ORIGINAL ARTICLE

A Suicide Prevention Program in a Region With a Very High Suicide Rate

Katalin Szanto, MD; Sandor Kalmar, MD; Herbert Hendin, MD; Zoltan Rihmer, MD, PhD, DSc; J. John Mann, MD

Context: Suicide is a major cause of mortality worldwide. Rates vary widely within and between countries. A suicide prevention program has never been tested in a region with a very high suicide rate in comparison with control regions without such intervention over the same period.

Objective: To determine the effectiveness of a depression-management educational program for general practitioners (GPs) on the suicide rate in a region with a high suicide rate in Hungary.

Design: Effects were compared with a control region, the larger surrounding county, and Hungary.

Setting: Southwest Hungary.

Participants: Twenty-eight GPs servicing 73 000 inhabitants participated in the educational program.

Intervention: A 5-year depression-management educational program for GPs and their nurses was implemented together with establishment of a Depression Treatment Clinic and psychiatrist telephone consultation service in the intervention region.

Main Outcome Measures: The primary study outcome measure was annual suicide rate. The secondary outcome measure was antidepressant prescription use.

Results: The annual suicide rate in the intervention region decreased from the 5-year preintervention average of 59.7 in 100 000 to 49.9 in 100 000. The decrease was comparable with the control region but greater than both the county and Hungary ($P<.001$ and $P<.001$, respectively). In rural areas, the female suicide rate in the intervention region decreased by 34% and increased by 90% in the control region ($P<.07$). The increase in antidepressant treatment was greater in the intervention region compared with the control region, the county, and Hungary and in women compared with men ($P<.002$).

Conclusions: A GP-based intervention produced a greater decline in suicide rates compared with the surrounding county and national rates. Increases in patients with depression treated and of dosing were modest and may require additional measures such as depression-care managers. The importance of alcoholism in local suicides was unanticipated and not addressed. Optimal suicide prevention plans must consider major local risk factors.

Arch Gen Psychiatry. 2007;64(8):914-920

Author Affiliations: University of Pittsburgh School of Medicine, Western Psychiatric Institute and Clinic, Pittsburgh, Pennsylvania (Dr Szanto); Semmelweis Hospital, Kiskunhalas (Dr Kalmar), and National Institute of Psychiatry and Neurology, Budapest (Dr Rihmer), Hungary; and Suicide Prevention International (Dr Hendin) and Department of Psychiatry, Division of Neuroscience, Columbia University and New York State Psychiatric Institute (Dr Mann), New York.

ALTHOUGH SUICIDE HAS many causes, 80% to 95% of suicide decedents, including adolescents and elderly individuals, have a psychiatric illness.[1-4] The most common psychiatric disorder in suicide is a mood disorder, mostly untreated major depression.[3,5] General practitioners (GPs) have a key role in identifying and treating major depression and thereby in lowering community suicide rates.[6] This approach can be productive partly because 18% to 40% of individuals who die by suicide visited their GPs within 1 week of death.[7] A Hungarian study showed an inverse correlation between the number of practicing GPs and the suicide rate in counties.[8] In the United States, antidepressant medication prescription volumes and mean income level, perhaps reflecting access to health care, are inversely correlated with suicide rates at the county level.[9]

A 1983-1984 educational program in the Swedish island of Gotland aimed at improving GPs' knowledge of depression was followed by a decrease in suicide mortality compared with prior suicide rates in the same region.[10] Most of this decrease was among depression-related suicides and in women, perhaps reflecting the specificity of the educational program and the poorer help-seeking behavior of men.[11] The benefit faded as GPs were replaced by new doctors but there was some indication that it returned after a second education program.[12] Another Swedish study, in Jamtland, also reported a decrease in the suicide rate after a GP education program, compared with changes in the national suicide rate,[13] but the benefits of the program were less pronounced than in Gotland. The Jamtland study showed benefit of an education program during a period when the Swedish national suicide rate decreased. A Japanese community-based program of im-

Table 1. GPs' Annual Education Sessions

Date	Content	GP Participation Rate, %
October/ November 2000	Epidemiology, recognition, and treatment of depression; depression and anxiety; depression and serious, terminal physical illness; depression in young and old individuals; suicide as a problem in the intervention area and the GPs' role in suicide prevention; suicide risk recognition and appropriate response	90
September 2001	Annual results of the prevention program; bipolar depression and suicide; depression and suicide in the medically ill	60
July 2002	Annual results of the prevention program; antidepressants and anxiolytics; male depression; case discussions	43
September 2003	Annual results of the prevention program; depression and alcoholism; case discussions	60
September 2004	Annual results of the prevention program; anxiety disorders and suicide; depression and suicide in the elderly population; case discussions	39

