscheid et al. 1985; Gray and McNerney 1986; Dorwart et al. 1991; Culhane and Hadley 1992; Fisher et al. 1992; Frank and Salkever 1994; Olfson and Mechanic 1996; Schlesinger et al. 1997; Mechanic, McAlpine, and Olfson 1998; Milazzo-Sayre et al. 2001). Therefore, an increase in not-for-profit beds may not have the same suicide-reduction effect as would the public psychiatric hospitals.

The effect of bed reduction may depend on levels of public resources for community-based treatment. Regions with more community mental health re-

sources may better absorb negative effects of the reduced supply of public beds. Thus, we postulate that the negative effect of public bed reduction on suicide rates, if any, is smaller in a state with greater community mental health resources.

A central component of suicide prevention involves treatment of psychiatric disorders via proper pharmacotherapy (Goldsmith et al. 2002). Moreover, placement in institutional psychiatric settings serves the function, at least in the short term, of restricting access to common means to attempt suicide such as nonprescription drugs and firearms (Mann et al. 2005). Taken together, these circumstances imply that a change in mental health resources may influence the incidence of suicide concurrently.

METHODS

Identification

Psychiatric bed supply and community mental health resources varied substantially across states and times (Morrissey 1989; Mechanic and Rochefort 1990; Grob and Goldman 2006). This variation resulted from traditions and circumstances unique to each state. Some of these factors included the size of patient populations, the political clout of public hospitals and the professional psychiatric community, the strength of deinstitutionalization ideologies, and the states' budgets (Gronfein 1985b; Mechanic and Rochefort 1990; Grob and Goldman 2006). This state variability persists even in the contemporary mental health care setting (NRI 2006a).

We use the states' variation in the timing and size of changes in psychiatric beds and community mental health resources to identify their effect on suicide rates. Suicide rates also exhibited substantial interstate variation (see supporting information Figure S1). We control for potential confounders reported in the literature as well as unobservable characteristics unique to each state and time period.

Empirical Specification

We estimated the following equation to examine the relationship between public bed supply (*PUBLIC*) and suicide rates (*SUICIDE*):

$$\begin{aligned} SUICIDE_{st} = {} & \alpha_1 PUBLIC_{st} + \alpha_2 NFP_{st} + \alpha_3 FP_{st} + \alpha_4 CMHE_{st} \\ & \eta X_{st} + S_s + Y_t + \varepsilon_{st} \end{aligned} \tag{1}$$

where s and t index state and year, respectively. We controlled for the number of not-for-profit (*NFP*) and for-profit (*FP*) beds and community mental health

expenditures (*CMHE*) because these factors have accompanied public bed reductions and may also affect suicide rates.

X refers to a vector of each state's sociodemographic characteristics and economic conditions as well as changes in other mental health policies or resources. We specified in a set of sociodemographics age structure, sex ratio, racial composition, and urbanization variables. Economic conditions may affect both the supply of public beds and suicide rates. Thus, our covariates included the poverty rate, unemployment rate, and per-capita income. We also controlled for changes in mental health care financing and welfare state such as state mental health parity laws, the proportion of residents on Medicaid, and the proportion of AFDC/TANF residents. The number of psychiatrists was included as a proxy for changes in state mental health workforce. It may also reflect overall population mental health levels that may influence both public bed supply and suicide rates. We also controlled for unobserved state differences that do not change over time (S) and secular changes in suicide rates common to all states (Y).

We then explored our second aim of whether an increase in not-for-profit or for-profit beds can substitute for a decrease in public beds without increasing suicides. Equation (1) alone cannot address this substitution issue. For example, we may find that greater not-for-profit beds reduce suicide rates, holding other things constant. This finding, however, does not imply by axiom that not-for-profit bed supply could substitute for public bed reduction. It only suggests the ceteris paribus relationship between not-for-profit (or for-profit) bed supply and suicide rates. A more appropriate test of substitutability is to examine whether an increase in the ratio of not-for-profit beds (or for-profit beds) to public beds affects suicide rates, holding fixed the sum of not-for-profit and public beds (or the sum of for-profit and public beds) and other confounders.

