WHITE PAPER/POLICY BRIEF:

*Emerging Best Practices and Innovation in Suicide Prevention:
Toward an Updated Statewide Strategic Plan for California*[1]

Rebecca A. Bernert, PhD
Assistant Professor, Department of Psychiatry and Behavioral Sciences
Director, Suicide Prevention Research Laboratory
Stanford University School of Medicine

Suicide Risk, Rates, Prevalence

Worldwide. Suicide is a preventable public health problem and global disease burden, accounting for nearly 800,000 deaths annually.[1] Although significant differences exist by country, region, and access to means, suicide is a leading cause of death worldwide. The highest suicide rates occur in late life, whereas suicide ranks as the second leading cause of death among young adults globally (ages 15-29). Due to a lack of standardization in reporting procedures for death registries, as well as social, religious, and legal considerations influencing the accuracy of surveillance, such numbers are expected to represent a gross underestimate of true prevalence. Suicide attempts far exceed the number of suicide deaths, and represent a crucial opportunity for intervention. Given the profound impact of suicidal behaviors on the individual, family, community, economy, and society as a whole, the prevention of suicide has been named a national and global imperative.[1-2] This has motivated comprehensive strategies to improve awareness, advance research, and enhance access to care in the prevention of suicide.

Nationally. Suicide accounts for 44,193 American lives lost annually, representing 57% of all violent deaths.[3-4] This figure outnumbers homicide deaths and recently surpassed annual motor vehicle accident fatalities.[5] Despite unprecedented advancements in awareness and treatment, suicide rates appear intractable over time, and recently increased in the U.S. Deaths by suicide increased by 24% (10.5 to 13/100,000) 1999-2014, with the greatest rise among females, aged 10-14, and males, aged 45-64.[6] Nearly 50% of all suicides occur by firearm, whereas the majority of non-lethal suicide attempts occur by overdose.[3-4] Males attempt suicide at approximately four times the rate of females, accounting for 77% of suicide deaths.[3] Though suicide occurs across all demographic groups, the highest rates are observed among those aged 45-64 and 85 and older, with risk especially elevated among Whites and American Indians/Alaskan Natives.[4] Across all ages, White males account for 7 of 10 suicides in the U.S. Regarding regional differences, higher suicide rates are observed in mountain states and rural areas with reduced access to care and increased access to firearms,[4,7-9] resulting in national and state strategies focused on firearm safety.[10-11] The Institute of Medicine (IOM) further estimates that an additional 25 suicide attempts (100-200 for youth) occur for every suicide death, accounting for nearly 500,000 emergency room visits annually.[2-3]

State-Wide. In California, suicide is the 11th leading cause of death, resulting in 4,167 lives lost per year.[12] Significant disparities in suicide rates exist based on race, age, and gender, which significantly vary by method, region, and health care access. Commensurate with national statistics, the highest suicide rates are observed among middle aged and older adults, whereas suicide ranks as the 2nd and 3rd cause of death among those aged 25-34 and 10-24, respectively.[13] Suicide has emerged as a public health emergency in California, following several clusters of youth suicides that have occurred locally.[14-16] This prompted a recent CDC investigation, new legislature for school-based suicide prevention and postvention practices, multi-pronged training and prevention strategies, as well as recommendations to utilize multi-agency-supported media guidelines[17] and prioritize increased research.[14,18] Heightened risk for suicide is also observed among those interacting with the criminal justice system, where rates are higher relative to the general population. Finally, risk is elevated among those homeless or underserved, immigrants or refugees, veterans, and those who identify as LGBTQ.[19] Similar to across the U.S., the majority of suicides in California occur by firearm (42%), suffocation (27%), poisoning (19%), fall (4%), cutting (2%), drowning (1%), or by other means (5%).[13]

Impact and Inherent Challenges

Impact and Costs. Based on the profound suffering and impact of suicide at the level of the individual, family, community, and society, a social-ecological model guides public health strategies for prevention.[1] Regarding impact to the economy, the CDC estimates that suicide costs the U.S. approximately $51 billion.[3] Recent estimates, which adjust for underreporting, increase this number to $93.5 billion.[20] In California, $4.2 billion is estimated for combined medical and work loss costs associated with suicidal behaviors, or an estimated $1,085,227 per suicide death.[12] Beyond the inestimable costs to the family, community, and those directly impacted by suicide, highly favorable benefit-cost ratios are noted for investment in medical and linkage services, with enhanced continuity of care following a suicide attempt or admission prioritized.[20]

Prevention Models. In 2012, the World Health Organized (WHO) proposed a Public Health Model for Suicide Prevention, which consists of four areas of recommended focus: (1) *Surveillance of the Problem*, (2) *Identification of Suicide Risk and Protective Factors*, (3) *Development and Testing of Interventions*, and (4) *Implementation,* including the scaling up of interventions, programs and policies (WHO).[1]

Inherent Challenges. Despite this, a number of inherent *methodological, ethical, clinical*, and *statistical challenges* within suicide prevention critically impact advancements in each of these four areas. First, although a leading cause of death, suicide occurs rarely in the population, which poses challenges to prediction and prevention. Second, rates vary by a complex interplay of risk and protective factors, which may vary substantially over time and by risk factor. This presents need for longitudinal, population-based investigations or targeted evaluations of high suicide risk groups, which may be challenged by infrastructural barriers. Third, ethical issues, such as confidentiality and liability concerns, influence disclosure and accurate detection of risk, and a lack of uniformity in risk assessment may reduce comparability in research. Next, given distinct methodological considerations, risk surveillance demands an infrastructural need that is substantial and cost-prohibitive, including comprehensive data and safety monitoring to guide emergency management. Typically, this must be developed on a site-by-site basis, which may be mismatched to a relative scarcity of trained specialists. To this end, interventions tested for the prevention of high risk outcomes remain scarce in comparison with public health need and the extent to which suicide reflects a global disease burden.