Abbreviation: GP, general practitioner.

proved depression management in the elderly population in a rural village reported a reduction in suicide rates compared with prior rates in the village.[14] A recent German study of a depression education campaign (the Nuremberg Alliance Against Depression)[15] reported a reduction in nonfatal suicide attempts in an intervention region compared with a control region but no difference in effect on suicide rates. The strength of the German study is the use of a control region. Its limitation is that it used only 1 year of suicide data as baseline for the control and intervention regions, and a low base rate makes change in suicide rates difficult to detect. They did not report data on antidepressant use, leaving open the question as to why the rate of nonfatal suicide attempts declined. Whereas the Swedish and Japanese studies suggest that a simple educational intervention could have an impact on suicide mortality, unlike the German study, they did not use a control region to control for local or national changes in suicide rates and treatment practice.

Educational interventions targeting GPs do not always work. A UK study reported that educating GPs about depression treatment guidelines did not improve the rates of correct diagnosis of depression and treatment response.[16] Notably, better recovery rates from depression[17] were found in GP practices when education about diagnosis and treatment of depression was combined with a clinical monitor to improve compliance by the patient and systematic monitoring and follow-up by the GP. Another GP education study reported better recognition of suicidal ideation in intervention practices but no effect on starting an antidepressant drug regimen or suicidal ideation after 6 months.[18] Thus, increased recognition of suicidal ideation or depression may or may not improve outcome, and therefore, it is important to measure impact on treatment practice.

To address these methodological issues, we conducted a 5-year suicide prevention program for GPs and their nurses in a largely rural region with a very high suicide rate. To increase the methodological rigidity of this quasi-experimental design, we used 3 comparisons: a small, nearby but noncontiguous rural region; the surrounding larger county; and the entire country. Hungary has had the world's highest suicide rate averaged over the last 100 years. Despite a decline in suicide mortality since 1998, it is still among the 10 countries with the highest suicide rates; in 2004, its suicide rate was 27 per 100 000 persons, approximately 2 and a half times the US national rate. Within Hungary, the county with the highest suicide rate is Bacs-Kiskun County. Two regions were chosen in Bacs-Kiskun County, Kiskunhalas as the intervention region and Kiskunfelegyhaza as a local control region, because they had suicide rates that were twice the national average.

The primary outcome measure of the study was suicide rate in the intervention region compared with the local control region, the surrounding county (minus the intervention region), and the whole country during the two 5-year periods before and during an educational intervention targeting the GPs and their nurses. The secondary outcome measure was antidepressant prescription use. Data were collected on alcohol-related liver death and unemployment rates, because alcoholism and employment status are potential risk factors for suicide.

METHODS

SITE

The intervention region has 73 000 inhabitants. It is a predominantly rural region with 44 000 inhabitants living in villages and on farms and 29 000 living in the only bigger town of the region, also called Kiskunhalas (same name as the province). The town has 1 hospital. The local control province or region is not contiguous with the intervention region and has 54 000 inhabitants, of whom 22 000 live in villages and on farms and 32 000 live in town. Bacs-Kiskun County includes both regions and has approximately 540 500 inhabitants. The percentages of women (52%) and elderly individuals (22% are 60 years and older) are similar in both the intervention and the control regions, and the main source of livelihood is agriculture, including wine making.

INTERVENTION

Training

Twenty-eight of the 30 GPs in the intervention region signed consent to participate in the project and 27 attended the first educational program. Each GP takes care of approximately 2100 adult inhabitants. In addition to the GPs and their nurses, the 4 psychiatrists and the only psychologist of the region also participated in the education program. Because half of the GPs were on-call at any one time, 2 alternative times for the 4 main training sessions were offered. The content and dates of the main education sessions are listed in **Table 1**. Initial training involved a didactic lecture format. Later booster sessions in-