Our empirical model takes the following form:

$$SUICIDE_{st} = \alpha BED\_CMHE_{st} + \eta X_{st} + S_s + Y_t + \varepsilon_{st} \qquad (2)$$

where *BED_CMHE* refers to a vector of main independent variables. We included in *BED_CMHE* the ratio of not-for-profit (or for-profit) beds to public beds, the sum of not-for-profit (or for-profit) and public beds, for-profit (or not-for-profit) beds, and community mental health expenditures. The ratio variable measures whether the substitution between not-for-profit (or for-profit) and public beds affects suicide rates.

To address our third aim of whether the effect of public bed reduction on suicide rates varies with the availability of community mental health

resources, we estimated the following equation including an interaction term of public beds and community mental health expenditures (*PUBLIC* × *CMHE*):

$$SUICIDE_{st} = \alpha_1 PUBLIC_{st} + \alpha_2 NFP_{st} + \alpha_3 FP_{st} + \alpha_4 CMHE_{st} \lambda PUBLIC \times CMHE_{st} + \eta X_{st} + S_s + Y_t + \varepsilon_{st} \quad (3)$$

Estimation

In our equations, the magnitude of the error term may be inversely correlated with population size. Unweighted estimates could produce heteroskedasticity and render findings difficult to interpret. We rejected the null hypothesis of homoskedasticy in all models, and therefore we estimated the above equations with weighted least squares (WLS) that use state population size as the weights.

We addressed potential violations of OLS standard assumptions in panel data: (1) panel heteroskedasticity, that is, each state may have its own error variance; (2) contemporaneous correlation, that is, the error variance for one state may be correlated with the errors for other states; and (3) serial correlation, that is, the errors for a given state are correlated with the previous errors for that state. We applied the method of panel corrected standard errors (PCSE) that has excellent statistical properties for time-series-cross-section (TSCS) data (Beck and Katz 1995, 1996). Although this technique has not yet been widely employed by health services researchers, it serves as a modern econometric technique for TSCS data and addresses important issues related to correct inferences in the current analysis.

A crucial assumption for the method of PCSE is that the errors are free of serial correlation. We conducted a series of F-tests for serial correlation (AR(1)) in panel data models developed by Wooldridge (2003) and found no evidence of serial correlation.

DATA

We retrieved state-level data from various sources for the years 1982–1998 for 50 U.S. states and the District of Columbia. Table 1 provides definitions and summary statistics for the variables used in this study.

Suicide Rates

We derived state-level suicide rates from the National Center for Health Statistics Compressed Mortality File (NCHS 1982–1998). The mortality file

provides information from death certificates on cause of death, including death from suicide or self-inflicted injuries (ICD-9 codes E950-E959). Suicide rates are calculated as the number of suicides per 100,000 population for persons aged 15–64.

Table 1: Variable Definitions and Summary Statistics

Variables	*Definitions*	*Mean*	*Standard Deviation*
Dependent variable			
Suicide rates	Number of death from suicides per 100,000 persons	15.82	4.16
Main independent variables			
PUBLIC	Number of psychiatric beds per 100,000 persons	34.0	31.7
NFP		799	894
FP		403	692
CMHE	State mental health agencies' per-capita expenditures on community mental health programs (in 1998 dollars using the consumer price index)	36.7	26.7
Ratio variables			
Not-for-profit/ *PUBLIC*	Ratio of not-for-profit (or for-profit or community mental health expenditures) to public psychiatric hospital beds	33.2	44.4
For-profit/ *PUBLIC*		19.9	42.0
Covariates			
Age categories			
20–24	Proportion of residents within each category of age	0.078	0.018
25–34		0.164	0.017
35–44		0.148	0.17
45–54		0.106	0.014
55–64		0.086	0.009
Male	Ratio of male to female residents	0.957	0.037
Black	Proportion of black residents	0.11	0.12
Nonblack–nonwhite	Proportion of non-black non-white residents	0.044	0.089
Metropolitan	Proportion of residents in metropolitan areas	0.66	0.22
Per-capita income	State per-capita income	21,703	4,016
Unemployment	State unemployment-to-population ratio	0.026	0.022
Poverty	Proportion of the poor	0.14	0.042
Parity law	Equals 1 for state with any mental health parity laws; 0 otherwise	0.03	
Medicaid	Proportion of Medicaid recipients	0.101	0.051
AFDC/TANF	Proportion of AFDC/TANF recipients	0.040	0.017
Psychiatrist	Number of psychiatrists per 100,000 persons	12.36	9.75

