Effects of Mental Health on the Costs of Care for Chronic Illnesses

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Objective: The study examined whether comorbid low mental health functioning inflates the cost of treating a chronic disease.

Methods: Data were from the 2015 Medical Expenditure Panel Survey (N=33,893). Costs were estimated from medical records and self-reported health care use. The mental component summary (MCS) score of the 12-item Short Form (SF-12) was used as a measure of mental health status. A general linear model estimated costs with fixed effects for chronic disease (present or absent) and mental health functioning (lowest, middle, and highest MCS score tertiles indicating low, middle, and high levels of mental health functioning, respectively). The SF-12 physical component summary score was a covariate. Eight conditions (arthritis, chronic obstructive pulmonary disease [COPD], high cholesterol, cancer, diabetes, stroke, coronary heart disease, and asthma) were analyzed separately.

Results: For each analysis, presence or absence of the chronic condition had a strong impact on cost. Lower mental health functioning also had a significant impact on cost. However, the interaction between mental health functioning and chronic disease diagnoses was statistically significant for only three conditions and accounted for only a small variation in cost. Sensitivity analyses using MCS score as a continuous variable, using a log10 transformation of the cost variable, and focusing only on persons with scores on the extreme low end did not significantly alter the conclusions.

Conclusions: Contrary to expectation, the combination of poor mental functioning and chronic disease diagnosis did not have a strong synergistic effect on cost. Mental and general medical conditions appear to have independent effects on health care costs.

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When a mental health condition, such as depression, is combined with a chronic medical diagnosis, the costs of medical care can be substantially inflated (1). It has been suggested that the added costs of treating a chronic illness, such as diabetes mellitus, in combination with a lower mental health score, are significantly higher than the costs of treating each condition independently. The cost-multiplier estimates range from about 1.5 to 4.5 (2–6), suggesting that the costs of treating the combination of conditions are 150% to 450% higher than the expected costs of treating each condition separately. However, other analyses have indicated that the costs of treating the two conditions follow an additive model—that is, the overall costs equal the sum of the costs of treating each condition. For example, using aggregation of Medicaid claims from across states, Kronick and colleagues (7) found that the cost of treating the combination of depression and diabetes was approximately equal to the sum of the costs of treating each condition separately.

The literature on the effects of comorbid mental illness on cost is difficult to interpret because studies apply different definitions of mental health conditions and use different outcome measures. Although a few studies have had large samples, most have been limited to observations of only a

HIGHLIGHTS

- It is widely assumed that low mental functioning comorbid with a chronic disease acts synergistically to amplify the costs of care.
- Belief in the synergistic effect of health mental functioning on health care costs is often used to justify embedding mental health care providers in clinics where chronic diseases are treated.
- Using data from the 2015 Medical Expenditure Panel Survey, costs of care for persons who reported mental health problems and chronic disease diagnoses were estimated separately and in combination.
- Across eight chronic conditions (arthritis, chronic obstructive pulmonary disease, high cholesterol, cancer, diabetes, stroke, coronary heart disease, and asthma), no strong evidence was found that poor mental health functioning amplified the cost of chronic disease care.

few hundred individuals. Furthermore, most studies have focused on convenience samples, and few have been generalizable to the larger population that receives health care. Studies using claims data have confounded diagnosis with care access and care seeking. Population-based surveys avoid these biases.

Understanding the costs of comorbid mental illness is important for payers and for the organization of health care delivery. Confidence in the synergistic effect of comorbid mental illness on health care costs is significant, because it fuels the trend of embedding mental health services in primary health care (8). If costs are additive, future costs can be estimated by simply adding together the costs of treating various diagnoses. On the other hand, if costs are multiplicative, the cost consequences of untreated comorbid mental illness might be higher than the sum costs of providing mental health plus physical health care.

Using data from the Medical Expenditure Panel Survey (MEPS), a large-scale survey of individuals representative of the U.S. population, medical providers, and employers, we examined the effects on total health care expenditures of treating eight chronic general medical conditions among persons who had or did not have comorbid mental health problems. Mental health status was estimated from the mental component summary (MCS) score of the 12-item Short Form Health Survey (SF-12) (9). Most previous studies have assessed mental health status on the basis of a formal diagnosis in the medical record. However, diagnosis is not the most reliable estimate of mental well-being. Some patients avoid discussing mental health conditions with their providers, and some providers are reluctant to enter a diagnosis of a mental health condition in the patient's record. Use of the mental health measure provided by the MCS score has the advantage of assessing mental health status independent of provider judgment. Another advantage of the MEPS data is that the MCS score is a continuous variable. Many previous studies have considered only patients with serious mental illness.