Nomenclature and Risk Assessment

Suicidology remains challenged by a lack of standardized nomenclature for suicidal behaviors, which impede accurate reporting, comparability in research and clinical practice, surveillance of suicidal behaviors, and treatment development. As a result, federal health agencies have called for uniform terminology in the assessment and monitoring of suicidal behaviors. The FDA now mandates administration of a standardized measure to assess suicide risk across all central nervous system (CNS) drug trials,[21-22] and the CDC has published a manual of uniform guidelines in the surveillance, research, and monitoring of suicidal behaviors.[23] This includes the following recommended definitions: (1) *suicidal self-directed violence*: self-directed behavior that deliberately results in injury or the potential for injury, where there is evidence of suicidal intent; and (2) *non-suicidal self-directed violence*: self-directed behavior that deliberately results in injury or the potential for injury, where there is no evidence of suicidal intent. This further distinguishes a *suicide attempt* from: an *interrupted attempt*, an *aborted attempt*, and *preparatory behaviors* (i.e., preparatory acts occurring before the potential for harm has begun; e.g., buying a firearm, collecting pills, etc.). In addition, the CDC suggests abandoned use of non-specific or potentially stigmatizing terms (e.g., *completed suicide, committed suicide, failed attempt, non-fatal suicide, parasuicide, successful suicide, suicidality, suicidal gesture or threat*) in place of other language to guide uniformity, precision, and comparability.[23] Aligned with this, the Columbia Suicide Severity Rating Scale (C-SSRS) aims to uniformly assess the severity and intent of suicidal ideation and behaviors.[24] In 2012, it was designated as the standard assessment measure for regulatory data collection in CNS clinical trials.[21] Though not without controversy,[22,26] this produced a critical mandate in suicide risk assessment and a growing body of research in drug safety and development. The C-SSRS has since been adopted by major health agencies at both the state and national level, translated into multiple languages, and tested across cross-cultural samples. While adherence to CDC guidelines is unknown, findings show that a lack of consensus also exists across clinical practice parameters used internationally by multidisciplinary health specialties.[26] This highlights the need for additional research regarding how such variability may impact training, and prevention. Importantly, research investigating universal screening approaches, such as in emergency department (ED) settings, indicate that the use of standardized screening methods, including across diverse healthcare systems and hospitals, significantly increases detection of suicide risk (i.e., by 2-fold) and intervention opportunity. (For review, see ED-SAFE studies; Am J Prev Med 2016;40(5):445-453; JAMA Psychiatry 2017;74(6):563-570).

Risk and Preventive Frameworks

Prevalence. Suicide is the complex outcome of medical illness, with lifetime suicide ideation observed among 3.1%-56% of the population.[27] By comparison, lifetime suicide attempts are estimated to occur among 0.4%-5.1% of the population, with elevated rates among those with a psychiatric diagnosis and chronic medical

conditions.[28-29] Research indicates that more than 90% of suicide decedents have a diagnosis at the time of death, with risk increasing in additive fashion with each additional medical condition.[30]

Warning Signs. The American Association of Suicidology (AAS) and American Foundation for Suicide Prevention (AFSP) have published the following warning signs of suicidal behaviors:[31-32] (1) *expressed or communicated ideation or plans to hurt oneself*; (2) *increased substance use*; (3) *espousing few reasons for living*; (4) *anxiety, panic, or agitation*; (5) *inability to sleep or oversleeping*; (6) *feeling trapped*; (7) *persistent feelings of hopelessness*; (8) *social withdrawal*; (9) *uncontrolled anger or rage*; (10) *acting reckless, or engaging in risky activities*; (11) *feelings of guilt, shame, or self-blame*; (12) *appearing sad or depressed*; or *exhibiting changes in mood*; and (13) *making plans or preparations for an attempt* (i.e., researching or procuring means, giving away possessions). Though these may reflect symptoms of depression, other warning signs may be visible even when depression or a psychiatric condition is not.