CMHE, community mental health expenditures; *FP*, for-profit hospital psychiatric beds; *NFP*, not-for-profit hospital psychiatric beds; *PUBLIC*, public psychiatric hospital beds.

Psychiatric Beds

We retrieved the number of psychiatric beds from American Hospital Association's Annual Survey of Hospitals (AHA 1982–1998). Psychiatric care facilities included public and private psychiatric hospitals and psychiatric units in general hospitals. We collapsed observations at the state level and calculated the per-capita number of psychiatric beds per 100,000 persons, separately by public, not-for-profit, and for-profit status.

Community Mental Health Expenditures

We used state mental health agencies' (SMHA) per-capita expenditures on community-based mental health programs from the NRI. NRI has intermittently conducted the SMHA revenues and expenditures study in 1981, 1985, 1987, 1990, 1993, 1997, and 2001. We linearly interpolated expenditure data for the intervening years. The data include SMHA-controlled expenditures on mental health including medications and drug and alcohol programs (Lutterman and Hogan 2001).

Covariates

Sociodemographic controls include age categories including the proportions of the state residents 20–24, 25–34, 35–44, 45–54, and 55–64 years old, a ratio of male to female residents, the proportions of black and nonblack–nonwhite residents, and the proportion of metropolitan residents in a state. Economic factors include poverty rates, state unemployment rates, and state per-capita income. We retrieved data from the U.S. Census Bureau, the Bureau of Economic Analysis, and the Bureau of Labor Statistics.

We specified several variables reflecting changes in mental health financing and workforce as well as welfare state, including state mental health parity laws, the proportion of Medicaid recipients, the proportion of welfare (AFDC/TANF) recipients, and the per-capita number of psychiatrists per 100,000 persons. The parity law variable takes the value of 1 for the years that each state had any mental health parity laws and 0 otherwise. We accessed parity law data from the National Conference of State Legislatures (2008). Information on Medicaid and welfare recipients came from the U.S. Census Bureau. The per-capita number of psychiatrists per 100,000 persons was retrieved from the American Medical Association's Physician Characteristics and Distribution in the United States (1982–1999).

RESULTS

Supply of Public Beds and Suicide Rates

The supply of public beds was negatively associated with suicide rates (see Table 2). A one public bed reduction per 100,000 persons was associated with an increase of 0.025 suicides per 100,000 persons annually, holding constant the supply of not-for-profit and for-profit beds and community mental health funding. To gauge the magnitude of this effect, we calculated the predicted suicides that could result from an additional decrease in public beds. Using the adult population size aged 15–64 in 1998, one public bed decrease per 100,000 persons corresponds to approximately 1,818 fewer public beds nationwide. Using our coefficient in Table 2 (i.e., -0.025), this crude calculation shows that a one public bed decrease per 100,000 persons would result in about 45 additional suicides per year ($-0.025 \times 1{,}818$), or about 1,988 years of potential life lost before the age of 80 (CDC 2008).

No association was found between suicide rates and the supply of not-for-profit and for-profit beds. We observed a positive significant relationship between per-capita community mental health spending and suicide rates. This result, however, was not robust to different specifications and the removal of outlying states (see the *Robustness* section). The existence of parity laws and the proportions of metropolitan and nonblack–nonwhite residents were negatively correlated with suicide rates. Unemployment rates and the proportion of residents aged 55–64 were positively correlated with suicide rates.