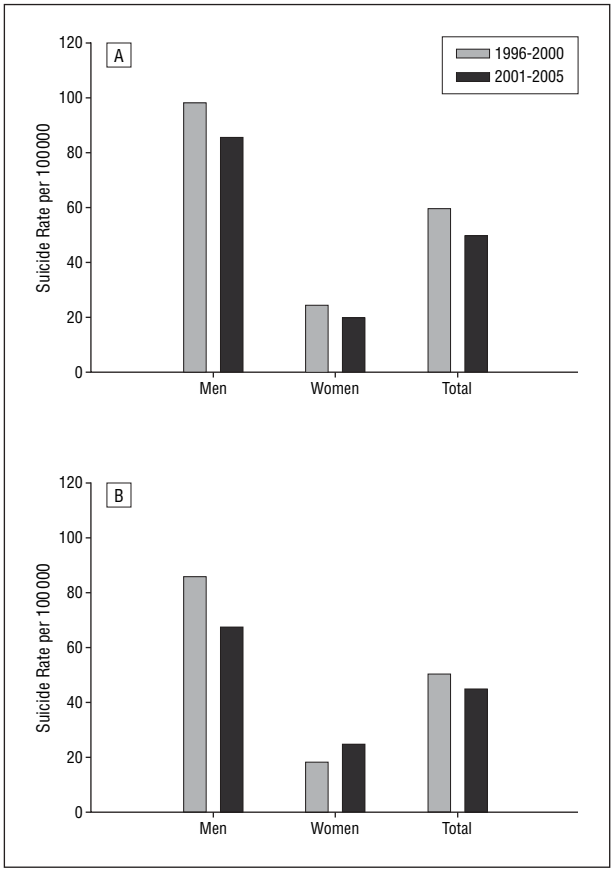

Figure. Comparison of suicide rates in 1996 through 2000 (the 5-year period before the prevention program) and 2001 through 2005 (the 5-year period during the prevention program) in the intervention (Kiskunhalas) (A) and the local control (Kiskunfelegyhaza) (B) regions of Hungary.

cluded interactive question-and-answer sessions, including case discussions of patients who had recently died by suicide, and 3 times per year during the 5 years, the GPs and their nurses were invited to a 1-hour lecture on topics related to suicide prevention, delivered by 2 of us (S.K. and Z.R.).

Improving Access to Depression Treatment

To improve detection of patients with depression, GPs were encouraged to use a modified Beck Depression Inventory (with an added question related to current and lifetime suicidality) in their practices. To improve treatment, GPs had access to free telephone consultation provided by the local psychiatrists, could refer patients to a newly set-up depression clinic (funded by this study in 2001-2004), and could get expedited authorization for cheaper antidepressants for patients.

OUTCOME MEASURES

Number of Suicides

Suicide data were collected from the police department. Reporting of suicides in Hungary is quite accurate because an autopsy is required in every suspected case of suicide.

Prescription of Antidepressants

The Hungarian National Health Insurance Company, which has data on filled prescriptions, provided 2 indicators of antidepressant use: (1) the number of patients taking an antidepressant and (2) the days of treatment using defined daily dose (DDD) of antidepressants. The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults. The advantage of the DDD is that it provides a fixed unit of measurement enabling the researcher to assess trends in drug consumption and to perform comparisons between population groups,[19] but DDD only gives a metric of prescription per patient and that level does not always represent an adequate amount of medication. We did not make any assumptions about adequate length of treatment. We calculated DDD per 1000 population per each day of the year ([(DDD/365)/population] × 1000). Days of treatment data were available for the 1999-2004 period; thus, we used 1999 and 2000 as baseline for comparison.

Alcohol-Related Deaths and Unemployment

Data were obtained from the National Statistical Office and were available for the 1999-2004 period; thus, we used 1999 and 2000 as baseline for comparison. Data on alcohol-related death were restricted to alcoholic cirrhosis and other alcoholic liver disease.

Statistical Analysis

Suicide rates, antidepressant prescription rates, and alcohol-related death rates were compared using repeated-measures, generalized mixed linear models implemented in SAS GLIMMIX software (SAS Institute Inc, Cary, North Carolina). A Poisson distribution and a log-link function were used. Poisson distribution was used because suicide is a rare event and this allowed modeling the distribution of counts with multiple factors. Geographic region was considered a random effect and time (before and after intervention) was the main effect. The suicide rates within each geographic region were treated as repeated observations over the 2 intervals. A significant interaction between region and time would indicate that the rates changed over time differently between the 2 regions. An unstructured variance-covariance matrix was used and summary type 3 results are reported. Unemployment rate and baseline suicide rate in the intervention and control regions were compared using the nonparametric Wilcoxon rank sum test. Data from 1996 through 2000 was preintervention and data from 2001 through 2005 was postintervention.

RESULTS

PRIMARY OUTCOME: CHANGE IN THE ANNUAL COMPLETED SUICIDE RATE IN THE INTERVENTION REGION COMPARED WITH THE CONTROL REGION, COUNTY, AND HUNGARY

During the 5-year preintervention period, the average suicide rate in the intervention region was similar to the control region (χ^2_1=0.54; P=.46). During the 5-year preintervention period, the average suicide rate in the rural intervention region was higher than in the intervention town (χ^2_1=7.14; P=.008).