Risk and Protective Factors. A diverse interplay of biological, psychological, social, and cultural variables are associated with suicidal behaviors, which may heighten or attenuate risk. Worldwide, men die by suicide at approximately four times the rate of women, with China as an exception.[1] This is heavily influenced by method selection, where males tend to select more lethal means (e.g., firearms) for a suicide attempt relative to females. Additional risk factors[31-32] include: (1) *marital status* (e.g., unmarried, divorced, separated); (2) *employment status* (e.g., unemployed); (3) *ethnicity and cultural factors* (i.e., member of underrepresented, minority, or indigenous group); (4) *access to means*; (5) *previous suicide attempts/SDV*; (6) *family history of suicide*; (7) *psychiatric disorder* (e.g., depression, schizophrenia, SUD) or *chronic health condition*, (8) *early life stress* (e.g., child maltreatment), *recent life events* (e.g., divorce, job loss), and *prolonged stress* (e.g., bullying, relational problems); (9) *media exposure to graphic accounts of suicide*; (10) *non-suicidal self injury*; (11) *elevated pain tolerance or exposure*; (12) *sleep disturbances* (e.g., insomnia, nightmares); (13) *interpersonal factors* (e.g., hopelessness, low belongingness, perceiving self as burden); and (14) the *structure of suicidal symptoms* (i.e., resolved plans, intent vs. suicidal desire; symptoms that are intense, pervasive, and difficult to control). Given that depression presents highest risk for suicide, risk factors that stand alone to confer risk (i.e., independent of depression severity) are prioritized, especially those visible, proximal to risk, and modifiable.[2] Protective factors may include absence of such risk, as well as increased access to care, strong connections to family/ community, non-violent ways of handling conflict, cultural or religious beliefs that may discourage suicide, and restricted access to means. Best practices in suicide risk assessment utilize a transparent and collaborative approach to safety planning, including informed consent to the risk assessment process and the use of clinical decision trees to routinize risk designations. These are based on suicide attempt history, the severity of current suicidal symptoms, and integration of risk factors (See Brown & Stanley, 2008; VA Memorandum; Stanley & Brown, 2012).

Interventions. Interventions for suicide prevention may include primary, secondary, selective, or universal frameworks. *Primary interventions* focus on prevention of suicide incidence, as well as other factors that may increase risk. Whereas *secondary frameworks* may occur at any stage of risk, often focusing on early detection to improve intervention opportunity (e.g., primary care-based screening for depression). *Selective interventions* may include psychotherapy and pharmacological treatments for suicidal behaviors, while *Universal interventions* offer population-based strategies to reduce risk by universally promoting health or other factors. Interventions may range from individual treatments to peer or community outreach models; crisis helplines; safety monitoring; and service-oriented/healthcare systems-focused provisions (See ZeroSuicide.org).

Emerging State of the Science
The emerging state-of-the-science in suicidology centers on addressing critical gaps and problems in our existing scientific literature. As a non-exhaustive list, three examples are discussed to index recent advancements that may guide future public health strategy: (1) lethal means restriction, (2) treatment innovation, and (3) new technologies in risk detection and triage.

1. Lethal Means Restriction
Lethal means restriction is a universal strategy to limit access to means for a suicide attempt to prevent its occurrence in the general population. Central to our national strategic plan,[33] a large body of research indicates that reducing access to lethal means is among the most potent, underutilized approaches to suicide prevention.[34-36] This includes international evidence from multiple countries (e.g., U.S., Australia, Canada,

Japan, Sri Lanka, New Zealand, and multiple European countries), encompassing a wide range of interventions, from CO emission controls in vehicles, to suicide deterrent systems implemented on railways (i.e., locking platform screen doors, Hong Kong Subway) or bridges (e.g., Bern Muenster Terrace; Maine Memorial Bridge), as well as firearm safety and overdose prevention protocols (e.g., naloxone, blister packaging, etc.). Using bridge systems as an example, effectiveness is supported by a "reduction to zero" effect observed following implementation of a suicide deterrent system at sites where suicides are known to regularly occur.[35-36] Effects are both large and immediate subsequent to installation, and evidence does not support increases in suicides thereby occurring at other locations or by other methods.[37-38] Over 90% of those who attempt suicide do not go on to die by suicide,[39] and a positive impact in population suicide rates is observed in some cases.[36] Research likewise shows that suicides increase upon barrier removal (e.g., Grafton Bridge in NZ), which reduce to zero following re-installation.[37] Despite this, lethal means restriction remains underutilized as a public health strategy in need of a research and policy agenda.[40] In California, construction began for a suicide deterrent system on the Golden Gate Bridge, following more than 1,700 deaths at this location. Such systems present critical opportunities for data monitoring (i.e., pre- and post-implementation) to inform effectiveness and guide prevention strategies at other public structures in California, where fatalities persist (e.g., Coronado Bridge; The Bay Bridge). However, bridge and rail suicide deaths are not reported in a unified manner by individual sites, with information instead housed across multiple agencies (e.g., Caltrans, the CHP, federal rail authorities, county sheriff-coroners or medical examiners). While compiling such data is crucial to evaluating public health risk and policy need,[8,23] a centralized reporting system is not currently in place. Next, although Caltrans is required to consider suicide risk in the new design or redesign of California bridges, with federal funds accessible for construction,[41] applicable standards for this requirement do not currently exist to guide prevention and policy at other local structures or neighboring sites. Finally, death monitoring is not standardized across counties, nor are death records uniformly digitized—challenging real-time surveillance of suicidal behaviors and epidemiology. These reflect potential targets for future innovation.