METHODS

Data Source

We used data from the 2015 MEPS, which included 13,800 households. The sample included multiple persons per household and involved 33,893 persons. The sample is designed to be representative of the U.S. civilian noninstitutionalized population. A new panel is drawn every year and is followed for 2 years. Information is collected on health care utilization, health care expenditures, health insurance coverage, sources of payment, access to health care, health care quality, and health care experiences. Most of the analyses reported here were based on 21,370 adults who were age 26 or older at the time of the 2015 interview and for whom complete data on mental health and health care expenditures were available.

MEPS has three components: a household component that is based on a subsample from the National Health Interview Survey; a medical provider component that surveys the health care providers who care for the respondents; and an employer component that surveys employers to collect information on offers, enrollment, and the cost of employer-sponsored insurance coverage. This study used the household component for most measures; the medical provider component was used to verify and impute measures of health care expenditures and sources of payment (10). Details of the MEPS methodology have been summarized by Cohen and Cohen (11). Because MEPS is a curated public access data set with all cases stripped of personal identifiers, the study qualified as exempt from review by a human subjects committee.

Primary Outcome

The primary outcome in the analysis was total cost of medical care, based on the medical provider component of the survey. MEPS estimates expenditures based on payments, rather than on charges. These estimates are derived from different components, including payments to providers and out-of-pocket payments. Expenditures by private insurance, Medicaid, Medicare, and other payers are included.

Health Variables

We measured the presence of chronic illness by using MEPS questions that ask respondents whether they had been diagnosed by a physician or nurse after the age of 17 as having one of a list of priority medical conditions. Thus, for each chronic condition, respondents were coded as having or not having the condition after age 17. The conditions included arthritis; chronic obstructive pulmonary disease (COPD), in particular emphysema; high cholesterol; cancer; diabetes; asthma; coronary heart disease; and stroke.

To measure mental health status, we used the Medical Outcomes Study (MOS) SF-12 (9). The MOS 36-item Short Form Health Survey (SF-36) and its shorter form, the SF-12, are the most widely applied measures of patient health status in the world, with more than 32,000 citations in PubMed. The SF-12 assesses eight health concepts: physical functioning, role-physical, bodily pain, general health perceptions, vitality, social functioning, role-emotional, and mental health (12). Factor analysis studies have demonstrated that these eight concepts map onto two dimensions: a physical component summary (PCS) and the MCS. Several studies have shown that the SF-12 summary scores are very highly correlated with scores on the SF-36 (9). For example, validity studies have demonstrated that the SF-12 achieves an R^2 of 0.911 and 0.918 in predicting PCS and MCS scores, respectively, from the SF-36. A summary of 14 independent validity tests demonstrated that using physical health criteria achieved validity coefficients ranging from 0.43 to 0.93 (median=0.67). PCS and MCS scores are reported as T scores with a mean of 50 and a standard deviation of 10.

TABLE 1. Effects of chronic condition, mental health functioning, and their interaction on total health care costs among respondents to the 2015 Medical Expenditure Panel Survey[a]

Condition	Diagnosis of condition (N)		Condition effect[b]	Mental health functioning effect[b]	Interaction effect[b]	With adjustment for for PCS score[b,c]
	Yes	No				
Coronary heart disease	1,105	20,240	222.52***	15.50***	1.35	1,497.19***
Diabetes	2,389	18,889	108.53***	28.41***	5.49**	1,527.20***
Asthma	2,061	19,216	14.72***	13.21***	.73	1,835.00***
Arthritis	5,522	15,754	89.75***	27.94***	2.43	1,173.02***
Chronic obstructive pulmonary disease	405	20,943	11.73***	9.57***	3.40*	1,785.64***
High cholesterol	6,460	14,813	81.31***	35.90***	.75	1,524.01***
Cancer	1,924	19,351	210.63***	41.59***	11.68***	1,600.49***
Stroke	883	20,465	183.36***	8.89***	.64	1,533.91***

[a] Analysis-of-variance estimates. The condition effect reflects differences in cost between respondents who did or did not report the diagnosis (highly significant for each condition). The effect of mental health functioning reflects the comparison of costs between tertiles of the mental health component score from the 12-item Short Form Health Survey (SF-12). The interaction effect reflects estimates of the independence of the effects of condition and mental health functioning on cost.
[b] F ratio.
[c] This column shows the large effect of the physical component summary (PCS) score on cost.
*p<.05, **p<.01, ***p<.001.