The suicide rates decreased during the 2000-2005 intervention period compared with the previous 5 years in both local regions (**Figure** and **Table 2**), in the rural areas (**Table 3**), and more so in men (Table 3). There was no region × time interaction in the total sample. When sex was entered into the model, a 3-way interaction for

Table 2. Annual Number and Rates of Suicides Over 10 Years in the Intervention and Local Control Regions

	Intervention Region (Kiskunhalas, Hungary)		Control Region (Kiskunfelegyhaza, Hungary)	
Year	No. of Suicides	Rate	No. of Suicides	Rate
Preintervention				
1996	36	48.3	31	56.0
1997	50	67.3	17	30.9
1998	41	56.0	37	68.1
1999	51	69.3	19	35.3
2000	42	57.7	33	61.7
Intervention				
2001	43	57.1	25	45.8
2002	34	45.3	23	42.6
2003	42	56.2	21	39.2
2004	37	50.0	27	50.7
2005	30	40.7	25	47.1

Table 3. Analysis of Suicide Rates in the Intervention Region Compared With the Local Control Region Using All 10 Years of Data

	Time (*df*=1,16)		Region × Time (*df*=2,16)	
	F Test	*P* Value	*F* Test	*P* Value
Suicide by Region and Time				
Total region	3.33	.09	1.61	.23
Town	0.01	.92	1.73	.21
Rural	4.52	.05[a]	0.33	.72
Suicide by Sex, Region, and Time				
Men				
Total region	5.05	.04[a]	1.76	.20
Town	0.02	.88	1.17	.34
Rural	7.47	.02[a]	0.14	.87
Women				
Total region	0.10	.76	1.16	.34
Town	0.01	.91	0.53	.60
Rural	0.26	.61	3.23	.07[a]

[a] Statistically significant.

the rural area ($F_{1,32}$=4.94; P=.03) was observed. There was a trend for a region × time interaction in women in the rural area, where the female suicide rate in the intervention region decreased by 34% from 27 in 100 000 to 18 in 100 000, while in the local control region, it increased by 90% from 20 in 100 000 to 37 in 100 000 ($F_{2,16}$=3.23; P=.07).

At baseline, the intervention region had a higher suicide rate than both Hungary and the county (respectively, χ^2=6.82; P=.009 and χ^2=4.81; P=.03). There was a time effect (**Table 4**) such that the suicide rate decreased in the 2001-2005 intervention period compared with 1996 through 2000. In the intervention region, the 5-year preintervention and postintervention mean (SD) annual suicide rates per 100 000 population were 59.7 (8.6) and 49.9 (7.0), and the decline in the suicide rate was 9.8. In the county, excluding the intervention region, the 5-year preintervention and postintervention mean (SD) annual suicide rates were 44.3 (4.0) and 37.4 (2.4), and the decline in the rate was 6.9. In Hungary, the preintervention and postintervention mean (SD) annual suicide rates were 32.5 (0.8) and 28.0 (0.9), and the decline in the rate was 4.5. There were region × time interactions because the decrease in annual suicide rate was greater in the intervention region compared with the county minus intervention region and compared with all of Hungary (Table 4).

SECONDARY OUTCOME MEASURE: CHANGE IN ANTIDEPRESSANT USE

Change in antidepressant use was evaluated in the intervention region, the local control region, the county, and Hungary by comparing the number of persons treated with antidepressants and level of treatment, calculated as DDD per 1000 population per each day of the year.

Treatment improved over time in the intervention region, the local control region, the county, and Hungary (**Table 5**). A region × time interaction effect was found for number being treated with antidepressants and for DDD in both sexes (P<.001 for all) when comparing the intervention and the local control regions and when comparing the intervention region with the county and Hungary (P<.001 for all); the increase in both treatment indexes was greater in the intervention region. For example, during the intervention period in the intervention region, 25 in 1000 women filled antidepressant prescriptions in DDDs for a year, compared with only 15 in 1000 women in the local control region. Only about 10% of the antidepressants used in the intervention region were tricyclics; the rest were selective serotonin reuptake inhibitors, dual-action agents, and reversible inhibitors of monoamine oxidase type A.

ALCOHOL-RELATED DEATHS

The intervention region had a higher alcohol-related death rate both before and after the program compared with the control region (alcohol-related annual death rate preintervention and postintervention per 100 000 in the intervention region, 96.3 vs 68.5; in the control region, 89.5 vs 54.3). There was a decrease in alcohol-related deaths over time in both regions ($F_{1,8}$=22.79; P=.001), but there was no region × time interaction ($F_{2,8}$=2.18; P=.18).

UNEMPLOYMENT RATE

Using the mean unemployment rate values averaged over the period for which data were available (1999-2004), the rate was higher in the intervention region (9.1%) compared with the local control region (7.0%) (χ^2_1=8.31; P=.004). In comparison, in 2004, the unemployment rate of Hungary was 6.1% and in the county, 7.1%. There was no change in the local unemployment rate over time (intervention region, 9.2% preintervention and 9.1% intervention; local control region, 7.3% preintervention and 6.9% intervention).