2. Treatment Innovation
Multiple individual interventions reduce risk for suicide, including pharmacological (e.g., antidepressants, SSRIs, etc.) and psychotherapy treatments.[42-44] However, this largely relies on a treatment-by-proxy approach (e.g., depression treatment), with few selective agents tested for suicidal behaviors, specifically. By comparison, selective interventions—empirically tested for suicidal behaviors—remain alarmingly scarce or inaccessible to those in need. Compounding this problem, those at risk for suicide were historically excluded from clinical drug trials until recently,[22] limiting testing of new treatments among at-risk groups. Although selective psychosocial interventions (e.g., dialectical behavior therapy, cognitive behavior therapy) developed for suicidal behaviors show strong efficacy data (i.e., reducing risk by up to 50%),[44] dissemination and access to specialized care providers remain a significant barrier to wide-scale access, use, and adoption. In addition, the time required for therapeutic response to pharmacologic and psychotherapy treatments (i.e., weeks, months) remains mismatched to the acute nature of a suicidal crisis. This heightens the urgency to identify brief or rapid-action therapeutic agents for indication using novel treatment approaches. To this end, several clinical trials are underway, testing the efficacy of non-mental health treatments for suicide prevention, such as sleep treatments, based on growing evidence that underlying sleep complaints represent a risk factor and warning sign of suicide.[47-49] This includes brief, non-pharmacologic[45-46] and pharmacologic[47] insomnia treatments for suicidal behaviors among those at elevated risk. Such strategies highlight the call to target highly treatable risk factors using low-risk interventions to prevent suicide.[48] Additional areas of innovation include clinical trials testing the preliminary efficacy of rTMS and ketamine for anti-suicidal symptom response, as well as stigma reduction education, and means safety clinical trials focused on gun lock safe storage practices (See NCT026937, 03502551, 03646903, 03375099).

3. Risk Detection, Prediction, and Screening
Despite many known risk factors and warning signs for suicide, current risk variables show poor sensitivity in the prediction of suicidal behaviors. Emerging technologies thus pose new possibilities in risk detection, screening, and improved triage. Machine learning (ML) is a form of Artificial Intelligence (AI) that enables a computer to learn patterns without prior programming and devise complex algorithms to improve the accuracy of prediction.[50] Importantly, such algorithms perform optimally with big data or hundreds of variables, which are atheoretical in how relationships among variables may be learned. Such advancements

offer new opportunities for prevention within both public[51] and private industry[52] relevant to behavioral health outcomes. Facebook recently released a press briefing, noting real-time suicide prevention tools, which use AI to identify signs of risk with advanced options to enhance connection to additional services (e.g., in Facebook Live).[52] This poses unique promise to real-time safety monitoring, as well as research that may advance risk prediction. For example, a deep learning investigation of a large number of electronic health records significantly predicted new-onset conditions of rare occurrence with remarkable accuracy (i.e., >90%), such as new-onset cancers, diabetes, CHF, etc. [53] Applied to suicidal behaviors, preliminary reports evaluating the classification of suicide risk show promising findings using novel prediction strategies.[54] This includes the use of administrative records among military personnel to predict suicide risk, [55-56] natural language processing (NLP) to identify risk across diverse medical settings,[57-58] and social media posts to index elevated suicide risk among users.[59-60] Given that the majority of suicide decedents consult with their doctor in the weeks and months preceding death,[61] advanced options in data science may delineate new risk factors to enhance triage in the prevention of suicidal behaviors.

Conclusions and Summary
Such examples show the way in which emerging best practices may advance prevention and policy. Due to inherent challenges within suicide prevention, multidisciplinary collaborations are required, resulting in increased calls for private-public partnerships to advance suicide prevention initiatives. The National Institute of Mental Health (NIMH) includes an action plan with a central focus on collaboration.[62] This includes alignment with other national agencies, such as the National Action Alliance for Suicide Prevention and the American Foundation for Suicide Prevention, in support of a shared goal to reduce suicide rates by 20% in 10 years.[62-63] This builds upon recent data science initiatives in suicide prevention led by the White House, the U.S. Department of Veteran Affairs (VA), the National Institutes of Health (NIH), and the Department of Defense (DoD).[64] The need for shared data repositories to develop evidence-based screening tools and algorithms has also been prioritized.[63] This is motivated by research showing that low-risk screenings and interventions delivered in emergency settings improves identification and decreases risk for future suicide attempts.[65-67] Importantly, low-cost interventions (e.g., brief follow-up notes post-ED admission) significantly reduce suicide risk and health care costs,[68] which aligns with cost-effectiveness research in means restriction.[69]

In conclusion, recommendations include increased calls for multi-agency collaboration, identification of improved risk factors among high risk groups and settings where considerable health disparities exist, and the development of brief, low-cost interventions for suicidal behaviors. Given the impact of universal strategies in means restriction, improved data monitoring and implementation standards will aid understanding of public health impact, need, and policy. (See recent policy change related to mandated suicide prevention programming and required trainings for psychologists: CA Assembly Bill No. 89, Chapt. 182; Assembly Bill No. 2246, Chapt. 642). Additional research is warranted to evaluate the use and implementation of novel strategies for lethal means restriction and safety planning,[70-75] which remain under-utilized—despite emphasis across suicide prevention strategies globally. Finally, integration of new technologies and data analytics represent a central priority to enhance surveillance, data monitoring, and innovation in treatment—across all levels of prevention.

