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## You Can't Fix What You Haven't Found: Reframing Suicidal Behavior as a Brain-Based Disorder

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### Abstract

Contrary to popular belief, suicidal behavior is rarely impulsive. Research increasingly shows that it stems from dysfunction in specific areas of the brain that may include the prefrontal cortex, limbic system, and temporal lobes responsible for judgment, impulse control, and emotional regulation. When these regions are impaired, individuals may struggle to assess consequences, manage distress, or access hope. Advanced neuroimaging techniques, including EEG and SPECT, have identified abnormal activity patterns in these brain regions in individuals at high risk for suicide. This biological basis helps explain why some people develop persistent suicidal thoughts and why using precise targeted therapies like TMS will restore healthy brain function. Recognizing suicide as a brain-based medical issue shifts the conversation from blame and bridge barriers for suicide to reliable prevention and effective treatment. With barriers in place, without timely and effective mental health therapy, suicide risk and mental health problems will likely escalate from self-harm to potential harm to others. Viewing suicide as purely spontaneous has misdirected prevention strategies.

**Keywords:** Suicide Prevention, Brain Dysfunction, TMS, EEG-Guided Therapy, Bridge Barriers, Public Health, Cost-Effectiveness

### Highlights

- Contrary to common belief suicidal behavior is not so impulsive; it stems from dysfunction in specific areas of the brain that impairs judgment
- SPECT and EEG imaging can reveal brain dysfunctions linked to elevated suicide risk
- Elevated suicide rates on bridges indicate a failure of effective therapy in specific geographic areas
- Relying on barriers without therapy is reactive and costly.
- Most suicidal individuals will attempt suicide with another method if a preferred method is unavailable.
- Bridge barrier do not fix mental health, the problem will manifest in other way that may threaten public safety

### Introduction

For decades, suicide prevention policy has been shaped by the belief that suicidal behavior is impulsive and location-dependent. This belief has justified the construction of costly physical barriers on bridges and other landmarks. However, this approach overlooks the core issue: suicidal behavior often arises from dysfunction in specific brain regions involved in judgment, impulse control, and emotional regulation. When these dysfunctions remain untreated, the individual risk not only persists however may manifest in different, often more dangerous forms, including violence toward others. Without addressing the root neurobiological cause through targeted therapy, suicide prevention remains reactive, not restorative. Failing to acknowledge this perpetuates systemic gaps in mental health care and exposes communities to escalating public safety risks.

Data indicate that psychiatric disorders, particularly major depression and related mood disorders, play a significant role in suicidal behavior. Existing research shows that over 90% of suicide victims suffer from at least one psychiatric condition.

TMS therapy has shown promise in treating conditions like treatment-resistant depression, which is linked to suicidal thoughts [1]. Despite its potential, TMS therapy remains underutilized and underfunded, with limited access for patients. In a typical TMS center treating 1,600 patients per year, approximately 160 to 240 patients would likely have elevated suicide risk and could benefit directly from EEG-guided TMS as a suicide prevention measure.

This paper will compare the cost-effectiveness and patient outcomes of bridge barriers and EEG-guided TMS therapy in suicide prevention, highlighting the need for data-driven mental health strategies.

### Bridge Barriers in Suicide Prevention

Bridge barriers serve as a physical impediment designed to reduce the lethality of suicide attempts by preventing individuals from accessing the edge of a bridge. This intervention is based on the premise that limiting immediate access to means of suicide can reduce "impulsivity" and thereby lower overall suicide rates at high-risk locations.

However, the cost of such infrastructure is substantial. The Golden Gate Bridge suicide net cost \$224 million, with ongoing maintenance expenses. In contrast, EEG-guided TMS therapy offers a targeted approach to suicide prevention by addressing underlying brain problems associated with suicidal ideation. Although much of the literature focuses on high-profile bridges, medium-sized bridges often have less iconic status in urban and suburban settings.

### Effectiveness of Bridge Barriers

Research indicates that when appropriately designed and installed, bridge barriers can reduce the incidence of suicide at the targeted site while, in many cases, overall suicide rates in the area remain more likely stable.