Table 4. Analyses of Suicide Rates for 5 Years Before and 5 Years During the Intervention: Intervention Region vs County Minus Intervention Region and vs Hungary

	Time (*df*=1,16)		Region × Time (*df*=2,16)	
	F Test	*P* Value	*F* Test	*P* Value
County minus intervention region	10.09	.006	14.54	<.001[a]
Hungary	10.70	.005	71.04	.001[a]

[a] Statistically significant.

Table 5. Antidepressant Use in 1999 and 2000 (Preintervention Period) and in 2001 Through 2004 (Postintervention Period)[a]

	Time (*df*=1,8)		Region × Time (*df*=2,8)	
	F Test	*P* Value	*F* Test	*P* Value
Intervention Region vs Local Control Region				
Level of treatment	258.87	<.001[b]	233.34	<.001[b]
Rate of treated persons	304.32	<.001[b]	230.12	<.001[b]
Sex				
Male				
Level of treatment	93.35	<.001[b]	30.81	<.001[b]
Rate of treated persons	129.96	<.001[b]	30.54	<.001[b]
Female				
Level of treatment	168.79	<.001[b]	208.36	<.001[b]
Rate of treated persons	179.63	<.001[b]	209.91	<.001[b]

	Time (*df*=1,7)		Region × Time (*df*=2,7)	
	F Test	*P* Value	*F* Test	*P* Value
Intervention Region vs Hungary and the County Minus the Intervention Region				
Hungary				
Level of treatment	433.98	<.001[b]	164.57	<.001[b]
Rate of treated persons	511.89	<.001[b]	98.92	<.001[b]
County minus intervention region				
Level of treatment	553.79	<.001[b]	128.23	<.001[b]
Rate of treated persons	602.80	<.001[b]	59.17	<.001[b]

[a] Level of treatment was calculated as ([defined daily dose/365]/population) × 1000. Rate of treated persons was calculated as (number of persons treated/population) × 1000.
[b] Statistically significant.

ASSOCIATION OF SUICIDE RATE WITH ANTIDEPRESSANT USE AND ALCOHOL-RELATED LIVER DEATH

There was a trend for negative correlation between the suicide rate in the intervention region and rate of treatment (Spearman ρ = –0.77; *P* = .07). There was no correlation between alcohol-related liver death and suicide rate in the intervention region (Spearman ρ = –0.16; *P* = .83) and unemployment rate and suicide rate (Spearman ρ = 0.26; *P* = .62).

COMMENT

The annual suicide rate in the intervention region decreased during the period of the intervention, from 59.7 in 100 000 to 49.9 in 100 000, resulting in 34 fewer lives lost in the 2001-2005 period compared with the previous 5 years. The decrease was comparable with that in the control region but was greater than the decrease in the whole county and the whole country. Although the numbers are smaller, when the population is divided into rural and urban sections and into men and women, there was a region × sex × time interaction due to the 34% decrease in the female suicide rate in the intervention region, while there was a 90% increase in the rural female suicide rate in the local control region. This may be a consequence of the higher antidepressant prescription rates for women in the intervention region.

These results are promising but not as dramatic as in Gotland,[10,13] perhaps highlighting the limitations of an intervention that is not tailored to the profile of causes of suicide in this intervention region and also reflecting the impact on suicide rates of changing prescribing patterns throughout the country where suicide rates have been falling for over a decade, including during the time of this study. Nevertheless, benefits could be demonstrated in comparison with the whole country and to the much larger surrounding county after excluding the intervention region. A consequence of the smaller population of the local control region was a higher annual variance in the suicide rate, making it more difficult to show a difference compared with the intervention region. Thus, comparisons between the local control and the intervention regions that appeared to be clinically significant were not statistically significant. Compared with the local control region, a benefit was detected for women in rural areas. It is conceivable that the prevention program was more effective in rural areas, where the suicide rate was higher during the 5-year preintervention period, compared with the town and the level and accessibility of psychiatric care had been poorer compared with the town, thereby making the benefit of the intervention greater in the rural area. The finding of a greater decrease in suicide rate in the intervention region compared with the surrounding county occurred despite the potential spillover effect of the educational intervention into contiguous regions of the county.