Substitutability between Public and Private Psychiatric Beds

Table 3 presents results from the models that examine whether an increase in not-for-profit beds (see Model 1) and for-profit beds (see Model 2) can substitute for public bed reduction. There was a statistically nonsignificant relationship between suicide rates and the ratio variables. This finding suggests that the substitution of public with not-for-profit or for-profit beds did not increase suicide rates. However, this result was not robust to the removal of outliers (see *Robustness* section).

Interaction Effect of Public Beds and Community Mental Health Spending

We find that levels of community mental health resources modify the effect of a decrease in public beds (see Table 4). The coefficients of public beds and the interaction term were jointly significant at the $p < .001$ level. This indicates that the relationship between public bed supply and suicide rates appears to vary by the level of the per-capita community mental health expenditures.

Table 2: Relationship between Public Psychiatric Bed Supply and Suicide Rates

Variables	*Coefficient*
PUBLIC	–0.0252**
	(0.0043)
NFP	0.00019
	(0.00016)
FP	0.000055
	(0.000087)
CMHE	0.0105*
	(0.0036)
Age	
20–24	12.5
	(18.1)
25–34	14.5
	(12.0)
35–44	24.8
	(24.0)
45–54	–3.8
	(17.3)
55–64	99.1**
	(17.3)
Male	–24.2
	(13.3)
Black	–9.42
	(9.03)
Nonblack–nonwhite	–55.1**
	(10.4)
Metropolitan	–0.087**
	(0.023)
Per-capita income	0.000010
	(0.000067)
Poverty rate	–0.027
	(0.030)
Unemployment	0.194**
	(0.038)
Parity law	–0.90**
	(0.19)
Medicaid	–0.59
	(1.43)
AFDC	–2.14
	(7.71)
Psychiatrist	0.000081
	(0.000056)

Panel corrected standard errors are in parentheses.

*$p < .01$.

**$p < .001$.

CMHE, community mental health expenditures; *FP*, for-profit hospital psychiatric beds; *NFP*, not-for-profit hospital psychiatric beds; *PUBLIC*, public psychiatric hospital beds.

To determine the conditions under which a reduction in public beds has a statistically significant negative effect on suicide rates, we calculated corresponding 95 percent confidence intervals. Once the per-capita community spending was greater than roughly US$107 in 2008 dollars, a decrease in public beds no longer had a significant negative effect on suicide rates. We applied this result to recent data on state-level community mental health expenditures in 2004 (NRI 2006b). Estimates indicate that an additional reduction in public beds would increase suicide rates for all states except Pennsylvania and Vermont. In these two states, per-capita community mental health spending is US$120 and US$109 in 2008, respectively.

Robustness

We assessed the robustness of our results in several ways (see supporting information in Table S1). We began by including state-specific time trends to

Table 3: Relationship between Additional Increase in Relative Hospital Bed Ratios and Suicide Rates

Main Variables	*Model 1*	*Model 2*
NFP/PUBLIC	–0.0005	NA
	(0.0010)	
FP/PUBLIC	NA	–0.0016
		(0.0011)
NFP+PUBLIC	0.000284*	NA
	(0.000096)	
FP+PUBLIC	NA	0.000132
		(0.000077)
NFP	NA	0.000339**
		(0.000091)
FP	0.000067	NA
	(0.000056)	
CMHE	0.0173**	0.0170**
	(0.0037)	(0.0036)

Panel corrected standard errors are in parentheses. Only the coefficients on the main independent variables are reported. Suppressed covariates include the same sociodemographics, economic variables, other mental health policy and resources, and state and year fixed effects.

*$p < .01$.

**$p < .001$.

CMHE, community mental health expenditures; *FP*, for-profit hospital psychiatric beds; *NFP*, not-for-profit hospital psychiatric beds; *NFP/PUBLIC*, ratio of not-for-profit to public beds; *FP/PUBLIC*, ratio of for-profit to public beds; *NFP+PUBLIC*, sum of not-for-profit and public beds; *FP+PUBLIC*, sum of for-profit and public beds.

control for state trends in suicide rates. The coefficient on public beds appears attenuated but consistent with our main findings (e.g., $\hat{\alpha}_1 = -0.0173$; standard error = 0.0065; $p < .01$). However, both ratio variables became positive although still insignificant.