### Estimated Costs for Medium Bridges

Installation costs for bridge barriers depend on several factors including bridge dimensions, design complexity, and environmental considerations. According to data obtained from federal transportation reports and state-level case studies, the estimated cost for installing a suicide prevention barrier on a medium-sized bridge in the United States ranges from approximately \$1 million to \$3 million. These costs generally include material expenses, labor, design, and maintenance over an estimated lifespan that can extend from 20 to 30 years.

### Cost-Effectiveness Considerations

This figure must be contextualized within broader metrics of public health investment, where the value of a statistical life often ranges from several million dollars. Thus, even at these high initial costs, bridge barriers appear to be an economically favorable intervention in terms of life saved.

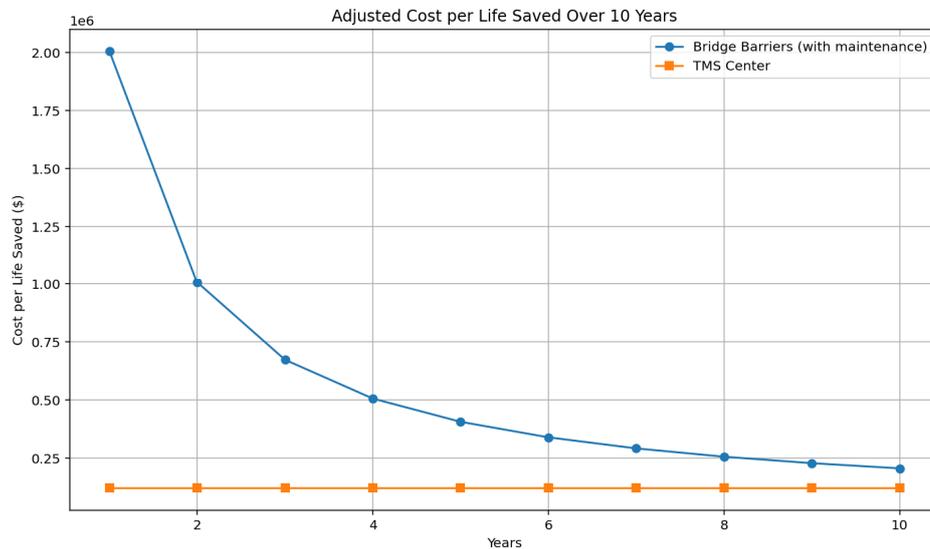
To evaluate the cost-effectiveness of bridge barriers, one can consider the following simplified model. Estimates suggest that a medium bridge, if known as a suicide hotspot before intervention, might observe prevention of 2–3 suicide attempts per year. For example, assuming an installation cost of \$2 million, a lifespan of 30 years, and an average of 2.5 suicides prevented annually, the cost per suicide prevented can be approximated as:  $\text{Cost per Suicide Prevented} \approx \$2,000,000 / (30 \times 2.5) \approx \$26,667$

Parameter	Value	Notes
Installation Cost per Bridge	\$1,000,000 – \$3,000,000	
Estimated Lifespan	30 years	Durable with low maintenance costs
Suicides Prevented per Year	2 – 3	Based on hotspot data
Estimated Cost per Suicide Prevented	~\$20,000 – ~\$40,000	Calculated over the lifespan

**Table 1: Summary of Bridge Barrier Cost Metric Effectiveness**

While bridge barriers have been championed as visible and permanent suicide prevention tools, recent research increasingly questions their cost-effectiveness and scalability compared to clinical psychiatric interventions

like Transcranial Magnetic Stimulation (TMS). Bridge barriers at suicide hotspots can cost upwards of \$20 million per project and typically prevent approximately 5 to 15 suicides per year per location [2].