One reason for a greater benefit for women in the rural area may be because most prescriptions for antidepressants were filled by women (during the intervention period, on average, 8 DDD per 1000 men vs 25 per 1000 women per each day of the year). As a comparison, in Sweden in 2002, the antidepressant consumption was 57.2 DDD per 1000 inhabitants per day[13] and may explain part of the reason for the lower suicide rate in Sweden compared with Hungary as has been shown in a study of 25 countries.[20] Further, 80% of patients treated at the Depression Treatment Clinic were women. A greater impact on the treatment of depression in women than men is also consistent with the results of the Swedish Gotland study, where the decrease after the first intervention was almost totally in suicides of women with major depression and male suicide rates were almost unaffected,[21] and with recent findings in the United States, where women have almost double the prescription rate of antidepressants and almost double

the fall in suicide rates.[22] Women's help-seeking behavior is considered to be better than men.[23,24]

In Gotland, the decrease in the female suicide rate in the intervention region occurred during a period when the suicide rate in Sweden increased or was stable, whereas in Hungary, the suicide rate decreased during the investigated period. Thus, our finding of a greater decrease in the intervention region compared with the entire country and the surrounding county is more striking. Theoretically, the lower suicide rate in the intervention region, which had a suicide rate twice as high as the national average, could be attributed to the regression to the mean. However, if this would be the only reason for the lower suicide rates, we would not have detected a significant difference in the reduction of the suicide rate of the intervention region as compared with the suicide rate of the surrounding county (minus the intervention region). The selected control county is the one with the highest suicide rate in Hungary and the regression to the mean effect should be comparable in the intervention region and in that county.

The relatively smaller effect observed in this study compared with the Gotland study may reflect more limitations of the program than just the degree of impact on prescribing of antidepressants. According to our psychological autopsies in the intervention region during the time of this study (K.S., J.J.M., H.H., unpublished data, 2001-2004), alcoholism was present in 75% of male suicides and 21% of female suicides. There is no Alcoholics Anonymous group in the intervention region; the only treatment program for alcoholism is brief hospitalization for delirium tremens and about 300 cases were treated each year in the hospital, indicating the seriousness of untreated alcoholism. General practitioners had difficulty recognizing major depression that was often comorbid with alcohol abuse/dependence and were skeptical about effectiveness of treatment for alcoholism. We found no impact of the program on alcohol-related liver death during the intervention period, although an effect on alcohol-related liver deaths would take years to become apparent because it takes many years of heavy drinking to damage the liver fatally. There is a correlation between daily alcohol consumption and suicide rates.[22] Individuals with comorbid alcohol use disorder and depression are at exceptionally high risk for suicide.[25] Treatment of the male alcoholic population will likely require an intensive public education campaign and specialized treatment facilities but, if successful, should further lower suicide rates in the intervention region.

We chose the local control region because it had a similar annual completed suicide rate as the intervention region and many sociodemographic characteristics were similar in the 2 regions. Still, in certain demographic characteristics they were different (eg, in the intervention region, 60% of the population lives on farms and in villages; this ratio is only 40% in the local control region). Accessing specialist care is easier in urban areas and that would favor the control region over the intervention region. Further, in the intervention region during the 10-year investigated period, the unemployment rate was higher than in the control region. While a newly built highway connects the control region to the rest of the country, the intervention region has remained more isolated; thus, the decrease in the suicide rate occurred despite the unchanged social environment that favored the control region over the intervention region.

Educating GPs to change clinical practice in regard to treatment of depression may not alter treatment practice.[16] Most of the GPs expressed interest and enthusiasm regarding the suicide prevention project. However, they seemed less alarmed by a suicide than our personal observation suggests is the case in regions of the United States, where the suicide rate is much lower, such as New York, New York. Whereas it is estimated that GPs in the United States experience an average of 1 suicide in 3 years, in the intervention region, the average was 1 suicide per year per GP during the intervention period. In 5 years, only 3 of the 28 GPs did not lose a patient by suicide, 1 GP lost 9 patients, and 3 lost 7. During the education program, the rate of GP attendance at educational sessions declined from 90% at the first training session (2000) to 60% (2001). During the following 4 years, it fluctuated between 60% and 39%, and the attendance percentage for the booster sessions also fluctuated from 80% to 39%. Possible reasons for variable attendance were that the GPs were overworked, lost interest, or felt they learned everything they needed from the first session or lacked financial incentive to participate and some of the meetings were poorly scheduled, such as during annual vacation periods. There was also variation in how closely GPs followed the suicide prevention program's recommendations and used its services. Most GPs used the Beck Depression Inventory to screen fewer than 5% of their cases, whereas we recommended screening all patients annually. One service that the GPs consistently used was the consultation with the psychiatrists; on average, 2 to 3 telephone calls per week were made by the GPs to the local psychiatrists. This number remained constant during the 5 years.

Health care resources in the intervention area (measured by the number of GPs per population) are similar to the rest of the country. Still, we cannot verify whether the critical ingredient in this multicomponent intervention was the educational program, the availability of additional resources, or the two provided a synergistic effect.

