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# Risk of suicide and related adverse outcomes after exposure to a suicide prevention programme in the US Air Force: cohort study

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## Abstract

**Objective** To evaluate the impact of the US Air Force suicide prevention programme on risk of suicide and other outcomes that share underlying risk factors.

**Design** Cohort study with quasi-experimental design and analysis of cohorts before (1990-6) and after (1997-2002) the intervention.

**Participants** 5 260 292 US Air Force personnel (around 84% were men).

**Intervention** A multilayered intervention targeted at reducing risk factors and enhancing factors considered protective. The intervention consisted of removing the stigma of seeking help for a mental health or psychosocial problem, enhancing understanding of mental health, and changing policies and social norms.

**Main outcome measures** Relative risk reductions (the prevented fraction) for suicide and other outcomes hypothesised to be sensitive to broadly based community prevention efforts, (family violence, accidental death, homicide). Additional outcomes not exclusively associated with suicide were included because of the comprehensiveness of the programme. **Results** Implementation of the programme was associated with a sustained decline in the rate of suicide and other adverse outcomes. A 33% relative risk reduction was observed for suicide after the intervention; reductions for other outcomes ranged from 18-54%.

**Conclusion** A systemic intervention aimed at changing social norms about seeking help and incorporating training in suicide prevention has a considerable impact on promotion of mental health. The impact on adverse outcomes in addition to suicide strengthens the conclusion that the programme was responsible for these reductions in risk.

## Introduction

Suicide is a major public health problem in many industrialised countries, but there is little evidence of the effectiveness of prevention programmes.<sup>1</sup> The low base rate of suicide makes it difficult to implement randomised trials that have sufficient statistical power when suicide is used as the major outcome. Synthesis of results from 20 randomised controlled trials of the effectiveness of psychosocial and drug treatments that used repetition of self harm as the outcome did not overcome this lack of power.<sup>2</sup>

From 1990-4 suicide rates in the US Air Force increased significantly overall ( $P < 0.01$ ), particularly among African-American and white men aged 24-35 years. Senior figures in the US Air Force became concerned that suicide represented the end of a long road of personal suffering in which multiple indicators of vulnerability pointed to the need for help. They

reasoned that this extended period of distress also offered an opportunity for preventive intervention. From their perspective, a responsible suicide prevention programme had to deal with the entire range of afflictions experienced by individuals, families, and their communities.

While many individuals have risk factors, only a few will ever attempt suicide. However, many exhibit decreased functioning, contributing to lost workdays, reduced productivity, great personal suffering, and substantial family distress. The uniqueness of the continuing programme has been its emphasis on early prevention, by intervening at the first signs of dysfunction or distress before the risk of suicide is imminent, while at the same time enhancing the detection and treatment of those at increased danger of taking their own lives. Early population based intervention to prevent suicide, however, has been relatively uncommon.

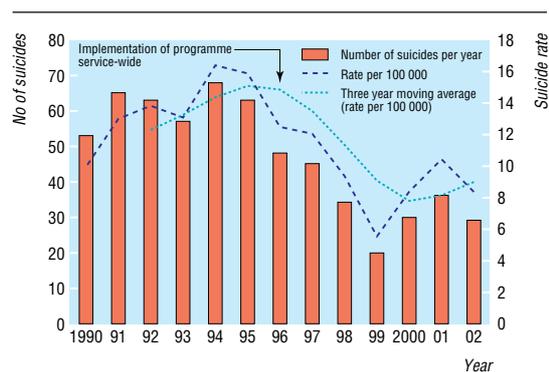
During 1995 there were limited prevention efforts in selected groups of the Air Force and the suicide rate remained unacceptably high. In 1996, the Air Force implemented a population based prevention programme, involving community agencies inside and outside the healthcare sector. Fundamental to the approach taken by the Air Force was the understanding that only through reducing stigma could its community save lives. Emphasis was placed on institutionalising community-wide training efforts to heighten awareness of a range of risk factors that confer vulnerability for various behavioural and physical adverse events or problems, foremost of which was suicide. In addition, on an ongoing basis, the entire community received education about policy changes regarding the availability of resources to those in need. Finally, the senior ranks in the Air Force strongly endorsed a radical change in social norms to decrease stigma around help seeking behaviours for all members of the community, and subsequently worked to sustain these newly stated values. We report on the effectiveness of the first six years of this ongoing programme, using a quasi-experimental (before and after) cohort study design.

## Methods

The study population consisted of a dynamic cohort of 5 260 292 active duty US Air Force personnel between 1990-2002.