The validity of the MCS score has been shown in many different studies. Salyers and colleagues (13) observed a systematic linear relationship between the MCS score and the number of hospitalizations in the past year. No such relationship was observed for PCS scores. The SF-12 MCS score is most highly correlated with measures of depression. For example, it has been shown to be significantly associated with the Center for Epidemiologic Studies Depression Scale (CES-D), which has been validated in a variety of studies (14). Using a cross-section survey in six European countries, Vilagut and colleagues (15) demonstrated that the MCS score had 86% sensitivity and 88% specificity to detect 30-day depressive disorders when using an MCS cutoff score of 45.6. On the basis of this evidence we assume that MCS is a reasonable proxy for depression. Other studies have confirmed the reliability and validity of the SF-12 score within the MEPS survey (9).

Recode of MCS

The MCS score was divided into tertiles to form three equal-sized groups according to MCS score: highest, middle, and the lowest scores. Respondents with the lowest score were considered to be the most depressed. We divided the MCS into three categories because, for diagnoses of mental health conditions, the relationship between score and outcome is not continuous. It is assumed that much of the variability within the normal range is not of great interest. We focused on the top third of the distribution because the literature suggested that this is where the important variability would be. A meta-analysis by Anderson and colleagues (16) suggested that as many as 30% of people with diabetes experience depression. In addition to considering tertiles of the MCS, we also performed sensitivity analysis using MCS as a continuous variable. Furthermore, we compared respondents at the extreme of the distribution (the 6% with the lowest scores) with those in the center of the score distribution.

Education–Socioeconomic Status

To estimate socioeconomic status (SES), we used educational attainment as a proxy. Among a wide range of variables that constitute SES, educational attainment has the strongest association with health outcomes and life expectancy (17). We applied a MEPS recode that classifies individuals as follows: less than a high school education, high school completion, some college, and college graduate or higher.

