HBI solutions

National Suicide Prevention Month 2018

Patient-Risk Surveillance Reduces Disaster in Underserved Populations in Mental Health

Death by suicide is increasing.

Death by suicide has risen 28% nationwide from 1999 to 2016, and in 2013 CDC data reported the total medical system cost of death by suicide was $50.8 billion. With 123 suicides per day[1], it is reported to be the 10th leading cause of death in the United States. And with 25 attempts for every suicide, that means over 3,000 suicide actions take place each and every day on average.

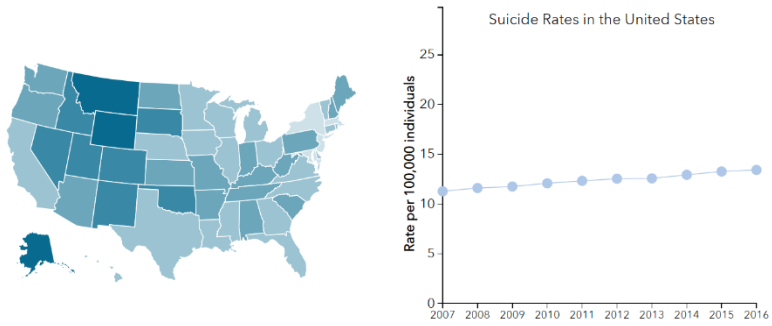


Figure 1: https://afsp.org/about-suicide/suicide-statistics/

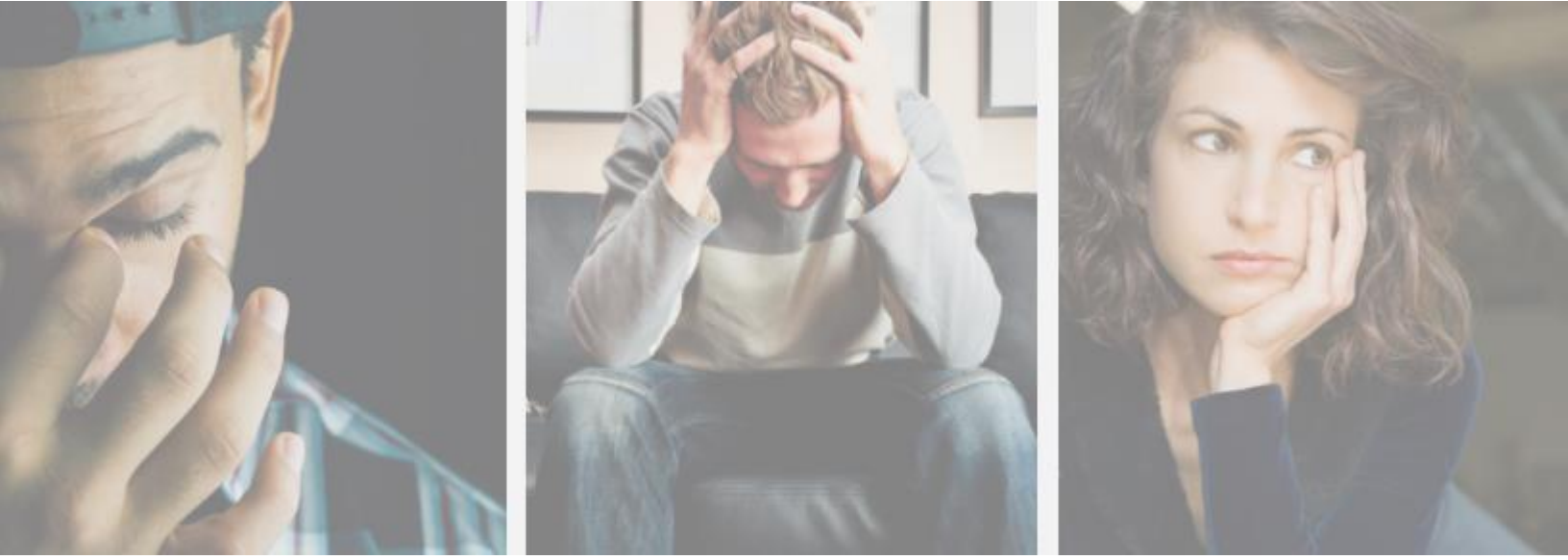
These disturbing statistics also show that in 2015, 8.6 percent of youth in grades 9-12 reported that they had made at least one suicide attempt in the past 12 months. Girls attempted twice as often as boys and teens of Hispanic origin reported the highest rate of attempt.

