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Understanding The Positive Correlates Of Veteran Suicide: A Review And Call For Research

Kevin R. Driscoll
driscollk7@gmail.com

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Kevin Robert Driscoll

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Laura K. Andrews

Laura K. Andrews, PhD, APRN, ACNP-BC

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Understanding the positive correlates of veteran suicide: a review and call for research

Kevin R. Driscoll[a*], Judith Welsh[b], Laura K. Andrews[c], Ruth McCorkle[d]

a National Institutes of Health, Bethesda, Maryland, USA & Yale University, School of Nursing, New Haven, Connecticut, USA

b NIH Library, Division of Library Services, Office of Research Services, National Institutes of Health, Bethesda, Maryland, USA

c, d Yale University, School of Nursing, New Haven, Connecticut, USA

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Abstract

The Veterans Administration is facing an epidemic amongst its population and is looking for novel ways to ensure "no solider is left behind" despite a complex data structure that makes it hard to extrapolate rates of suicide.

An epidemiologic approach grounded in the understanding of patterns as well as identifying the risk factors for suicide is at the epicenter for a population health approach. It is the understanding of the positive correlates for veteran suicide that provide an opportunity to ensure resources and policy intersects to advocate and allocate resources appropriate for geographically defined populations. Advanced modeling technologies, such as geographic information systems (GIS), shows promise as a solution for a population health approach to the epidemic of veteran suicide to look at the system as a whole rather than the individual parts.

Keywords: Veterans, Suicide, Health Risk, Mental Health, GIS,

1. Introduction

Advancements in trauma medicine and refinement of the "golden hour" of care have fulfilled our promise to our troops to provide cutting-edge treatment in their hour of need. It is through these advances that battlefield mortality has substantially decreased, yet beyond their hour of need it appears we fail veterans in the prevailing months, years, and decades as it relates to easing the burden of their sacrifices (Russ et al., 2015). This failure is veiled by the complex physiologic response to stress, pain, trauma, and coping coupled with our naïve understanding of the association between these variables. Although these variables can and have been studied in seclusion, it appears that each are positively correlated with suicide. Veterans compromise 7% of the United States population yet account for 20% of suicides (Department of Veteran Affairs, 2013). The conflicts in Iraq (Operation Iraqi Freedom (OIF)) and Afghanistan (Operation Enduring Freedom (OEF)) have raised awareness to a growing epidemic of poorly understood suicide in the veteran population which is compounded by the multiple physiologic

manifestations of stress born out of our success to rescue what was once a battlefield casualty.

2. Background

In 2012, suicide was the number one cause of death among US troops (Department of Veteran Affairs, 2012). In fact, more US soldiers, airmen, seamen, and marines died by their own hands than in battle (Clement, 2012). An often-quoted, yet misinterpreted, suicide study by the Department of Veteran Affairs (2013) has pinned the number at 22 veteran suicide deaths per day. A critical appraisal of this study indicates that, as alarming as this study is, it may not accurately reflect the magnitude of the problem, especially in the OEF and OIF populations. In fact, the study found that the majority of suicides is among the 50-year-old and older population, which is not the main demographic of OEF and OIF. When these data are compared against Kaiser Family Foundation (KFF) and Washington Post polls of OEF and OIF veterans (N=819), the KFF reported that 51% of the respondents know a service member who has attempted or committed suicide (KFF, 2014). This begs the question as to reliability of reported suicide data, and personal communication with the Department of Veterans Affairs (VA) echoes that same concern. What is known is that there is a growing problem of suicide in the veteran population (Kang and Bullman, 2001; Kaplan, et al., 2007).

The studies of veteran suicides have been hampered by incomplete and mischaracterized data as well as logistics for data sharing agreements between agencies and localities. The National Death Index (NDI) is encumbered by lengthy delays and the need for VA population lists to cross-check for cause of death verification, veteran status, etc. In addition, VA Secretary Shinseki's request for state collaboration has identified variability in state level data in which misclassification was considerably higher among validated veterans, female veterans, those younger and unmarried, and veterans with lower levels of education (Department of Veteran Affairs, 2013). Such misclassification decreases sensitivity of research in certain sub-groups, leading to underestimates and decreases the generalizability of study findings while increasing the external validity threats of such research.