An Updated State-Driven Suicide Prevention Strategy
In 2008, the *CA Strategic Plan on Suicide Prevention*[76] was released by the former Department of Mental Health, which housed the CA Office of Suicide Prevention. This office was subsequently disbanded and is now represented by the Department of Health Care Services. Based on such changes, advancements in research and policy, and a national and local rise in suicide rates—an updated statewide suicide prevention strategy is needed. We recommend this build upon the previous *Strategic Plan* to evaluate the implementation status of past work, identify areas of need, and address key gaps in knowledge for prioritization. We suggest this align with national and global calls for increased research and partnerships, while specifically addressing fundamental barriers to prevention. As an economy, community, and leader in technology innovation, California is uniquely positioned to advance suicide prevention. A central emphasis on innovation in technology and research, community-driven partnerships, and collaboration between public and private industry is recommended. Bridging best practices with technology promises a foundational roadmap of statewide leadership to enhance risk detection, intervention, and surveillance in the prevention of suicide.

References

1. World Health Organization (WHO). *Preventing Suicide: A Global Imperative*. WHO Report. 2014. Geneva, Switzerland. News Release. First WHO Report on Suicide Prevention. Released on September 4, 2014. Accessed on October 8, 2017 at http://www.who.int/mediacentre/news/releases/2014/suicide-prevention-report/en/

2. Goldsmith SK, Pellmar TC, Kleinman AM, Bunney WE (Eds). Institute of Medicine (IOM) Report: Reducing Suicide: A National Imperative. Committee on Pathophysiology & Prevention of Adolescent & Adult Suicide, Board on Neuroscience and Behavioral Health. *The National Academies Press*. 2002. Washington DC.

3. National Center for Disease Control and Prevention, CDC. *Suicide Facts at a Glance: 2015*. Accessed October 11, 2017 at https://www.cdc.gov/violenceprevention/pdf/suicide-datasheet-a.pdf

4. Ivey-Stephenson AZ, Crosby AE, Jack S, Haileyesus T, Kresnow-Wedacca M. Suicide trends among and within urbanization levels by sex, race/ethnicity, age group, and mechanisms of death—United States, 2001-2015. Surveillance Summaries. Centers for Disease Control and Prevention, CDC. Morbidity and Mortality Weekly Report. *Surveill Summ 2017;66(No. SS#18):1-9.*

5. Rockett IRH, Regier MD, Kapusta ND, et al. Leading Causes of Unintentional and Intentional Injury Mortality: United States, 2000–2009. *American journal of public health.* 2012;102(11):e84-e92.

6. Curtin SC, Warner M, Hedegaard H. Increase in suicide in the United States, 1999–2014. NCHS data brief, no 241. Hyattsville, MD: National Center for Health Statistics. 2016.

7. Siegel M, Rothman EF. Firearm ownership and suicide rates among U.S. men and women, 1981-2013. *American Journal of Public Health; 2016. 106(7):1316-1322.*

8. Miller M, Azrael D, Barber C. Suicide mortality in the United Sates: the importance to attending to method in understanding population-level disparities in the burden of suicide. *Annu Rev Public Health; 2012;33:393-408*

9. Miller M, Lippmann SJ, Azrael D, Hemenway D. Household firearm ownership and rates of suicide across the 50 states. J Trauma: Injury, Infection, Crit Care. 2007; 62(4):1029-1035.

10. The Brady Campaign to Prevent Gun Violence [Online]. Accessed on October 9, 2017 at https://www.bradycampaign.org/

11. Harvard TH Chan School of Public Health. *Means Matter: The Gun Shop Project* [Online]. Accessed October 11, 2017 at https://www.hsph.harvard.edu/means-matter/gun-shop-project/

12. American Foundation for Suicide Prevention. Suicide: California 2017 Facts & Figures. Accessed October 10, 2017 at http://chapterland.org/wp-content/uploads/sites/10/2016/03/California-Facts-2017.pdf

13. National Center for Injury Prevention and Control, CDC. Data Source: NCHS Vital Statistics System for numbers of deaths. *WISQARS: Web-based Injury Statistics Query and Reporting System. (1999-2014).* Accessed October 8, 2017 at https://webappa.cdc.gov

14. Center for Disease Control and Prevention, CDC; Substance Abuse and Mental Health Services Administration, SAMHSA. *Epi Aid 2016-18: Undetermined risk factors for suicide among youth, ages 10-24—Santa Clara County, CA.* 2016.

15. News Release [News Article], *California Law Spurs Reforms after Suicide Cluster.* Published June 1, 2017 [Online]. Accessed October 13, 2017 at https://edsource.org/2017/spurred-in-part-by-new-california-law-clovis-unified-takes-team-approach-to-suicide-prevention/58234

16. News Release [News Blog]. *Yurok Tribe Declares Emergency after Rash of Suicides.* [Online] Published January 24, 2016. Accessed online on October 13, 2017 at https://www.northcoastjournal.com/NewsBlog/archives/2016/01/24/yurok-tribe-declares-emergency-after-rash-of-suicides

17. ReportingOnSuicide.org. *Recommendations for Reporting on Suicide* [Online]: 2011 Consensus Guidelines. 2011. Accessed on October 13, 2017 at http://reportingonsuicide.org/

18. Assembly Bill No. 2246, CHAPTER 642, Section 215. CHAPTER 2 OF PART 1 OF DIVISION 1 OF TITLE 1 OF THE EDUCATION CODE, RELATING TO PUPIL HEALTH. Approved by Governor September 26, 2016. Filed with Secretary of State September 26, 2016. Accessed [Online] on October 13, 2017 at http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB2246

19. U.S. Department of Health and Human Services, Office of the Surgeon General and National Action Alliance for Suicide Prevention. *2012 National Strategy for Suicide Prevention: Goals and Objectives for Action.* 2012. Accessed on October 11, 2017 at https://www.surgeongeneral.gov/library/reports/national-strategy-suicide-prevention/full-report.pdf

20. Shepard DS, Gurewich D, Lwin AK, Reed GA, Silverman MM. Suicide and suicide attempts in the United States: Costs and policy implications. 2016; Suicide and Life Threatening Behavior; 46(3):352-362.