Research shows important suicide factors, that are particularly present in the underserved population, but not exposed to providers, include environmental, lifestyle, socio-economic and access to care challenges. These factors are mostly absent from the medical record systems that providers rely on at the point of care. These factors are generally not reported, not documented or coded, or not accurately or easily interpreted as risk factors. As a result, at-risk populations go unnoticed and untreated in outpatient, inpatient and emergency settings, as well as in the community.

Primary care providers need accurate assessment tools at the point of care to identify and stratify at-risk patients. These tools would allow providers to better integrate medical and mental health care, explore social determinants that contribute to risk and impose barriers to care, and to avert the risk and address underlying mental health issues by referring patients to mental health professionals. The same awareness of risk is important for providers treating patients for other unrelated acute and emergent issues.

New care models need to include analytics that provide insight into needed mental health support from the data available to providers. This paper will compare existing research with HBI Spotlight Suicide Attempt model results to showcase how data science can improve physician decision support tools.

[1] American foundation for suicide prevention https://afsp.org/about-suicide/suicide-statistics/



Social determinants of health are key drivers of risk.

Access to care is perhaps one of the most significant barriers to identifying and treating mental health conditions that can lead to suicide. Lack of access can arise from financial, transportation, insurance or language barriers, as well as limited mental health providers and locations.

Affordable and available care affects rural areas, uninsured, underinsured and the homeless. Frustration associated with the cost and quality of available care is an increasing problem for healthcare providers as suicide rates climb. As many as 17% of adults with mental illness are not insured. Even when covered, mental health services lack payment parity compared to other healthcare services in many states.

One out of five adults with mental illness report that they are unable to obtain the care they need[2].

If you do not have insurance that pays for care, you will not receive treatment. If you do not have the time to miss work or available childcare, you will not receive treatment. If you suffer from suicidal ideation but have no psychological support available, you will not receive necessary treatment. When a provider recommends psychological care and a patient has a lack of follow through, what appears to be "noncompliance" may actually be a manifestation of social economic barriers.

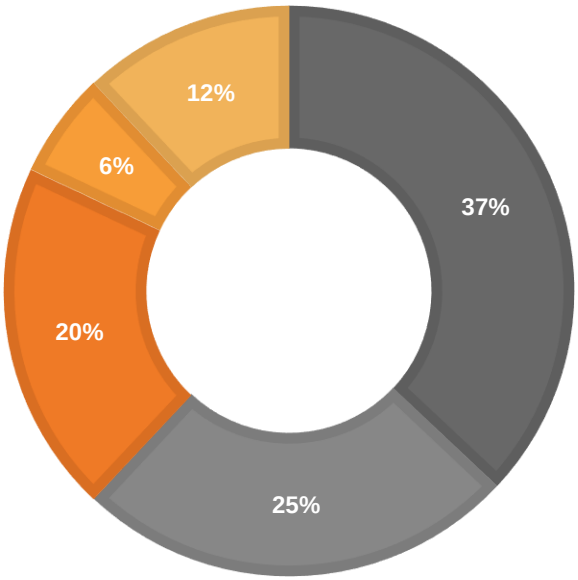
Additional social factors that impact mental illness care are ethnic disparities, which include language barriers. Study shows similar[2] risk to that of the homeless population within ethnic minorities due to a lack of resources and language barriers. Providers should be aware of the resource gap related to these social determinants of health (SDOH). According to the American Psychological Association,[3] "[p]rimary care providers practicing in neighborhoods with higher percentages of African Americans and Hispanics were less likely to have

[2] http://www.apa.org/advocacy/workforce-development/gpe/populations.aspx
[3] http://www.apa.org/advocacy/workforce-development/gpe/populations.aspx

geographically proximate behavioral health professionals." The same holds true within rural populations. Many rural white patients have a lack of mental health support, coupled with greater access to lethal means through firearms[4]. Rural suicide statistics models should be viewed within the lens of decreased access to mental health care and increased access to guns and other lethal means.

Another factor is food insecurity. Healthy eating is an important part of healing, and without healthy food at home, individuals have even more difficulty recovering from illness or surgery. For mental illness and suicide attempts this goes beyond actual healing, since food insecurity in children can lead to long term health problems as adults, including symptoms ranging from eating disorders to devastating mental health impact. Food insecurity has PTSD-like symptoms in terms of mental health outcomes. Some of the SDOH might masquerade as mental illness or have a strong impact on mental illness. Sometimes a diagnosis of PTSD represents a patient with food insecurity needs[5].