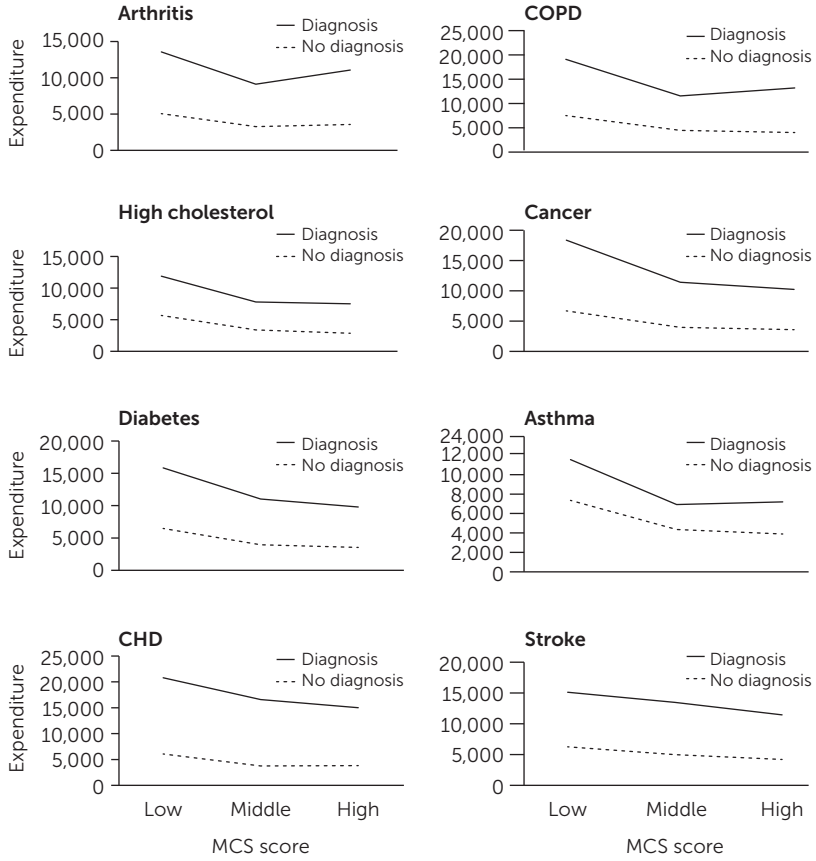
Analysis

The analysis used general linear models with total costs as the dependent variable and disease (yes or no) and MCS score (low, middle, or high) as independent variables. The analysis-of-variance model applied in this study is mathematically equivalent to multiple regression, with group membership coded by using dummy or binary variables (18). It would be expected that persons with a greater degree of physical disability would spend more on health care services. Therefore, the PCS score of the SF-12 was used as a covariate. Each of the eight chronic general medical conditions was analyzed separately. Missing data in MEPS are minimal, and we used casewise deletion when key analysis variables were missing. Because the cost outcome was positively skewed, we applied a log10 transformation to this outcome in the sensitivity analysis.

RESULTS

The numbers of persons with each of the eight general medical conditions are shown in Table 1, which also summarizes the analysis-of-variance results for each diagnosis. The table estimates the effect of depression on cost, the effect of diagnosis of a chronic disease on cost, and the interaction between diagnosis and depression. The influence of statistically controlling for PCS is also shown. The results, including estimated costs, are also summarized in Figure 1.

FIGURE 1. Mean total health care expenditure for eight general medical conditions, by tertile of mental health component (MCS) score[a]



[a] COPD, chronic obstructive pulmonary disease; CHD, coronary heart disease. Analyses for each general medical condition adjusted for the 12-item Short Form physical health component score. Expenditure values are in 2015 US dollars. Parallel lines suggest that the effects of the chronic disease diagnosis on cost were independent of MCS score, with lower scores indicating worse mental health functioning. Nonparallel lines indicate that the relationship between chronic condition and MCS score on cost was multiplicative (synergistic). Separation between lines represents the effect of the chronic disease diagnosis on cost. The slope of the lines defines the effect of mental health functioning (low, middle, and high MCS score) on health care costs.

As the data in Figure 1 suggest, the presence of a chronic disease diagnosis had a very strong effect on health care expenditure. The main effects for mental health status and the presence of each of the eight general medical conditions were highly significant. In addition, the effect of the PCS score on cost of medical care was highly significant for each condition. Figure 1 shows that respondents with any of the eight diagnoses consumed significantly more resources, compared with those without these diagnoses. Health care services for respondents with a low level of mental health functioning had significantly higher costs, compared with those with high mental health functioning, even after the analysis controlled for physical health status using the PCS score.

The central focus of this analysis was the interaction between mental health functioning and chronic disease diagnosis. In Figure 1, an interaction is indicated by deviation from parallel lines in the two-dimensional graphs. The interaction terms for three of the conditions (diabetes, COPD, and cancer) were statistically significant. However, in each of these cases, the effect sizes tended to be small. Eta^2 (η^2) is an approximate index of the proportion of total variance in cost attributable to each effect in the model. The interaction effect of η^2 was 0.1% in cancer, 0.06% in diabetes, and 0.004% in COPD. In contrast, averaged across the eight general medical conditions, the η^2 for the PCS score was 7%. Visual inspection of Figure 1 suggests that the effect of a mental health condition on cost was similar in magnitude for those who did or did not have each of the eight diagnoses.

Psychiatric diagnoses are more likely to occur in groups with lower SES, and some chronic conditions, such as diabetes, are also more likely to occur in these groups. To address this issue, we applied additional statistical adjustment for SES. Education had a strong effect on health outcome for all eight general medical conditions. Across the eight conditions, adjustment for education had slight effects on the mental health × condition interaction. However, adjustment for education changed the statistical significance only in relation to asthma (F value changed from 2.43 to 3.54; p value changed from 0.08 to 0.03). For cancer, adjustment for education reduced the p value for the interaction (from <.001 to <.03). Although education and SES have been shown to have strong effects on cost and health outcome, these effects appeared independent of the interaction between mental health status and chronic disease diagnosis.