**Figure 1: While Bridge Barriers Appear to Be Cost-Effective Over Time, TMS Provides Greater Annual Life-Saving Potential and Broader Mental Health Benefits, Making It Essential for Policymakers to Weigh Both Economic and Therapeutic Outcomes, Particularly for High-Risk Populations**

### The Limits of Physical Barriers

Bridge barriers target only one modality and one location of suicide, while neglecting the broader, more diffuse mental health crisis underlying suicidal behavior. Goldsmith et al. (2002) argued that such environmental deterrents, though politically appealing are not significantly lower overall suicide rates, as they fail to reach the broader population of individuals at chronic risk [3]. In addition, contrary to common belief, suicidal behavior is not so impulsive; it stems from dysfunction in specific areas of the brain that impairs judgment (see Figure 1). In fact, relying on barriers without therapy is reactive and costly. Most suicidal individuals will attempt suicide with another method if a preferred method is unavailable. This analysis is further supported by real-world tragedies. In a recent mass killing in Vancouver (CTV News, April 29, 2025), the suspect, Kai-ji Adam Lo, was on extended psychiatric leave under the Mental Health Act and reportedly under the care of a mental health team at the time of the attack (CTV News, 2025). This incident illustrates the consequences of inadequate gaps in mental health infrastructure, particularly for high-risk individuals with untreated or poorly monitored mental health condition.

### Transcranial Magnetic Stimulation (TMS) Clinics

Transcranial magnetic stimulation (TMS) is an established neuromodulation intervention used primarily in the treatment of major depressive disorder with the leading risk for suicide. TMS operates by delivering targeted magnetic pulses to specific regions of the brain. TMS not only alleviates depressive symptoms it can prevent and remove the risk of suicide.

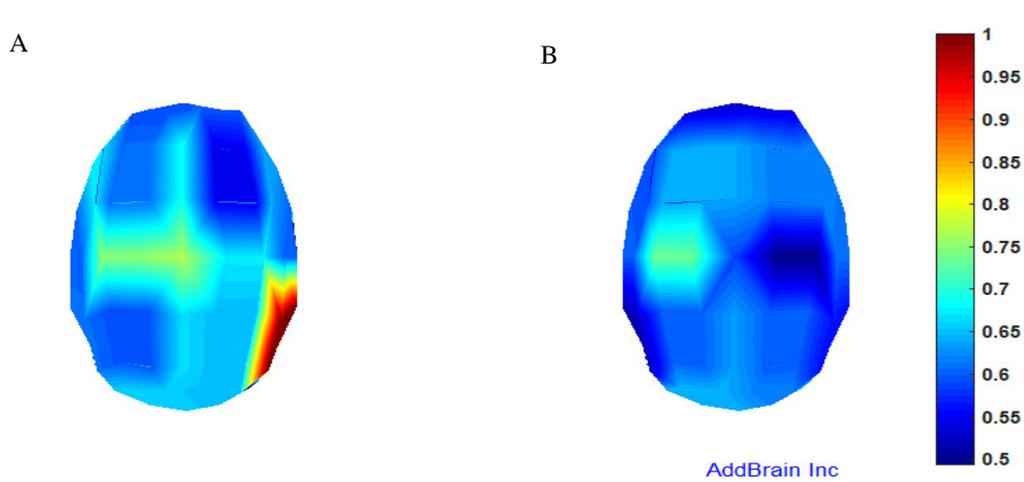
### Clinical Effectiveness in Reducing Suicidal Ideation

A notable study evaluating the anti-suicidal efficacy of repetitive TMS (rTMS) in patients with depressive disorders reported that out of 711 patients treated over a 15-year period, only one patient (0.1%) committed suicide during the course of treatment [4]. These findings imply that TMS is not only safe but may reduce suicide risk when integrated as part of a broader treatment protocol for depression [4]. In a subsample analysis of 332 patients using the Hamilton Depression Rating Scale (HAM-D), 47% of patients showed improvement in suicidality, while 41.3% exhibited no change, and 11.7% experienced an increase in suicidality score. This increase in suicidality scores is solely due to improper application of TMS specifically, a failure to target the brain regions responsible for suicidal ideation. While TMS has proven effective in reducing suicidality, its therapeutic success depends on precise anatomical and functional targeting.