Data science and risk prediction tools can aid providers in ameliorating some of these problems, by illuminating risk factors that may not otherwise be self-evident at the point of care.



As a determinant of overall health, healthcare plays a minor role.

- Behavioral
- Genetic
- Socioeconomic
- (Physical) environment
- Healthcare

Source: Schroeder, M.D., Steven A. We Can Do Better – Improving Health of the American People. NEJM. 2007 Sept 20; 357:12;1221-1228

[4] https://www.hsph.harvard.edu/means-matter/means-matter/risk/
[5] http://mcsilver.nyu.edu/sites/default/files/Child%20Food%20Insecurity%20and%20Mental%20Health.pdf

Data challenges need to be addressed.

One of the biggest challenges in exposing needed information to providers, is that important non-medical information is not always available in the patient chart or history[6]. Recently, efforts to codify and capture social determinants has manifested in the ICD-10-CM Z-codes, which are factors influencing health status and contact with health services. Among these classifications are codes for "Persons with potential health hazards related to socioeconomic and psychosocial circumstances" and "Persons with potential health hazards related to family and personal history and certain conditions influencing health status". However, according to a Health Affairs study[7], use has been lackluster, particularly in the ambulatory setting where trained coders are not always used.

Indications of lifestyle and social factors may be hidden in free-text physician notes, if they are discussed and noted at all, making them invisible for many predictive risk models.

Response to suicidal ideation is complicated by legal obligations, such as reporting risk of self-harm to police. This creates a disincentive to report suicidal thoughts impacting providers' access to accurate risk information. Response to self-harm events are similar to response to crime, and without adequate education for emergency responders and law enforcement, some interventions lead to negative consequences and long-term reluctance for the individual to seek care. Similarly, if a patient with suicidal ideation reports that feeling to a friend or family member and then has a forced hospitalization or law enforcement intervention, they may withhold reporting future suicidal thoughts.

HBI Spotlight risk solution puts useful information in the hands of care providers.

HBI Spotlight Population Risk Solution now includes suicide attempt risk for populations. Using data already available in EHR's and including publicly available community social determinants, the HBI data science team applied advanced machine-learning algorithms and Deep Neural Networks in the process of feature selection and model building. Highly accurate risk scores and important risk features are now available to care providers, coordinators and organizations taking on the risk of populations at the point of need.

[6] https://hbisolutions.com/translate-social-determinants-of-health/
[7] https://www.healthaffairs.org/doi/abs/10.1377/hlthaff.2016.0723

The one-year suicide attempt risk model attained an area under the curve (AUC) of 0.792 and 0.769[8] in the retrospective and prospective cohorts, respectively. The suicide attempt rate in the "very high risk" category was 60 times greater than the population baseline when tested in the prospective cohorts, 10 times greater in the "high risk" group, and 5 times greater in the "medium risk" bin. Mental health disorders including depression, bipolar disorders and anxiety, along with substance abuse, impulse control disorders, clinical utilization indicators, and socio-economic determinants were recognized as significant features associated with incident suicide attempt. The "very high risk" population was primarily comprised of individuals with mental illness, in the age groups of 6-24 and 25-54.

The model echoes the importance of social determinants, as well as lifestyle and behavioral health diagnoses as important influences on the risk. However, as with other risk models some features, and strength of influence may not be self-evident.

Access and affordability features:

Features related to access and affordability surface as important risk drivers in the studied population.

HBI Spotlight Suicide Attempt model results show that patients with private health insurance, but low income have a higher risk of suicide attempts.

Patients that have insurance through their work or through private pay do not qualify for Medicaid. Lower income patients with private insurance spend a larger percentage of their total income on healthcare costs. The working poor are likely to have less access to mental health resources despite having private insurance. Impacts of inadequate insurance coverage also have significant overlap with rural areas and homelessness. Patients that technically qualify for public insurance based on income don't always have the means for realizing those benefits. Lack of access to insurance due to homelessness or other access barriers can mean that even very low-income patients that might qualify for programs on a financial basis have an extremely difficult time maintaining application requirements and missing deadlines for renewal of Medicaid coverage.

The poor and disadvantaged suffer disproportionately from common mental disorders such as depression and anxiety. Many studies show a positive association between mental health disorders and poverty. Mental health is worse for those with poor social support, which is not immediately seen at the point of care. This is a cyclic relationship. Poor mental health leads to worse social and economic status, which in turn increases risk of further mental disorder.