In response to the rise in the numbers of suicides in 1990-5 the vice chief of staff mandated that prevention of suicide become a service-wide priority. He commissioned a team representing 15 functional areas (community based social service providers, operational components of the occupational community (command and supervision, safety), healthcare delivery, prevention and health promotion, and justice) and experts

from the Centers for Disease Control to lead a systematic study of the issue and recommend a prevention strategy. The team used a data driven prevention model to examine extant community data and identified stigma, social norms, and commonly held beliefs that together apparently discouraged people from seeking help. The team adopted a population oriented risk reduction approach<sup>3</sup> that focused on reducing modifiable risk factors and enhancing factors considered protective. Eleven “initiatives” were developed that targeted strengthening social support, promoting development of effective coping skills, and changing policies and norms so as to encourage effective help seeking behaviours (see [bmj.com](http://bmj.com)).



**Fig 1** Number of suicides, suicide rates, and three year moving average for rates of suicide, US Air Force, 1990-2002

## Results

*Trend analysis of rates of suicide and related outcomes*—Analysis of the suicide data showed a linear trend for a reduction in the proportion of suicides each year across the decade ( $\chi^2=11.3785$ ,  $df=1$ ,  $P=0.0007$ ). Analysis of the combined data on homicides and accidental deaths also indicated a linear trend for a decline in these outcomes ( $\chi^2=5.3526$ ,  $df=1$ ,  $P=0.05$ ). Analysis of the data on family violence found evidence for an increase in mild family violence ( $\chi^2=1239.29$ ,  $df=1$ ,  $P<0.0001$ ). There was a decrease in both moderate ( $\chi^2=268.33$ ,  $df=1$ ,  $P<0.0001$ ) and severe family violence ( $\chi^2=227.14$ ,  $df=1$ ,  $P<0.0001$ ). Figure 1 shows yearly rates and raw numbers for suicide from 1990-2002. Details on the estimated rates and the 95% confidence intervals for all of the outcomes for the years 1990-2002 can be found on [bmj.com](http://bmj.com).

*Relative risk of suicide and related outcomes*—The table gives details of relative risk and the preventive fraction for suicide and other violent outcomes. There was 33% relative risk reduction of suicide in the exposed cohort; risk reductions for accidental death, homicide, and moderate and severe family violence ranged from 18-54%. The relative risk of reported mild family violence was greater than 1 (relative risk 1.18, 95% confidence interval 1.16 to 1.20), indicating there was an excess risk of the incidence of mild cases in the exposed cohort.

*Analysis of potential population confounds*—When we investigated potential demographic confounders we found no significant changes in sex, race, or age distribution in the cohort. There were also no differences in socioeconomic status (using rank as a proxy). The por-

portion of unmarried individuals rose slightly, though any confounding effect of this increase would serve to increase not decrease the risk of suicide. There was no difference in the two cohorts for the proportion of all disability cases that were assigned a mental health diagnosis, which would have caused them to be removed from active duty. Case reporting and overall distribution of deaths due to homicide, accidental death, undetermined causes, or suicide remained stable over the decade.

Outcome	Relative risk (95% CI)	Risk reduction (1–relative risk)	Excess risk (relative risk–1)
Suicide	0.67 (0.57 to 0.80)	33%	—
Homicide	0.48 (0.33 to 0.74)	51%	—
Accidental death	0.82 (0.73 to 0.93)	18%	—
Severe family violence	0.46 (0.43 to 0.51)	54%	—
Moderate family violence	0.70 (0.69 to 0.73)	30%	—
Mild family violence	1.18 (1.16 to 1.20)	—	18%

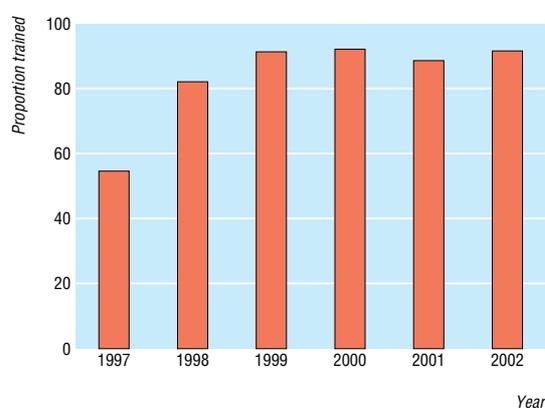
Changes in practice—The 11 initiatives were originally implemented through the release of Air Force instructions released early in 1997. All were associated with specific performance indicators (see [bmj.com](http://bmj.com)). Figure 2 shows the proportion of people who received specific training in suicide and violence education; this increased significantly from 1997 to 2002 ( $\chi^2=175677$ ,  $df=1$ ,  $P<0.0001$ ).