It is a limitation of the study that we did not collect reliable data on suicide attempts, and consequently, we could not include attempter data in the final analysis. Data on suicide attempts were obtained from the local ambulance service, and suicide attempts that were not deemed to require emergency department evaluation or hospital treatment were not included. Based on that data, we detected no change in the number of suicide attempts during the investigated periods but do not know how many attempts of lesser lethality were made. One of the lessons to be learned from this study is the importance of reliable attempter data because nonfatal suicide attempts have a higher base rate than completed suicide and may be a more sensitive outcome measure.

During the intervention period, antidepressant use increased in both the intervention and the control regions, and a modest negative correlation was detected between antidepressant use and suicide rates in the intervention region. This is consistent with many re-

ports of such a relationship[26] and indicates a possible causal association between the decreased rural female suicide rate and the prevention program.

To our knowledge, this is the first suicide intervention study in a high–suicide-rate region of the world. Strengths are the long intervention period, reliable data on completed suicide and antidepressant use prior to and during the intervention, and the use of control regions to control for secular trends in prescribing behavior and other general effects on suicide rates other than due to the intervention. The greater decrease in the annual suicide rate in the intervention region compared with the larger surrounding county and the whole country is promising, but the study also shows the challenges of suicide prevention programs. In view of the heterogeneity of the psychiatric causes of suicide in men and women, in addition to improvement of depression treatment, a prevention program should target other important local causes of suicide, such as men with alcoholism in this intervention region. Further, improving depression treatment in primary care may necessitate more than education, namely structural changes in GP practices, such as employing depression-care managers.[17,27] The control region must be of sufficient population to allow robust estimates of local suicide rates over the period of intervention to detect benefit.

Submitted for Publication: September 1, 2006; final revision received December 5, 2006; accepted January 15, 2007.
Correspondence: J. John Mann, MD, Department of Neuroscience, New York State Psychiatric Institute, 1051 Riverside Dr, Box 42, Unit 42, New York, NY 10032 (jjm@columbia.edu).
Author Contributions: Dr Szanto had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Financial Disclosure: Dr Mann has received research support from GlaxoSmithKline and served as an advisor to Eli Lilly and Company and Lundbeck. Dr Kalmar received support from Servier-Egis. Dr Rihmer received financial support from Eli Lilly and Company, Organon, Pfizer, Servier-Egis, AstraZeneca, Lundbeck, Sanofi-Aventis, and GSK.
Funding/Support: This project was supported by the American Foundation for Suicide Prevention, which obtained grant support from the Open Society Institute, New York, New York, and from Johnson & Johnson and Janssen-Cilag through the King Baudouin Foundation in Belgium.
Role of the Sponsor: None of the sponsors had a role in the design or conduct of the study; collection, management, analyses, or interpretation of the data; and preparation, review, or approval of the manuscript.
Additional Contributions: Fewer suicides reflect the efforts of the 28 primary care physicians (GPs) and their nurses who participated in the prevention program and the psychiatrists and psychologist of Kiskunhalas Hospital, who provided consultation to the GPs and operated the Depression Clinic.