Because our main results use WLS, which places greater weights on states with larger population, all regression models were re-estimated after removing the five most populous states. We also examined the sensitivity of the results to removal of five states with the highest suicide rates. Results were similar to our initial findings. However, the finding on the for-profit ratio variable was not consistent.

We then re-estimated all regression models with OLS and adjusted standard errors for arbitrary forms of error correlations but left unadjusted between-panel error correlation. Next, we fitted the models using feasible generalized least squares, allowing for heteroskedastic and correlated error structures. Results were quite similar.

Table 4: Interaction Effect of Public Psychiatric Hospital Beds and Community Mental Health Spending on Suicide Rates

Variables	*Coefficient*
PUBLIC	–0.0298**
	(0.0052)
PUBLIC × *CMHE*	0.00009†
	(0.00005)
CMHE	0.0060
	(0.0050)
NFP	0.00019
	(0.00015)
FP	0.00006
	(0.00009)
p-value of joint significant test of *PUBLIC* and *PUBLIC* × *CMHE*	<.001

Panel corrected standard errors are in parentheses. Only the coefficients on the main independent variables are reported. Suppressed covariates include the same sociodemographic and economic variables, other mental health policy and resources, and state and year fixed effects. Although the interaction term is not significant at the .05 level, it must be in the equation because we are interested in the interaction effect of *PUBLIC* and *CMHE* (e.g., Wooldridge 2003). *PUBLIC* and *PUBLIC* × *CMHE* are jointly significant.

†$p < .1$.

**$p < .001$.

CMHE, community mental health expenditures; *FP*, for-profit hospital psychiatric beds; *NFP*, not-for-profit hospital psychiatric beds; *PUBLIC*, public psychiatric hospital beds; *PUBLIC* × *CMHE*, interaction between *PUBLIC* and *CMHE*.

We tested whether outlier states influenced our results by checking whether there were states for which trends in public, not-for-profit, and for-profit beds and community mental health expenditures were particularly close to trends in suicide rates. The result on public beds was quite robust. However, the not-for-profit ratio variable became positive and significant. We also checked for states with large changes in public, not-for-profit, and for-profit beds and community mental health expenditures over the study period. Results remained robust.

DISCUSSION

The transformation of the mental health system in the United States continues at an unabated pace. The philosophy of community treatment of severe mental illness, which has guided national mental health policies for several decades, is now evolving toward a recovery-oriented, consumer-operated, and culturally competent system. California's recent Mental Health Service Act of 2004 exemplifies this change (Scheffler and Adams 2005). However, our study provides a cautionary note regarding this transformation as we find that downsizing of public inpatient mental health services may lead to increased suicide rates. If other conditions do not change, retaining public psychiatric hospital beds may have a suicide prevention effect.

To help gauge the cost-effectiveness of maintaining public beds, we estimated the cost per life-year saved due to retaining public beds. Using data on national expenditures for inpatient treatment in state psychiatric hospitals (US$7,447 million in 2002 dollars; see NRI 2006b) and the number of public psychiatric hospital beds in 2002 (57,263 beds; see Manderscheid et al. 2004), we estimate the cost of maintaining a public bed at US$130,049 per year. One public bed per 100,000 persons, therefore, costs US$236,428,082 (US$130,049 $\times$ 1,818 beds). Under the assumption that this additional retention of public beds prevents 1,988 years of potential life lost due to suicide, we estimate a cost to society of about US$118,928 per year of life saved. This amount appears substantially lower than suggested thresholds used to determine cost-effectiveness (e.g., US$200,000 per life-year; see Ubel et al. 2003).