Several studies have explored suicide in the veteran population (Kang and Bullman, 2009; Ursano et al., 2015) yet there has not been a review analysis of the positive correlates to suicide in veterans to assimilate the mounting body of knowledge across medical ailments. The collective understanding of the independent variables which form an *at-risk group* may provide insight to both individual and population approaches to healthcare delivery. In addition, the convergence of Electronic Health Records (EHR) and novel applications of technology may help inform the allocation, distribution, and utilization of healthcare resources. Since suicide rates in the Veteran's Health Administration (VHA) remain high yet stable, compared to the general population, a strong population approach call to action requires novel approaches to ensure no veteran is left behind. In this paper, we examine the correlates of veteran suicide from evidence-based literature at the individual level and propose a call for population-based research using GIS analyses.

3. Method

The literature was searched for articles focused exclusively on veterans, suicide, and positively correlated health variables/risks. PubMed, EMBASE, PsycINFO,

CINAHL Plus, and Scopus databases were searched to capture relevant published studies on factors associated with suicide in veterans. The searches were not limited by publication year. Principal keywords encompassed key concepts and terms garnered from literature of predictive modeling for risk of suicide in the veteran population to included veterans, military personnel, suicide, warfare, post-traumatic stress, traumatic brain injury, substance abuse, and mental disorders. The search strategies as reported in Appendix 1 were adapted to accommodate the unique searching features of each database, including database-specific MESH and EMTREE controlled vocabulary terms as appropriate. Appropriateness of the articles and abstracts obtained were examined for relevance. References from the selected articles were further vetted for additional eligible articles.

Journal articles meeting the following criteria were included: Published in English in the last 50 years (January 1967 to January 2017) to encompass modern warfare campaigns from the Vietnam Conflict to OEF and OIF; quantitative veteran and suicide focus; health variables/risks focused. Articles that found no statistically significant health risk variables were excluded, as were articles that exclusively focused on demographics (e.g., income, ethnicity) or program and/or intervention validation.

The search yielded 411 articles of which a total of 54 articles met the inclusion criteria. The gathered literature provided evidence of the association for a positive correlation between the risk of suicide and diagnosed health variables. Groupings of four areas validated the positive relationship and were categorized as 1) Mental Health Diagnosis (included substance abuse, PTSD, and depression); 2) Traumatic Brain Injury (TBI); 3) Chronic Pain; 4) Previous suicide attempts. Evidence of how the individual characteristics associate with an increased risk for suicide are presented.

4. Results

Correlational data to support the independent variables as well as the strong association among the interplay of independent variables can be distributed into four broad categories: Psychiatric diagnosis (depression, substance abuse, PTSD); TBI; Chronic pain; and prior attempt at suicide. Beyond these broad categories, co-occurrences often exist in the literature.

4.1 General psychiatric diagnosis

Psychopathologic conditions are some of the most well-studied links to an increased risk for suicide (Ilgen et al., 2010). Diagnosis and the risk for suicide have been extensively studied and there is a strong positive correlation between the two variables. Although psychiatric diagnosis is a broad category, themes have developed in the combat veteran which identify a veteran at greater risk for suicide within this domain (depression, PTSD, substance abuse). Under the broad umbrella of psychiatric diagnosis/mental health illness two small studies demonstrated a relationship. O'Toole et al. (1995) provided evidence in a retrospective cohort to predict a 46-fold difference in death rates while Mahone (2005) declared it an independent risk factor for firearm-related suicide. Both large sample studies by Hyman et al. (2012) and Ilgen et al. (2012) confirmed mental health diagnosis as an independent variable in the OEF/OIF veterans' suicides.