REFERENCES

1. Barraclough B, Bunch J, Nelson B, Sainsbury P. A hundred cases of suicide: clinical aspects. *Br J Psychiatry*. 1974;125(0):355-373.
2. Shaffer D, Gould MS, Fisher P, Trautman P, Moreau D, Kleinman M, Flory M. Psychiatric diagnosis in child and adolescent suicide. *Arch Gen Psychiatry*. 1996; 53(4):339-348.
3. Waern M, Runeson BS, Allebeck P, Beskow J, Rubenowitz E, Skoog I, Wilhelmsson K. Mental disorder in elderly suicides: a case-control study. *Am J Psychiatry*. 2002;159(3):450-455.
4. Conwell Y, Duberstein PR, Cox C, Herrmann JH, Forbes NT, Caine ED. Relationships of age and axis I diagnoses in victims of completed suicide: a psychological autopsy study. *Am J Psychiatry*. 1996;153(8):1001-1008.
5. Oquendo MA, Malone KM, Ellis SP, Sackeim HA, Mann JJ. Inadequacy of antidepressant treatment for patients with major depression who are at risk for suicidal behavior. *Am J Psychiatry*. 1999;156(2):190-194.
6. Mann JJ, Apter A, Bertolote J, Beautrais A, Currier D, Haas A, Hegerl U, Lonnqvist J, Malone K, Marusic A, Mehlum L, Patton G, Phillips M, Rutz W, Rihmer Z, Schmidtke A, Shaffer D, Silverman M, Takahashi Y, Varnik A, Wasserman D, Yip P, Hendin H. Suicide prevention strategies: a systematic review. *JAMA*. 2005; 294(16):2064-2074.
7. Pirkis J, Burgess P. Suicide and recency of health care contacts: a systematic review. *Br J Psychiatry*. 1998;173:462-474.
8. Rihmer Z, Rutz W, Barsi J. Suicide rate, prevalence of diagnosed depression and prevalence of working physicians in Hungary. *Acta Psychiatr Scand*. 1993; 88(6):391-394.
9. Gibbons RD, Hur K, Bhaumik DK, Mann JJ. The relationship between antidepressant medication use and rate of suicide. *Arch Gen Psychiatry*. 2005;62(2):165-172.
10. Rutz W, von Knorring L, Walinder J. Long-term effects of an educational program for general practitioners given by the Swedish Committee for the Prevention and Treatment of Depression. *Acta Psychiatr Scand*. 1992;85(1):83-88.
11. Rihmer Z, Rutz W, Pihlgren H. Depression and suicide on Gotland: an intensive study of all suicides before and after a depression-training programme for general practitioners. *J Affect Disord*. 1995;35(4):147-152.
12. Rutz W, Walinder J, von Knorring L, Rihmer Z, Pihlgren H. Prevention of depression and suicide by education and medication: impact on male suicidality. an update from the Gotland study. *Int J Psychiatry Clin Pract*. 1997;1:39-46.
13. Henriksson S, Isacsson G. Increased antidepressant use and fewer suicides in Jamtland county, Sweden, after a primary care educational programme on the treatment of depression. *Acta Psychiatr Scand*. 2006;114(3):159-167.
14. Chiu HF, Takahashi Y, Suh GH. Elderly suicide prevention in East Asia. *Int J Geriatr Psychiatry*. 2003;18(11):973-976.
15. Hegerl U, Althaus D, Schmidtke A, Niklewski G. The alliance against depression: 2-year evaluation of a community-based intervention to reduce suicidality. *Psychol Med*. 2006;36(9):1225-1233.
16. Thompson C, Kinmonth AL, Stevens L, Peveler RC, Stevens A, Ostler KJ, Pickering RM, Baker NG, Henson A, Preece J, Cooper D, Campbell MJ. Effects of a clinical-practice guideline and practice-based education on detection and outcome of depression in primary care: Hampshire Depression Project randomised controlled trial. *Lancet*. 2000;355(9199):185-191.
17. Schulberg HC, Block M, Madonia M, Scott C, Rodriguez E, Imber S, Perel J, Lave J, Houck P, Coulehan JL. Treating major depression in primary care practice: eight-month clinical outcomes. *Arch Gen Psychiatry*. 1996;53(10):913-919.
18. Nutting PA, Dickinson LM, Rubenstein LV, Keeley RD, Smith JL, Elliott CE. Improving detection of suicidal ideation among depressed patients in primary care. *Ann Fam Med*. 2005;3(6):529-536.
19. WHO Collaborating Centre for Drug Statistics Methodology Web site. www.whocc.no/atcddd. Accessed 2006.
20. Ludwig J, Marcotte DE. Anti-depressants, suicide, and drug regulation. *J Policy Anal Manage*. 2005;24(2):249-272.
21. Rutz W, Walinder J, Pihigren H, von Knorring L, Rihmer Z. Lessons from the Gotland study on depression, suicide and education: effects, shortcomings and challenges. *Int J Methods Psychiatr Res*. 1996;6:S9-S14.
22. Grunebaum MF, Ellis SP, Li S, Oquendo MA, Mann JJ. Antidepressants and suicide risk in the United States, 1985-1999. *J Clin Psychiatry*. 2004;65(11):1456-1462.
23. Kessler RC, Brown RL, Broman CL. Sex differences in psychiatric help-seeking: evidence from four large-scale surveys. *J Health Soc Behav*. 1981;22(1):49-64.
24. Möller-Leimkühler AM. Barriers to help-seeking by men: a review of sociocultural and clinical literature with particular reference to depression. *J Affect Disord*. 2002;71(1-3):1-9.
25. Cornelius JR, Salloum IM, Mezzich J, Cornelius MD, Fabrega H, Ehler JG, Ulrich RF, Thase ME, Mann JJ. Disproportionate suicidality in patients with comorbid major depression and alcoholism. *Am J Psychiatry*. 1995;152(3):358-364.
26. Gibbons RD, Hur K, Bhaumik DK, Mann JJ. The relationship between antidepressant prescription rates and rate of early adolescent suicide. *Am J Psychiatry*. 2006;163(11):1898-1904.
27. Bruce ML, Ten Have TR, Reynolds CF, Katz IR, Schulberg HC, Mulsant BH, Brown GK, McAvay GJ, Pearson JL, Alexopoulos GS. Reducing suicidal ideation and depressive symptoms in depressed older primary care patients: a randomized controlled trial. *JAMA*. 2004;291(9):1081-1090.