To explore the robustness of the results, we performed a series of sensitivity analyses. One concern was that medical care costs were not normally distributed. A few individuals have very high costs, whereas most have low costs. To address this issue, we transformed the cost variable using a log10 transformation. Considering only the interaction terms, the log10 transformation resulted in a nonsignificant interaction for diabetes (p=0.25), whereas the interaction was significant without the transformation (p<0.001). Conversely, the interaction terms for arthritis and for high

cholesterol became statistically significant after the transformation while they had not been when raw units were used. The interaction for cancer remained statistically significant but the p level declined from 0.001 to 0.02. Overall, the effect size for the interactions remained low (all $\eta^2<0.1\%$) in relation to the effect size for PCS score and for diagnosis. (A table in an online supplement to this article presents the results of this analysis.)

We also completed a reanalysis of the interaction effects using both natural and log10 units for cost but without adjustment for the PCS score (see online supplement). When the data were analyzed in natural units, there was a significant interaction only for diabetes, arthritis, and cancer. When log10 units were used, the only significant interaction effect was observed for arthritis (p=0.009). Once again, the effect sizes for all the interactions were very small (<0.1%) in relation to the effects of PCS score and the effects of a diagnosis of a general medical condition.

The third component of the sensitivity analysis considered the concern that the mental health status variable was divided into three categories. We addressed this issue by using the MCS score as a continuous variable. Using multiple regression, we estimated the effect of MCS score, diagnosis, and a term representing the product of diagnosis × the continuous MCS on total health care costs. The analysis indicated significant interaction effects for diabetes, arthritis, COPD, and cancer (see online supplement). There were significant effects of mental health status for all diagnoses except coronary heart disease and stroke. Although the interaction effects were significant for four of the eight diagnoses, all effect sizes accounted for less than 0.1% of the variance.

Next, we calculated the 10% trimmed mean for expenditures. Although 90% of the respondents had medical expenses less than $10,000 per year, a few respondents had extremely high expenditures, ranging to over $8 million. To address this issue, we assigned a value of $10,000 to any expenditure greater than $10,000 (see online supplement). As in the other analyses, four of the eight interactions terms were statistically significant, but none accounted for more than 0.1% of the variance. Overall, the truncation did not affect the conclusions.

Finally, we considered whether dividing the MEPS respondents into tertiles was too broad a stroke. Estimates suggest that about 6% of the U.S. population has a major depressive disorder. By including the lowest-scoring third of the MEPS sample in the highest depression level, we may have mixed those with a major depressive disorder and those with subclinical depression and other mental health problems. Several studies have suggested that a multiplicative effect occurs only with persons in the category of major depressive disorder. To address this problem, we identified 2,130 MEPS participants with MCS scores less than 37.95, and they formed a group representing the lowest 6% of MCS scores. For comparison, we selected the 12% of the MEPS sample who had MCS scores in the middle of the distribution, between 51.73 and 56.95. Table 2 shows the significance levels for the interaction term (condition × mental health status) derived from analyses of the eight chronic disease categories among respondents with the lowest 6% versus lowest 12% of MCS scores. The three significant interactions from the main analysis (diabetes, COPD, and cancer) were replicated in this subgroup analysis that focused on individuals at the extreme of the distribution of MCS scores. In addition, there was a significant interaction for arthritis.

TABLE 2. Interaction effects on total health care costs for respondents with the lowest mental health component scores (N=2,130) versus those with scores in the middle of the distribution (N=4,293)[a]

Condition	Interaction effect	p
Coronary heart disease	1.34	.26
Diabetes	7.64	.001
Asthma	.87	.42
Arthritis	3.30	.04
Chronic obstructive pulmonary disease	3.45	.03
High cholesterol	.78	.46
Cancer	11.67	.001
Stroke	.64	.57

[a] This analysis focuses on the subset of respondents to the 2015 Medical Expenditure Panel Survey likely to have a psychiatric diagnosis (lowest 6% of mental component summary [MCS] scores) versus those from the center of the distribution (middle 12% of MCS scores). The interaction effect (F ratio) is an estimate of the independence of condition and mental health status upon cost.

DISCUSSION

We did not find strong evidence that poor mental health functioning acts synergistically with other chronic disease diagnoses to inflate health care expenditures.