21. United States Food and Drug Administration, United States Department of Health and Human Services. Guidance for Industry: Suicidality: Prospective Assessment of Occurrence in Clinical Trials, Draft Guidance. August 2012. Revision 1. http://www.fda.gov/downloads/Drugs/Guidances/UCM225130.pdf Accessed March 23, 2017.

22. Meyer RE, Salzman C, Youngstrm EA, Clayton PJ, Goodwin FK, Mann JJ, Alphs LD, Broich K, Goodman WK, Greden JF, Meltzer HY, Normand SL, Posner K, Shaffer D, Oquendo MA, Stanley B, Trivedi MH, Turecki G, Beasley CM Jr, Beautrais AL, Bridge JA, Brown GK, Revicki DA, Ryan ND, Sheehan DV. Suicidality and risk of suicide: definition, drug safety concerns, and a necessary target for drug development: a consensus statement. J Clin Psychiatry. 2012; 71(8):e1-e21.

23. Crosby AE, Ortega L, Melanson C. Self-directed violence surveillance: uniform definitions and recommended data elements, version 1.0. Atlanta (GA): Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. February 2011.

24. Posner K, Brown GK, Stanley B, Brent DA, Yershova KV, Oquendo MA, Currier GW, Melvin GA, Greenhill L, Shen S, Mann JJ. The Columbia-Suicide Severity Rating Scale: initial validity and internal consistency findings from three multi-site studies adolescents and adults. Am J Psychiatry. 2011. 168(12):1266-1277.

25. Sheehan DV, Giddens JM, Sheehan KH. Current assessment and classification of suicidal phenomena using the FDA 2012 Draft Guidance Document on Suicide Assessment: A critical review. Innov Clin Neurosci. 2014;11(9-10):54-65.

26. Bernert RA, Hom MA, Roberts LW. A Review of Multidisciplinary Clinical Practice Guidelines in Suicide Prevention: Toward an Emerging Standard in Suicide Risk Assessment and Management, Training and Practice. *Academic Psychiatry*. 2014;38(5):585-592.

27. Nock MK, Borges G, Bromet EJ, Alonso J Angermeyer M, Beautrais A, Bruffaerts R, Chiu WT, de Girolamo G, Gluzman S, de Graaf R, Gureje O, Haro JP, Huang Y, Karam E, Kessler RC, Lepine JP, Levinson D, Medina-Mora ME, Ono Y, Posada-Villa J, Williams D. Cross-national prevalence and risk factors for suicidal ideation, plans and attempts. *British J Psychiatry*. 2008;192:98-105.

28. Weissman MM, Bland RC, Canino GJ, Greenwald S, Hwu HG, Joyce PR, Karam EG, Lee CK, Lellouch J, Lepinine JP, Newman SC, Reubio-Stipec M, Wells JE, Wickramaratne PJ, Wittchen HU, and Yeh EK. Prevalence of suicide ideation and suicide attempts in nine countries. *Psychological Medicine*, 1999;29, 9–17.

29. Bertolote, J.M, Fleischmann, A., De Leio, D., Bolhair, J., Botega, N., De Silva, D., Thanh, H., Phillips, M., Schlebusch, L., Varnik, A., Vijayakumar, L., Wasserman, D. (2005). Suicide attempts, plans, and ideation in culturally diverse sites: the WHO SUPRE-MISS community survey. *Psychological Medicine, 1457-1465*.

30. Cavanagh JT, Carson A, Sharpe M, Lawrie SM. Psychological autopsy studies of suicide: a systematic review. *Psychol Med; 2003. 33, 395-405*.

31. American Association of Suicidology (AAS). Suicide Warning Signs. Accessed on October 8, 2017 at http://www.suicidology.org/resources/warning-signs

32. American foundation for Suicide Prevention (AFSP). Risk Factors and Warning Signs. Accessed on October 8, 2017 at https://afsp.org/about-suicide/risk-factors-and-warning-signs/

33. U.S. Department of Health and Human Services, Office of the Surgeon General and National Action Alliance for Suicide Prevention. *2012 National Strategy for Suicide Prevention: Goals and Objectives for Action*. 2012. Accessed on October 11, 2017 at https://www.surgeongeneral.gov/library/reports/national-strategy-suicide-prevention/full-report.pdf

34. Yip PS, Caine E, Yousuf S, Chang S, Wu KC, Chen Y. Means restriction for suicide prevention. Lancet. 2012; 379(9834):2393-99.

35. Pirkis J, Spittal MJ, Cox G, Robinson J, Cheung YTD, Studdert D. The effectiveness of structural interventions at suicide hotspots: A meta-analysis. International J Epidemiology. 2013; 42(2):541-5.