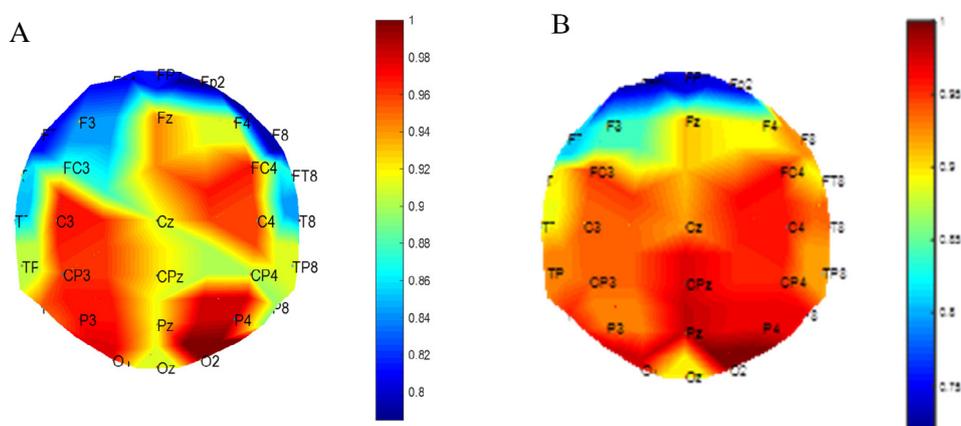
### Symptom-Based Targeting vs. Dysfunction-Based Targeting in TMS

In current practice, clinicians often rely on symptom-based heuristics to guide stimulation e.g. always targeting the left DLPFC for depression, without confirming whether the brain region is actually dysfunctional in a given patient. This approach neglects individual neurophysiology and accounts for cases where TMS appears ineffective or even exacerbates suicidality.

Both SPECT and EEG scans can indicate dysfunctional brain regions that may trigger high risk of suicide [5,6]. Our recent analysis performed in private psychiatric clinics demonstrates that using symptom-based targeting alone is insufficient. To improve outcomes, brain scanning should be integrated before TMS to accurately identify and treat dysfunctional brain areas, which will likely reduce suicidality score in over 90% of patients. By precisely targeting brain dysfunction, the electromagnetic stimulation (repetitive TMS) triggers self-healing, much like a hydrogel aids skin repair [6-9]. This paradigm shift from symptomatic to precise targeted-driven neuromodulation is essential for reducing treatment-resistant cases and improving suicide prevention in clinical psychiatry.



**Figure 2: A. Elevated Suicide Risk Persists After A Five-Year Period of Both Electroconvulsive Therapy (ect) and Medication. The Dysfunction at p8, Brodmann area 37 that Includes the Fusiform Gyrus in Red Color Can Trigger High Risk of Suicide [10]. b. The Risk of Suicide was Eliminated After Precise tms Therapy Targeted the Location of Brain Dysfunction.**



**Figure 3: A Severe depression at baseline, with non-remission status (HRSD score of 25 and suicide risk level 2). The dysfunction can be observed in the right DLPFC and in the right occipito-parietal region, see the dark red color at electrodes F4, Fc4, P4 and O2. The stimulation of left dorsolateral prefrontal cortex (DLPFC) at F3 site targets a healthy region. (B). Three months after stimulation, the dysfunction can be detected in the right hemisphere The stimulation of the healthy region has worsened the severity of depression HRSD=31 and increased suicide risk level to 3.**

Targeting Method	Input	Outcome
Symptom-Based Targeting	Diagnosis (e.g., MDD)	Probabilistic improvement
Dysfunction-Based Targeting	EEG/SPECT (e.g., abnormal activity at P8)	Precision therapy, higher success rate

### Consequences

- **Mis-targeting** may result in:
  - Partial or no response to treatment
  - Worsening of symptoms, including suicidality in rare cases
- **Patients labeled "non-responders"** may in fact have never received TMS to the region causing their symptoms.

### Estimated Costs for TMS Treatment

TMS treatment in the United States has become increasingly accessible, as its use has expanded into clinical practice for depression and suicidality. According to recent cost analyses, the average cost of a single TMS treatment session in the United States ranges between \$250 and \$300. A typical treatment course consists of approximately 30 sessions and the total cost per patient for a full course of TMS treatment is estimated at between \$7,500 and \$9,000. Even a moderate reduction in suicide risk if applied to a large, high-risk population can yield substantial public health benefits. In economic terms, if TMS treatment prevents even one suicide in a cohort of several hundred patients, the cost savings (when considering the lost productivity factors) are considerable relative to the treatment cost.