Lower income patients with private insurance spend a larger percentage of their total income on healthcare costs.

[8] Area Under the Curve (AUC) can range from 0.5 to 1.0, where 0.5 is an essential coin flip and 1.0 is a perfect predictor. This is also called the C-Statistic.

Military personnel and veterans are at higher risk.

The model also showed that those with Tricare Military or VA insurance are approximately 2.5 times more likely than the overall population to attempt suicide all else being equal.

High unemployment unsurprisingly shows increased risk factors for suicide attempts.

Homeless Americans are frequently part of this category. Inconsistent housing compounds the challenges for continuous mental health care, since patients in transitional housing can be more difficult to locate and follow up with. If a patient comes to the emergency room for healthcare and has mental health issues but has no means of being regularly contacted they will inevitably suffer from poor resource access. States with Medicaid work requirements and renewals with address requirements create a challenge for homeless Americans to access renewal and meet identify verification standards.

Lifestyle and behavior health factors:

Mental health remains the highest disease burden in the United States[9].

At least 25% of the American homeless are reported suffering from a serious mental illness. According to the Centers for Disease Control and Prevention (CDC), 1 in 13 Americans 12 years and older is depressed, and individuals living below the poverty level were nearly 2.5 times more likely to have depression than those at or above the poverty level. Of those with mild depressive symptoms, 45.7 percent reported difficulties in work, home and social activities, while 88 percent of those with severe depressive symptoms reported difficulties (CDC, 2014).

HBI Suicide Attempt model illuminates the importance of behavioral health issues.

Identifying significant risk influence associated with the drug class Serotonin Reuptake Inhibitor used to treat depression, along with diagnoses for Impulse Control Disorder, a major influence. Personality Disorder, Anxiety Disorder, and Schizophrenia or other psychotic disorders are also associated with high risk, while a past suicide attempt carried with it a 15-fold likelihood for a future attempt.

Substance abuse aggravates this burden and with the opioid crisis we are seeing increases in mental health problems and suicide attempts.

This relationship arises both from stressors from outside sources, and patients with a higher instance of mental health are likely to have difficulty with social integration. Schizophrenia has a higher risk for homelessness when it is comorbid[10] with drug use, poor global functioning and increased psychiatric symptoms. Comorbid substance abuse disorders are associated with increased homelessness and poor outcomes for social determinants of health[11].

[9] https://www.thelancet.com/journals/lanpsy/article/PIIS2215-0366(15)00505-2/abstract
[10] https://ebmh.bmj.com/content/2/4/122
[11] https://www.sciencedirect.com/science/article/pii/S0920996498001613

In the case of alcoholism as it relates to age, social factors have a huge impact. Family alcohol use and opinions impact the prevalence of alcohol use in younger patients. Poor and underprivileged groups often have higher substance abuse rates with lower access to support and treatment. This is reflected in suicide risk for Native Americans. Data about risk factors seen as lifestyle disorder are important to understanding mental health outcomes and suicide risk as they relate to SDOH[12].

HBI Suicide Attempt model recognizes these lifestyle features as influential.

While an alcohol-related disorder has nearly a 3-fold increase in the risk, a single admission for an alcohol-induced mental disorder is a staggering 11x risk. And a chronic diagnosis for a substance abuse disorder has as strong an impact on risk as serious mental illness such as schizophrenia or psychotic disorder. Impulse control is a major factor increasing risk of suicide and paired with an existing lifestyle disorder such as alcoholism, the data tell us that results can be fatal.

Other features:

Another feature of interest includes high emergency department utilization.

Individuals with behavioral health disorders frequent the ED for anxiety and stress that mimic urgent health issues and those with limited financial means or Medicaid tend to use the ED instead of primary care.

Demographically, our study shows higher risk attached to communities with high percentages of white, high school or above educated residents with low median incomes. And that individuals aged 12-18 held the highest risk among the age groups.

Solutions need to include programs based on the data.

Local programs and access initiatives that focus on addressing homelessness and joblessness have greater success at improving mental health and reducing suicide attempts, such as the Good Samaritan Health Center in Atlanta, GA[13]. Since data models need to be viewed within the context of very localized resources, traditional AI models need to be used as a diagnostic tool in coordination with local data.

Transient populations and populations with SDOH risk for financial instability have a lack of access to one of the most effective sources of support: regular primary care. Regular primary care programs and associated interventions have some of the highest success rates in suicide prevention.