36. Cox GR, Owens C, Robinson J, Nicholas A, Lockley A, Williamson M, Pirkis J. Interventions to reduce suicides at suicide hotspots: A systematic review. BMC Public Health. 2013; 13(1):214-218.

37. Beautrais AL, Gibb SJ, Fergusson DM, Horwood LJ, Larkin GL. Removing bridge barriers stimulates suicides: an unfortunate natural experiment. Aust N Z J Psychiatry. 2009; 43(6):495-7.

38. Law CK, Sveticic J, De Leo D. Restricting access to a suicide hotspot does not shift the problem to another location. An experiment of two river bridges in Brisbane, Australia. Aust N Z J Public Health. 2014; 38(2):134-8.

39. Rosen, D.H. Suicide survivors. A follow-up study of persons who survived jumping from the Golden Gate and San Francisco–Oakland Bay Bridges. *West. J. Med.* **1975**, *122*, 289–294

40. Barber CW, Miller MJ. Reducing a suicidal person's access to lethal means of suicide: A research agenda. Am J Prev Med. 2014; 47(3S2):S264-272.

41. Surface Transportation Block Grant Program (STBG). Federal Highway Administration (FHWA). CA GOVERNMENT CODE, TITLE 2, CHAPTER 2, SEC 14527.1 and 23 USC 133(b)7). [*The STBG promotes flexibility in State and local transportation funding decisions to best address State and local transportation needs.* (FAST Act § 1109(a))]

42. Mann, J.J.; Apter, A.; Bertolote, J.; Beautrais, A.; Currier, D.; Haas, A.; Hegerl, U.; Lonnqvist, J.; Malone, K.; Marusic, A.; *et al.* Suicide prevention strategies: A systematic review. *JAMA* 2005, *294*, 2064–2074.

43. Brent DA, McMakin DL, Kennard BD, Goldstein TR, Mayes TL, Douaihy AB. Protecting Adolescents From Self-Harm: A Critical Review of Intervention Studies. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2013;52(12):10.1016/j.jaac.2013.09.009. doi:10.1016/j.jaac.2013.09.009.

44. Calati R, Courtet P. Is psychotherapy effective for reducing suicide attempt and non-suicidal self-injury rates? Meta-analysis and meta-regression of literature data. J Psychiatr Res. 2016;79:8-20.

45. NCT01770587: *A Sleep-Oriented Intervention for Suicidal Behaviors*. Sponsor: The National Institutes of Health (NIH), The National Instiute of Mental Health (NIMH). Site: Stanford University. PI: Bernert.

46. NCT002248675: *An Adjunctive Behavioral Sleep Intervention to Prevent Veteran Suicides*. Sponsor: The VA Office of Research and Development. Site: Syracuse University. PI: Pigeon.

46. NCT01689909: *Reducing Suicidal Ideation through Insomnia Treatment*. Sponsor: The National Institutes of Health (NIH), The National Instiute of Mental Health (NIMH). Site: Augusta University. PI: McCall.

47. Bernert RA, Kim JK, Iwata NG, Perlis ML. Sleep disturbances as an evidence-based suicide risk factor. Curr Psychiatry Rep. 2015;17(3):554.

48. Bernert RA, Hom M, Iwata N, Joiner TE (in press). Objectively-assessed sleep variability as an acute warning sign of suicidal ideation in a longitudinal evaluation of high suicide risk young adults. *J Clin Psychiatry. 2017;78(6):e678-687*.

49. Pigeon W, Pinquart M, Conner K. Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. *J Clin Psychiatry. 2012;73(9):e1160-7*.

50. James G, Witten D, Hastie T, Tibshivani R (Eds). *An Introduction to Statistical Learning: with Applications in R*. Springer Publishing, 2013. New York.

51. News Release. HHS Substance Absue and Mental Health Services Administration Leverages tiag® Expertise in Clinical Informatics, Behavioral Health and Artificial Intelligence. *Released September 6, 2017*. Accessed on October 9, 2017 at http://tiag.net/hhs-substance-abuse-and-mental-health-services-administration-leverages-tiag-expertise-in-clinical-informatics-behavioral-health-and-artificial-intelligence/

52. News Release, Facebook Newsroom. Building a Safer Community with New Suicide Prevention Tools. Released March 1, 2017. Accessed at https://newsroom.fb.com/news/2017/03/building-a-safer-community-with-new-suicide-prevention-tools/

53. Miotto R, Li L, Kidd BA, Dudley JT. Deep Patient: An Unsupervised Representation to Predict the Future of Patients from the

Electronic Health Records. *Scientific Reports*. 2016;6:26094.

54. Kessler RC, Hwang I, Hoffmire CA, et al. Developing a practical suicide risk prediction model for targeting high-risk patients in the Veterans health Administration. Int J Methods Psychiatr Res. 2017;26:e1575.

55. Kessler RC, Stein MB, Petukhova MV, et al. Predicting suicides after outpatient mental health visits in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Molecular psychiatry*. 2017;22(4):544-551.

56. Kessler RC, Warner LCH, Ivany LC, et al. Predicting U.S. Army suicides after hospitalizations with psychiatric diagnoses in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *JAMA psychiatry*. 2015;72(1):49-57.