4.2 Depression, PTSD, substance abuse

Depression and PTSD often share overlapping symptomology, and frequently exist together among OEF/OIF veterans (Koenen et al., 2008; Seal et al., 2007); therefore it has been suggested that the two disorders be treated as a single condition rather than in isolation (Elhai et al., 2011; Gross et al., 2012; Miller et al., 2008;). Depression is three to five times more likely to occur in patients with PTSD than those without, so the two variables are often studied in tandem as they relate to suicide (Kessler et al., 1999; O'Donnell et al., 2004). The incidence and prevalence of PTSD in OEF and OIF populations is as variable as suicide data with rates as low as 10% to as high as 30% (Institute of Medicine, 2014; RAND Corporation, 2012;). Depression and PTSD are some of the most studied correlates and there is a strong correlation to an increased incidence of suicide (Bryan et al. 2015;Bullman and Kang, 1994; Handin and Hass, 1991; Jakupak et al., 2009, 2010; Lemaire and Graham 2010; Maguen et al., 2015; McLean et al., 2017; Nock et al., 2015; Pompili et al., 2013; Ramchand et al., 2015; Ramsawh et al. 2014; Seyfried et al., 2011; ; Ursano et al., 2016; Zivin et al., 2015). Within the domain of depression a small study by Bryan et al. (2015) demonstrated a link between depression, risk for suicide, and insomnia severity. In larger studies, it correlated to a larger hazard ratio, a primary correlate, as well as one of the strongest predictors of suicide.

As a means of coping, substance abuse is often seen with depression and PTSD. Alcohol and drug abuse disorders have been strongly related to risk for suicide (Cavanagh et al., 2003; Harris et al., 1997). When compared to those without substance abuse disorder, this population is six times more likely to attempt suicide in their lifetime (Kessler et al., 1999) and in the veteran population 2.3 times more likely to die from suicide. In addition, in women, it is associated with a 6.5-fold increase in risk for suicide (Ilgen et al., 2010). As previously mentioned, depression is a risk factor for suicide, but when combined with substance abuse the risk for suicide further increases (Connor et al., 2003; Harris et al., 1997; Ilgen et al., 2010). The following studies demonstrated the degree to which these variables impact individuals as both co-variates as well as independent variables: Bachynski et al. (2012), Bell et al. (2010), Cigrang et al. (2015), Cohen et al. (2016), Griffith (2016), Hellmuth et al. (2012), Holmes et al. (1998), Ilgen et al. (2009, 2010), Kaplan et al. (2012), Kausch and McCormick (2002), LeardMann et al. (2013), Maguen et al. (2015), Mash et al. (2014), Pietrzak et al. (2010), Valenstein et al. (2009), Vanderploeg et al. (2015), Yi et al. (2015), and Zivin et al. (2007). Although these variables have been shown to be independent, as well as co-occurring, the effect can vary. Benda (2005) found that in homeless women veterans suicidal thoughts were strongly associated with depression, versus substance abuse and PTSD in males.

4.3 TBI

TBI is associated with a neurologic abnormality such as altered neuromuscular and cognitive functioning, amnesia, and altered level of consciousness (Thurman et al., 1995). These injuries have seen a rapid increase in the OEF and OIF population due to the enemy's deployment of improvised explosive devices (IEDs) or "road bombs." The nature of emotional and cognitive defects due to TBI are poorly understood (Hoge et al., 2008). What has been established is that there is a positive correlation between TBI and suicide, suicidal attempts, and suicidal ideation (Anstey et al., 2004; Brenner et al., 2011; Gutierrez et al., 2008; Teasdale and Engberg, 2001). As Brenner et al. (2011) demonstrated through a large cross-sectional study of military veterans suffering from TBI, veterans were 1.55 times (95% CI) more likely to die by suicide than those without a TBI. However, in a smaller sample (2011) they identified no significant association when compared with PTSD, which may be due to the sample size that lacked power to

find an association. Bryan et al. (2013) identified TBI to be significantly associated with an increased risk of suicidality in depression and the interaction of depression and PTSD. Finally Bryan and Clemans (2013) concluded that as the number of TBIs increased so did the symptom and severity of depression, TBI, and PTSD.