Our findings show that although the substitution of private beds for public beds did not affect suicide rates, it appeared to increase suicide rates when outlying states were removed. In addition, ceteris paribus, greater private beds did not reduce suicide rates. The substitution issue warrants further investigation. Nevertheless, our discovered effect of increasing community

mental health funding may be promising because this spending may reduce the sequelae of public psychiatric bed reductions. We note that, at the current low level of community funding, a further reduction of public beds could yield adverse population mental health outcomes. Taken together, our results suggest that growth in community treatment options has not fully compensated for the reductions in the "safety net" capability of public beds.

The reader should interpret our results in light of several limitations. We report a positive, but nonrobust, relationship between community mental health funding and suicide. Advocates have suggested that community mental health resources inadequately serve a growing body of mentally ill persons in the community (Lamb, Weinberger, and Gross 2004). Increased spending, therefore, may serve as a marker for increased mental illness in that state but may not reach adequate levels to prevent suicide. We, however, found that increasing community funding reduces suicide rates only above a particular level. These results likely arise from the fact that reduction of public beds led to increased suicide rates, but the growth of funding for community mental health remained below the level of need.

We used suicide rates to gauge population mental health. Suicide is a relatively rare event and may be subject to considerable volatility even at the state level. Nevertheless, the suicide rate is a useful outcome for this particular study because of the frequently reported correlation between severe psychiatric episodes and suicide. Persons with severe mental illness, particularly schizophrenia, and substance abuse comorbidity are at an elevated risk of premature deaths, primarily due to unnatural causes such as suicides and accidents (Black and Fisher 1992; Simpson and Tsuang 1996; Ösby et al. 2000; Hiroeh et al. 2001; Colton and Manderscheid 2006; Miller, Paschall, and Svendsen 2006; Saha, Chant, and McGrath 2007). Since this population comprises the largest group of patients served by public psychiatric hospitals (Milazzo-Sayre et al. 2001), death from suicide may serve as a useful measure of mental health for a study that examines deinstitutionalization.

Another limitation includes measurement error in that suicide may be inappropriately classified as an accident or undetermined. Coroners appear more likely to misclassify suicides when, for example, they have fewer person-hours to investigate the case (Douglas 1967; Rockett, Samora, and Coben 2006). This misclassification is largely unidirectional since the risk of ruling a nonsuicide as a suicide appears small (Moyer, Boyle, and Pollock 1989; O'Carroll 1989). It remains possible, therefore, that states with relatively many health resources may more accurately measure suicides. This circumstance could bias results toward a positive association between public hospital beds and

suicide. The fact that we discovered an inverse association, however, implies that measurement error of suicide may attenuate the true magnitude of the effect.

Other features of community mental health programs that we did not investigate (e.g., the effective organization and utilization of resources and services) may have important implications. For example, inpatient services in community mental health centers or comprehensive support programs may buffer the effect of public bed reductions. Although these features are reflected in our expenditure metric, data limitations precluded examination of their potential effects on suicide. We view this as an important agenda for future research.

This study focused on the contemporaneous effect of a change in mental health resources on suicide rates. However, it remains possible that mental health resources could influence suicides in the following year. We explored this possibility with 1-year lagged values of the main independent variables. The discovered coefficients on the lagged explanatory variables bolster our main findings as they provide the same implications as those from the contemporaneous variables, although the size of the associations was smaller. Future studies with a priori hypotheses of a lag structure, particularly with an emphasis on causal mechanisms, may help better understand the sequence of the effect of a change in mental health resources on population mental health.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: Jangho Yoon is supported by the National Institute of Mental Health through the Ruth Kirschstein (T-32) National Research Service Award (MH 070335-01A1). Tim A. Bruckner is supported by the Agency for Healthcare Research and Quality through the Ruth Kirschstein (T-32) National Research Service Award (HS-00086-09). We would like to thank two anonymous reviewers for their valuable comments that helped improve this manuscript.

Disclosures: None.

Disclaimers: None.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.
Figure S1. Year-To-Year Percent Changes in the Number of Public Psychiatric Hospital Beds and Suicide Rates for Selected States, 1982–1998.
Table S1. Robustness Test Results for Tables 2–4.