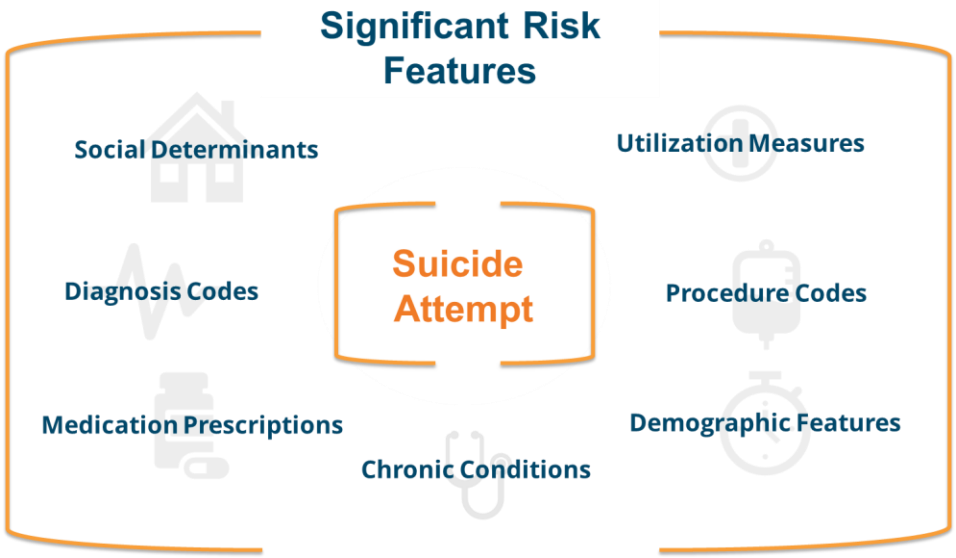
[12] https://www.cdc.gov/mmwr/volumes/67/wr/pdfs/mm6708a1-H.pdf
[13] https://www.bizjournals.com/atlanta/news/2018/05/04/groups-work-to-improve-access-to-health-care.html

Severe mental illness and common disorders have a decreased suicide-attempt risk when they have successful primary care. According to data from completed suicides in Monroe County, NY,[14] "[t]he primary care setting is an important venue for late life suicide prevention. Primary care providers should be well prepared to diagnose and treat depression in their older patients." Primary care is the ideal environment for providing mental health support and reducing risk. In a population with irregular insurance coverage or lack of financial availability of primary care, suicide risk will increase. Planning teams or care coordinators need to address the care transition between emergency acute care events and primary care providers for patients identified as having increased risk of suicide attempts.

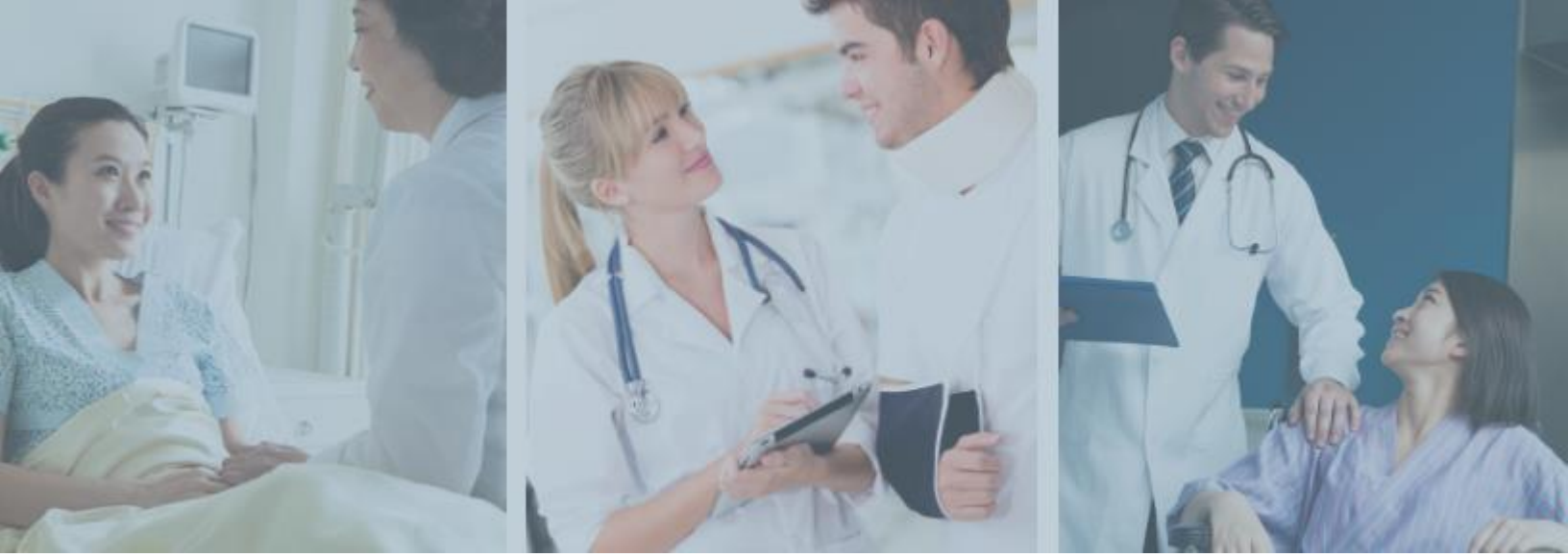
Tools that provide insight into proportionate risk of suicide and other mental health background can be used in planning short-term interventions and long-term population health improvement strategies.