4.4 Chronic pain

Chronic pain and depression are leading factors in suicide. Chronic pain has a two-fold risk of death by suicide, an almost three-fold prevalence of attempts when compared with those without chronic pain, and a 20% prevalence of suicide ideation (Magruder et al., 2012). Ilgen et al. (2010) utilized the 1999 Large Health Survey of Veterans and NDI and drew the association between self-reported pain severity and suicide among veterans. They stated that "veterans with severe pain were more likely to die by suicide than patients experiencing none, mild, or moderate pain (HR: 1.33; 95% CI: 1.15, 1.54), after controlling for demographic and psychiatric characteristics" (Ilgen et al., 2010, p. 597). As a result of their VA-funded research they recommended that pain should be included in suicide prevention efforts. In a large retrospective analysis (Ilgen et al., 2010), they identified that suicide risk was higher for various pain conditions except arthritis and neuropathy. When controlled for psychiatric conditions, the association between pain conditions was reduced but still significant in back pain, migraine, and psychogenic pain.

Lastly, research has demonstrated what could be an alarming connection between opiate and sedative use and an increased risk for suicide (Darke et al., 2004; Ilgen et al., 2007; Maloney et al., 2007; Wines et al., 2004) as this may greatly impact the veterans suffering from chronic pain who are prescribed such medications.

4.5 Previous suicide attempts

Britton et al. (2015), utilizing a moderate sample size, showed that depression and alcohol abuse was associated with prospective risk for nonfatal suicidal attempts. In addition, prior suicide attempts were associated with increase risk in the acute hospital discharge patient.

5. Discussion

Previous literature has demonstrated variables that form a high-risk individual for death by suicide in the civilian population. These variables include: prior suicide attempts, mental disorders, substance use disorders, and TBIs. Although one may view these variables in isolation, often there is an interplay. For example, a prior attempt of suicide is one of the strongest predictor of a following death by suicide (Harris and Barraclough, 1997; Isometsa and Lonnqvist, 1998), and people with PTSD are more likely to report past suicide attempts than those without the disorder (Farberow et al., 1990; Kessler et al., 1999; Sareen et al., 2005). Also, PTSD often coexists with depression and the Institute of Medicine (2002) predicted that 4 percent of this population will die by suicide. In this review, we sought to assimilate the body of knowledge to assess strong stability in those independent risk variables, seen in the civilian population, to the specific population of military veterans.

A Congressional Research Services report (2008) identified risk factors that comprise a high-risk veteran for suicide that include: PTSD, TBI, mental health issues, combat exposure, poor social support, and access to lethality. The review examined 54 quantitative studies that explored the relationship between suicide and health risks in the

veteran population. There is strong empirical evidence that particular health variables are associated with varying degrees of increased risk for suicide in veterans (TBI, psychiatric diagnosis, prior suicide attempt, and chronic pain) that also exist in the civilian population. These findings provide overwhelming validity to a recently released article: Predictive Modeling and Concentration of the Risk of Suicide: Implications for Preventive Interventions in the US Department of Veteran Affairs (McCarthy et al., 2015). The strong correlation of variables between the review and McCarthy et al,'s (2015) predictive model provide further support to the suggestion by Tran et al. (2014) for modeling to provide information to identify at risk individuals. How can we move from defining the individual at risk to defining populations at risk?

Bringing the science "where" it is needed when life matters, is critical. Spatial thinking in health policy and epidemiology is of growing importance. Utilization of Geographic Information Systems (GIS) technology has the ability to transform population health due to the analytic nature of uncovering trends and patterns in care delivery that have never been appreciated visually. The application of a question can now be portrayed in a multidimensional format to reveal trends, patterns, and relationships. Unlike traditional areas of clinical inquiry, which require years of data generation and collection, GIS allows the mining of data already available, from multiple sources, to place a question in the perspective of a geospatial reference. The technology provides a new lens to understand data so we can better manage resources to care for general as well as unique populations. As such there are two applications under GIS, studying health outcomes and epidemiology, and studying health outcomes and informing healthcare delivery, (Endacott et al., 2009) which can serve in the transformation of healthcare utilization, policy decision-making, and resource allocation.

GIS has the unique ability to communicate relationships and tell stories in a way that eludes other data presentation techniques (Mullner et al., 2004). Unlink, McCarthy et al.'s (2015) predictive modeling, which identifies individuals, uses GIS to reach beyond the intimacy of an exam room and look at the neighborhood, town, state, and nation. The application of disease mapping has become an invaluable and proven tool for disease prevention (Garnelo et al., 2005) and an extension of this tool into disease modeling has been used to pinpoint high-risk areas for prevention and intervention as well as for identifying gaps (Myers et al., 2000; Robinson, 2000). One such example in the VA system by Culpepper et al. (2010) utilized VA datasets within a GIS platform to improve access to multiple sclerosis specialty care in the VA system.