Parameter	Value	Notes
Cost per TMS Session	\$250 – \$300	US average estimation
Number of Sessions per treatment Course	Approximately 30	Standard treatment protocol
Total Cost per course Treatment	\$7,500 – \$9,000	Estimated overall cost

**Table 2: Summary of TMS Cost**

Mann et al. (2021) emphasized that evidence-based psychiatric strategies, including TMS and cognitive behavioral therapy (CBT), reduce suicide mortality in both acute and chronic presentations more reliably than location-specific physical barriers [11]. Moreover, Gupta et al. (2024) questioned the policy rationale of funding high-cost infrastructure interventions when public mental health systems are underfunded and under-accessed [12]. In their critique, they argue that bridge barriers serve symbolic rather than systemic solutions. Januel et al. (2022) added that such interventions do not scale well in urban environments with multiple potential jump sites, diluting their impact further [13].

## Discussion

The real issue lies in fragmented debates on minor issues within academic literature rather than a unified psychiatric consensus. We continue to invest millions e.g. \$20 million for suicide barriers in Vancouver when more impactful alternatives are ignored. That same funding could establish at least 100 TMS/EEG clinics. Why don't clinicians unite to oppose such disproportionate spending, given the limited impact on community mental health? Cost-effectiveness models support this critique. A single TMS-EEG clinic could potentially treat thousands of high-risk patients over a decade, many of whom are unlikely to seek help without active outreach [14]. Clinical screening and TMS access in primary care and outpatient psychiatric settings have proven more scalable, with greater return on investment in terms of disability-adjusted life years averted [15]. Additionally, bridge barriers do not alter the underlying psychopathology that leads to suicide, nor do they prevent suicides by other means or in private locations.

This concern is particularly urgent when considering that 160 out of every 1600 patients treated annually in a TMS center may be classified as high suicide risk, especially those with treatment-resistant depression. Chammas et al. (2022) emphasized that the majority of inpatient suicides occur among individuals who deny suicidal ideation, making reliance on physical prevention alone insufficient [13]. In contrast, TMS has shown significant efficacy in reducing suicidal ideation among patients who have not responded to medication or psychotherapy [1]. The installation of bridge barriers may reduce suicides at specific sites; however, it will obscure critical signals of unmet mental health needs in a community. By eliminating visible hotspots, a false sense of resolution is generated while underlying psychiatric issues remain unaddressed and worsen over time. This is akin to disabling a car's check engine light without fixing the engine itself: the warning sign disappears; however, the problem continues to deteriorate with more severe consequences (CTV News, 2025). With barriers in place, without timely and effective mental health therapy, suicide risk can escalate from self-harm to potential harm to others.

## Conclusion

The ethical landscape favors individualized psychiatric intervention. While barriers passively restrict means, TMS improves medical recovery. According to Gupta et al. (2024), overreliance on environmental controls ignores the structural gaps in psychiatric service delivery, particularly in low-resource areas [12]. Importantly, mental health infrastructure such as TMS centers can adapt to shifting demographic and epidemiological trends, while barriers are static and inflexible once built.

In conclusion, while bridge barriers may prevent some deaths at known hotspots, their impact on overall suicide prevalence is limited and context-dependent. Framing suicide as an impulsive act has overemphasized the effectiveness of physical barriers on bridges, while neglecting deeper issues, the failure of adequate mental health care and the harm caused when physical interventions replace or obscure the need for accessible, effective therapy.

The literature increasingly supports reallocation of resources toward scalable, clinically effective interventions like TMS, particularly for high-risk populations already engaged in the healthcare system. Therefore, suicide prevention strategy has to evolve beyond symbolic deterrence toward systemic psychiatric care capable of reaching those most in need.

**Note:** While AI holds immense potential, it can inherit and amplify biases present in peer-reviewed literature. This particular paper, developed with AI assistance, highlights the need for critical oversight when using AI to interpret mental health issues.

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