57. Pestian JP, Grupp-Phelan J, Bretonnel Cohen K, Meyers G, Richey LA, Matykiewicz P, Sorter MT. A Controlled Trial Using Natural Language Processing to Examine the Language of Suicidal Adolescents in the Emergency Department. Suicide Life Threat Behav, 2016;46: 154–159.

58. McCoy TH, Castro VM, Roberson AM, Snapper LA, Perlis RH. Improving Prediction of Suicide and Accidental Death After Discharge From General Hospitals With Natural Language Processing. *JAMA Psychiatry*.2016;73(10):1064–1071.

59. Cheng Q, Li TM, Kwok C-L, Zhu T, Yip PS. Assessing Suicide Risk and Emotional Distress in Chinese Social Media: A Text Mining and Machine Learning Study. Eysenbach G, ed. *Journal of Medical Internet Research*. 2017;19(7):e243.

60. Braithwaite SR, Giraud-Carrier C, West J, Barnes MD, Hanson CL. Validating Machine Learning Algorithms for Twitter Data Against Established Measures of Suicidality. Bamidis P, ed. *JMIR Mental Health*. 2016;3(2):e21.

61. Juurlink DN, Herrmann N, Szalai JP, Kopp A, Redelmeier DA. Medical Illness and the Risk of Suicide in the Elderly. Arch Intern Med. 2004;164(11):1179-1184.

62. National Action Alliance for Suicide Prevention: Research Prioritization Task Force. (2014). A prioritized research agenda for suicide prevention: An action plan to save lives. Rockville, MD: National Institute of Mental Health and the Research Prioritization Task Force.

63. Director's Message [Blog], National Institute of Mental Health (NIMH), National Institutes of Health (NIH). Suicide Prevention: Next Steps. Released on September 15, 2017. Accessed at https://www.nimh.nih.gov/about/director/messages/2017/suicide-prevention-next-steps.shtml

64. The White House Office of Science and Technology Policy, The National Institutes of Health, The U.S. Department of Veteran Affairs. *Open Data and Innovation for Suicide Prevention: #MentalHealthHackathon*. Boston, MA; Chicago, IL; San Francisco, CA; New York City, NY; Washington DC. December 12, 2015.

65. Carter GL, Clover K, Whyte IM, et al: Postcards from the EDge: 5-year outcomes of a randomised controlled trial for hospital-treated self-poisoning. British Journal of Psychiatry. 2013;202:372–380.

66. Brown GK, Ten Have T, Henriques GR, et al: Cognitive therapy for the prevention of suicide attempts: a randomized controlled trial. JAMA. 2005;294:563–570.

67. Miller IW, Camargo CA Jr, Arias SA, Sullivan AF, Allen MH, Goldstein AB, Manton AP, Espinola JA, Jones R, Hasegawa K, Boudreaux ED, ED-SAFE Investigators. Suicide prevention in an emergency department population: The ED-SAFE Study. JAMA Psychiatry, 2017;74(6):563-570.

68. Denchev P, Pearson JL, Allen MH, Claassen CA, Currier GW, Zatzick DF, Schoenbaum M. Modeling the cost-effectiveness of interventions to reduce suicide risk among hospital emergency department patients. Psychiatric Services, 2017; Epub ahead of print: September 15, 2017.

69. Whitmer D, Woods DL. Analysis of the cost effectiveness of a suicide barrier on the Golden Gate Bridge. 2012; Crisis; 34(2):98-106

70. Grossman DC, Mueller BA, Riedy C, Dowd MD, Villaveces A, Prodzinski J, Nakagawara J, Howard J, Thiersch N, Harruff R. Gun Storage Practices and Risk of Youth Suicide and Unintentional Firearm Injuries. *JAMA*.2005;293(6):707–714. doi:10.1001/jama.293.6.707

71. Barkin SL, Finch SA, Ip EH, et al. Is Office-Based Counseling About Media Use, Timeouts, and Firearm Storage Effective? Results From a Cluster-Randomized, Controlled Trial. *Pediatrics*. 2008;122(1):e15-e25.

72. Oliva EM, Chistopher ML, Wells D, et al, Veterans Health Administration Opioid Overdose Education and Naloxone Distribution National Support and Development Workgroup. Opioid overdose education and naloxone distribution: Development of the Veterans Health Administration's national program. J Am Pharm Assoc, 2017; 57(2S):S168-S179.

73. Betz ME, Miller M, Barber C, et al. Lethal means access and assessment among suicidal emergency department patients. *Depression and anxiety*. 2016;33(6):502-511. doi:10.1002/da.22486.

74. Boudreaux ED, Camargo CA, Arias SA, et al. Improving Suicide Risk Screening and Detection in the Emergency Department. *American journal of preventive medicine*. 2016;50(4):445-453. doi:10.1016/j.amepre.2015.09.029.

75. Stanley B, Brown GK. Safety planning intervention: A brief intervention to mitigate suicide risk. Cognitive Behav Pract. 2012;19: 256– 264.

76. California Department of Mental Health (DMH), Health and Human Services Agency. *California Strategic Plan on Suicide Prevention: Every Californian is Part of the Solution*. (2008). Approved by the Governor's Office of the State of California on June 30, 2008. Accessed on October 6, 2017 at http://www.sprc.org/sites/default/files/California_CalSPSP_V92008.pdf