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## Discussion

### Generalising the results

A community-wide suicide prevention programme in the US Air Force aimed at decreasing stigma, enhancing social networks, facilitating help seeking through system level policy changes, and enhancing understanding of mental health in the community was associated over time with a 33% risk reduction for completed suicide. However, as the US Air Force is a unique population for study, are the findings generalisable to other communities? While this is a concern, there is substantial value in examining such a setting. According to the theory of diffusion of innovations,<sup>4</sup> individuals and communities



**Fig 2** Proportion of Air Force personnel trained in suicide prevention (1997-2002)

who are first to implement novel interventions are designated as “early adopters.” Though the Air Force community represents a select population, its development of community based suicide prevention is in keeping with its tradition of early implementation of public health innovations.<sup>5</sup> Moreover, by studying this more stable population we were able to eliminate key confounders for risk of suicide, such as socioeconomic status and access to health care. While there is substantial diversity or heterogeneity within the US Air Force community, on the basis of educational level, financial resources, rank, job description, and installation assignment, the year to year variations in composition of the population as a whole are minimal, thus allowing the type of cohort analysis we used. This was confirmed by our examination of potential confounders. Scientific inference can be made more readily without confounding. Thus we consider that the ability to examine testable inferences about a theoretical model of suicide prevention was enhanced by studying this restricted population.<sup>6</sup>

Our findings support the theoretical models that form the foundation of the Air Force intervention. The fundamental goal of this population based risk reduction strategy was to decrease the mean population risk<sup>3</sup> for a range of risk factors that confer vulnerability for various adverse behavioural and physical events or outcomes. That this shift occurred is unequivocal. Mandated changes in policy provide evidence that system level changes actually occurred. Measurements on training further support the conclusion that the Air Force fundamentally institutionalised suicide prevention training, which may have had far reaching mental health effects. Measuring changes in social norms is less straightforward. However, in a random survey conducted in 1999, 73% of Air Force unit commanders identified risk of suicide as their highest concern regarding behavioural health in their units. Considering the low base rate of suicide and the relatively low probability of any one commander having a suicide in his or her unit, this level of concern is noteworthy in light of the social marketing campaign. Taken together with the sustained low rates of suicide and other adverse outcomes over the past six years, the social norm for help seeking behaviour (either for oneself or for a peer) seems to have shifted from being seen as a sign of weakness to a statement of strength and responsibility.

Community based approaches to health promotion present methodological challenges to study design and evaluation. The “noise” of real world environments often results in effect sizes smaller than expected.<sup>7</sup> In contrast, we found reductions in risk similar to those seen after community interventions for HIV prevention<sup>8</sup> that also have targeted changing social norms.<sup>9</sup> The effect sizes measured in this cohort on several related indices of public health call for replication studies in other populations. The key lessons derived from this community based intervention may be particularly adaptable in selected workplace contexts that are more tightly organised and provide or coordinate human services for their employees or in settings with naturally occurring social networks. These could include police and fire fighters, other elements of the armed services worldwide, larger corporations, states or smaller countries, and schools and universities. The results also indicate that, for smaller

### What is already known on this topic

There is a lack of evidence for the effectiveness of broadly based community level suicide prevention programmes

The risk factors for suicide—including mental health problems, substance misuse, relationship problems, poor coping skills, legal and financial problems, and social isolation—also confer risk for other adverse outcomes, such as accidental death, homicide, and family violence

Little is known about the role that protective factors might have in preventing suicide, including increasing social support, coping skills, and understanding of mental health, and decreasing stigma about the related need to seek care

### What this study adds

After the implementation of a broadly based, community level suicide prevention programme in the US Air Force, there were fewer suicides

The ongoing programme also reduced the rates of other adverse outcomes that share similar underlying risk factors

preventive studies, examination of other theoretically related adverse outcomes can potentially yield important data regarding the prevention of suicide and the array of events that seem to be tied to it.

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- Gunnell D, Frankel S. Prevention of suicide: aspirations and evidence. *BMJ* 1994;308:1227-33.
- Hawton K, Arensman E, Townsend E, Bremner S, Feldman E, Goldney R et al. Deliberate self harm: systematic review of efficacy of psychosocial and pharmacological treatments in preventing repetition. *BMJ* 1998;317:441-7.
- Rose G. Sick individuals and sick populations. *Int J Epidemiol* 1985;14:32-8.
- Rogers EM, Shoemaker EF. *Communication of innovation*. New York: Free Press, 1971:99-134.
- Clements-Thompson M, Klesges RC, Haddock K, Lando H, Talcott W. Relationships between stages of change in cigarette smokers and healthy lifestyle behaviors in a population of young military personnel during forced smoking abstinence. *J Consult Clin Psychol* 1998;66:1005-11.
- Rothman KJ. *Epidemiology*. Oxford: University Press, 2002:110-1.
- Merzel C, D’Affilitti J. Reconsidering community-based health promotion: promise, performance and potential. *Am J Public Health* 2003;93:557-74.
- Kelly JA, St Lawrence JS, Stevenson LY, Hauth AC, Kalichman SC, Diaz YE, et al. Community AIDS/HIV risk reduction: the effects of endorsements by popular people in three cities. *Am J Public Health* 1992;82:1483-9.
- Kelly JA. Community-level interventions are needed to prevent new HIV infections. *Am J Public Health* 1999;89:299-301. (Accepted 10 October 2003)