Methods for statistical testing of hypotheses were originally developed for studies with relatively small samples. In textbooks, most of the tables that give p levels for F ratios are for samples of up to only 1,000. Because the MEPS sample is more than 20,000, it was unusual to find a comparison that was not statistically significant. Although the interaction effect was statistically significant for three or four (depending on the analysis) of the chronic disease categories, the effect size was consistently very small. For example, the significant interaction between mental health status and diabetes accounted for 0.06% of the variance in cost. In contrast, treatment of the diagnosis of diabetes accounted for 0.4% of the cost variance (about seven times more than the interaction between mental health status and diabetes), and being in the lowest third of the distribution on MCS accounted for 0.3%. Physical health functioning (as measured by the PCS score) accounted for a full 6% of the variance (about 100 times more than the interaction between comorbid mental problems and diabetes). The observation of limited synergistic effects on treatment cost of comorbid mental problems and chronic disease is in contrast to various

studies that have suggested that mental illness in combination with chronic general medical illness has a strong synergistic effect on health care costs (8). In our study, the main findings were statistically adjusted for physical health status (PCS score) and did not change substantially by further adjustment for educational attainment.

Our results should in no way be interpreted as justification to restrict funding for mental health services. Mental health care improves quality of life and may extend life expectancy (19). Justification for treating mental health problems is no different than that for any other health problem, and evidence suggests that individuals with mental health challenges require more rather than less attention. Among persons with chronic general medical conditions, studies suggest that those with mental health conditions receive less care than those without mental health conditions. For example, Druss and colleagues (20) reported that patients with any comorbid mental health condition were less likely to receive costly but potentially effective cardiovascular interventions. Underdetection of depression, in particular, perpetuates a substantial shortfall in health care's potential yield (21).

Our study differed from previous contributions in several ways. First, we used a continuous score for mental health status rather than a psychiatric diagnosis. Epidemiologic studies suggest that major depression occurs in about 6% of the population (22). Many previous studies have focused on patients with a diagnosis of serious mental illness (23). However, focusing on the top 6% of the MEPS respondents who might be more likely to have major depressive disorder or another serious diagnosis did not alter the results, which suggested that the effects of comorbid mental challenges on costs are independent of the effects of other chronic conditions (Table 2). To be clear, the interactions shown in Table 2 were statistically significant for four of the eight general medical conditions. However, the effect sizes for all interactions, with the possible exception of cancer, were very small. Although the MEPS survey includes a nationally representative sample, it excludes individuals living in institutions. As a result, we likely excluded an important segment of people with serious mental health conditions. This difference in samples may explain why our results deviated from some those of previous studies.

One concern might be that because the SF-12, from which the MCS score was derived, is a short instrument, it may not be sensitive to important variations in mental health. We recognize the shortcomings of the MCS score as an important limitation of the study. On the other hand, as in many other studies, persons whose MCS score indicated poorer mental health functioning used significantly more health care, compared with those whose MCS score indicated better functioning, even after the analysis controlled for physical health status (24). If the MCS score were capturing only error variance, we would not have expected to see this systematic variation.

Another concern is that most previous studies focused on depression rather than on mental wellness generically. The MCS includes a variety of questions, some of which address mental health issues other than depression. Thus the MCS score may not be a reasonable proxy for an estimate of depression. However, other studies have shown that MCS scores are highly correlated with depression measures, such as the CES-D screening tool (14). More work is necessary to determine whether the MCS score captures meaningful variation in depression.

In addition to possible error in the assessment of mental health status, we recognize that assessments of the eight general medical conditions were based on self-report. Thus we cannot say with certainty that the classification into each of these chronic disease categories was accurate. Furthermore, total costs were estimated for each chronic condition separately. It was difficult to adjust for the effect of other comorbid chronic conditions, but it is known that some chronic conditions tend to occur together (e.g., coronary heart disease, diabetes, and high cholesterol). As a result, the estimated total costs may have been confounded by a third chronic condition.

CONCLUSIONS

The presence or absence of each of eight common chronic diseases assessed in the MEPS had a strong effect on health care costs. In addition, low scores on the MCS of the SF-12 (indicating a high level of depression) increased health care expenditures. Some have argued that the combination of mental health problems and chronic disease diagnoses has synergistic effects on cost. Our analyses suggest that the effects are additive rather than multiplicative. Advocates for the synergistic model argue that providing mental health services might greatly lower health care costs. By treating the mental health problem, they argue, the synergistic effect of comorbid mental health problems and chronic disease can be broken. Our findings suggest that for a population that does not include persons with serious mental illness, providing mental health care may reduce the health care costs attributable to the mental health conditions, but this effect may be independent of the cost effect of treating another chronic general medical condition.

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