Improvement of the factors beyond physicians' control also contributes to better physician satisfaction and better patient outcomes. Emergency providers might not have the information they need to be great judges of risk. Data science models can provide insights from readily available data sources to help physicians determine if a deeper dive into specific SDOH issues is needed. When patients come to the hospital, providers currently can only see what is in front of them and may only be focused on the reason for admission. We can use data science to help get a clearer, deeper picture of patients' lives outside the hospital and improve mental health outcomes.

HBI Solutions' Suicide Attempt Risk Model:



[14] https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1532-5415.2000.tb03024. x



Risk assessment is most beneficial at the point of care.

Integrating information on suicide attempt risk for an individual while being treated for another medical or behavior issue is key to holistic and effective care. Providers don't always have a great sense of mental health needs. Analytics engines can surface insights that evaluate many factors that might not be common in a practitioner's individual experience. This will be key in increasing non-intuitive decision-making capabilities for practitioners who have had less personal interaction with at risk patients. Novel disease correlations in mental health include insights about which social factors can influence the risk of suicide.

Analytics-based clinical assessment tools identify and expose significant risk factors and have a logical explanation at the point of care.

Interventions for mental health should be made with awareness of social risk factors and personalized for the needs of each patient. Increased visibility into disadvantages increasing risk will improve intervention plans. Data science pairs well with local knowledge of programs available to improve social outcomes. Making context visible lays the foundation for decreasing suicide risk and improving overall mental health outcomes.

Scarce resources can better allocate their time to at-risk populations with accurate stratification methods based on future risk. Addressing significant clinical need in an underserved area of healthcare, quickly surfacing risk factors for suicide attempt can improve patient outcomes and help systems alleviate social factors that increase risk, but do not find solutions in hospital or healthcare settings.

Artificial intelligence insights can provide greater physician confidence at the point of care and lower care delivery costs when used as decision support tools. With time, the standard process of mental health assessment and patients' prognoses will both improve as patients' needs are better understood.

Conclusions:

Insights from data science can be part of any healthcare systems' suicide risk management health protocols.

HBI Spotlight Solution makes it possible to generate and deploy accurate risk scores and risk features to the point of care with data that are typically available in the EHR, along with community-based social determinants of health.

Data science highlights outcomes and relationships that are not apparent to primary care providers and emergency care providers, as well as facilitates proactive program development.

Advanced machine-learning and deep neural networks harvest and expose risk influences that may otherwise not be known to care providers. These insights can light a path for intervention and risk mitigation that include non-medical factors.

Stratifications based on risk can help focus scarce resources.

As avenues to access are narrow, understanding who is at highest risk can help programs focus scarce resources, hotspot areas of significant need, and target interventions where the most impact can be realized.

Machine-learning outputs can be used to increase provider knowledge.

As with other evidence-based protocols, understanding the underlying risk drivers can help tune providers to risk correlations that would otherwise not merit attention.

HBI solutions

HBI Solutions was founded in 2011 by a physician, a data scientist, and a healthcare IT business executive who shared a vision of improving health and reducing costs. HBI partners with healthcare organizations worldwide to deliver actionable information that helps providers reduce patient health risks, improve care quality, and lower the cost of care. The HBI Spotlight solution is grounded in clinical care and data science, and the analytic approach and methods are prospectively tested, peer-reviewed, and published in leading scientific and medical journals. Visit HBI online at www.hbisolutions.com.

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