Place matters and fixing data to a geographic location (or geocoding) enables a layer of analysis that provides insight that cannot be garnered by classification, grouping, or taxonomy alone. Electronic health records (EHRs) allow a patient's physical locality of residence (as noted in the EHR) to be contrasted against the locality of care delivery (hospital or clinic physical location). Geographic information systems allow complex spatial analysis by taking the context of the geocoded variables (e.g., patient location vs disease classification) to the geocoded variable of site of care delivery (e.g., health care delivery locality). In this context the physical locality of patients with discrete diagnoses can be analyzed against care delivery sites as well as locality grouping. Such analysis can establish groupings of patients in a geographic location and establish locality of geographic disease burden and available health-care resources. In addition, complex analysis can be incorporated which compares the variables of patients to the variable of time and distance from care facility. Such analysis can define *at-risk populations* which are disenfranchised by proximity to adequate care facilities.

The topic of veteran suicide lends itself to a novel application of GIS since the empirical evidence by the Kaiser Family Foundation (2014) supports the discrepancy with previously reported suicide data. Additionally, McCarthy et al. (2012) examined the incidence of suicide between rural and urban populations and found rural patients had higher suicide rates (38.8 vs 31.4/100,000 person-years in FY04–05; 39.6 vs 32.4/100,000 in FY07–08). That rural residence was associated with greater suicide risks (20% greater, FY04–05; 22% greater, FY07–08) which validates the notion that place matters.

The VA has been at the forefront of EHR integration since it conceived the idea of the Veterans Health Information Systems and Technology Architecture (VistA) in the 1970s. Currently the VHA manages the largest medical system in the United States which consists of over 160 integrated modules, and encompasses 163 hospitals, over 800 clinics, and 135 nursing homes (VA). Although private and not-for-profit healthcare systems have been recently regulated to adopt EHR mandates by 2014 through the HITECH Act (2009), the VHA has clearly been a leader for over three decades. This history in EHR, and maturation of data acquisition, positions the VHA well for data mining to provide impactful insight and GIS analysis. VistA has been established and was in service during both OEF and OIF which encompass the population of interest. The large geographic footprint of the VHA also makes the information garnered through GIS data analytics both relevant and timely. The strong stability of the reviewed independent correlates to suicide provide confidence that the layered mapping of disease burden will provide accurate at-risk population distribution.

The VA VistA database poses both strengths and limitations. Strengths are born out of the long-standing integrity of the EHR system as well as the inclusion of all veterans that are currently active and utilizing VA services. However, the VistA system does not include veterans utilizing external sources of healthcare, are dishonorably discharged or misclassified, or wrongly diagnosed or inappropriately diagnosed; therefore, these data are not complete for the whole population.

Utilization of VA EHR datasets to the geocoded locality of healthcare delivery and the identification of geographic at-risk populations by geocoding patients with correlated suicide health risks may provide insight into at-risk populations. The prevalence of the stable positive correlates to suicide can be compared nationally as well as regionally and locally. The approach can be validated by utilizing the metadata in the VistA database to map models of at-risk populations in time and compare that against geocoded suicide data over time.

6. Conclusions

This review found evidence for the correlation between stable diagnosed health variables and the risk for suicide in the veteran population. This review further validates the conclusions of statistical rigor in predictive modeling and the association of variables which comprise an at risk population. However, this review did not explore the demographic variable that may also show a relationship to suicide.

The review highlights the need for both an individual and population approach to the epidemic of suicide in the veteran population. Predictive modeling can adequately inform a clinician to risk stratification as long as there is proper assessment and diagnosis of the individual. Yet a population approach to understand the distribution of at-risk individuals is needed to ensure the allocation, distribution, and scale of limited healthcare

resources. GIS may be a novel approach to provide a population perspective to the epidemic of veteran suicide.