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Advancing Suicide Prevention through Innovative Technology: The Durkheim Project

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Indian Health Service's National American
Indian/Alaska Native Behavioral Health
Conference

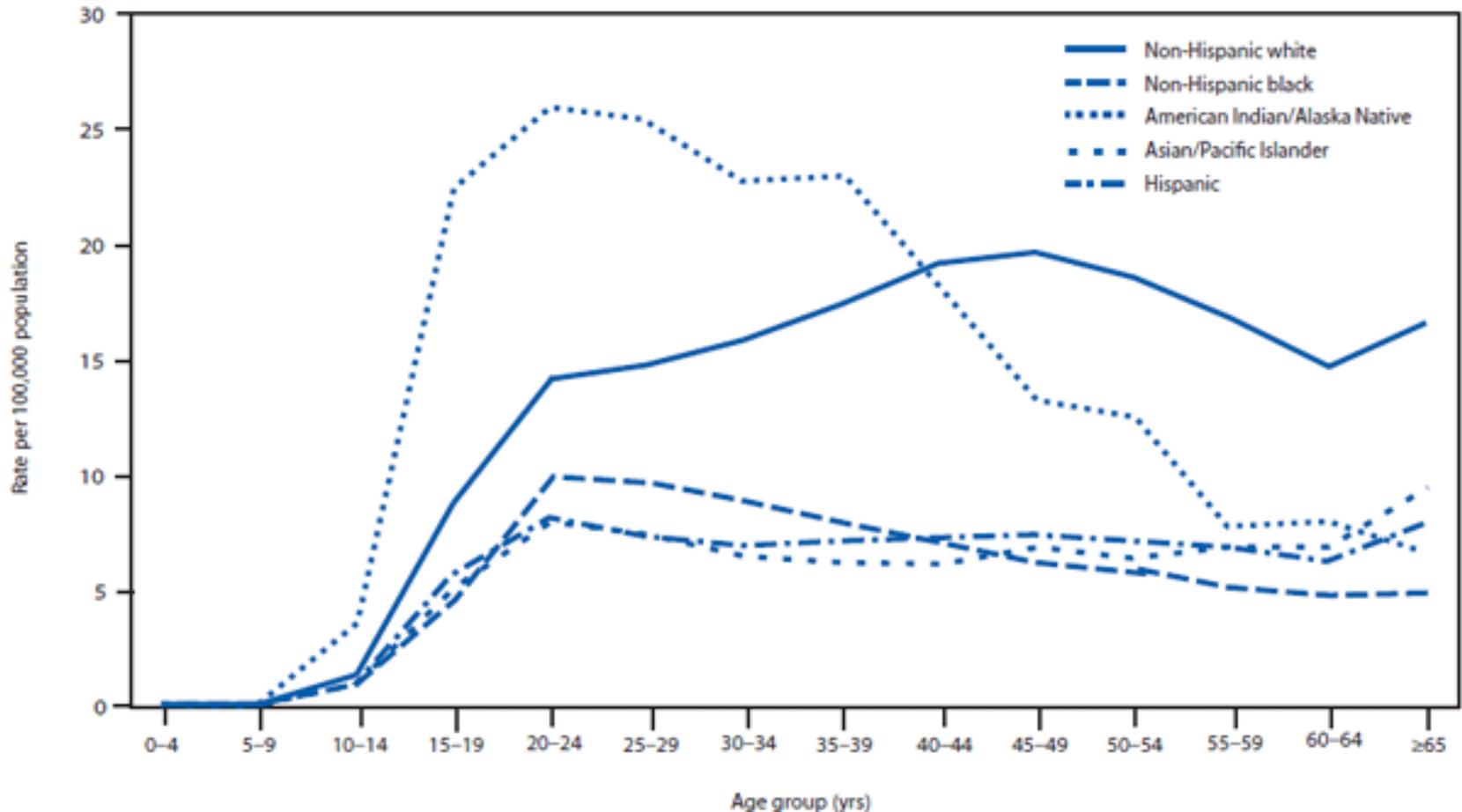


Goals for this presentation

- Give rationale for the need for additional suicide prevention strategies
- Provide information on currently available suicide prevention tool that incorporates social media data with machine learning to improve risk prediction

Suicide is a Public Health Problem

Suicide rates National Vital Statistics System, 1999--2007



Effective Identification is Essential for Suicide Prevention

- Assessment of individual risk typically places significant resource demands on the gatekeepers and clinicians who attend to suicide risk factors
- Garrett Lee Smith legislation **gatekeeper** training can be effective in reducing suicide attempts and death by suicide
- However, training efforts must be *ongoing* to yield reductions in suicide-related outcomes, as 1 year post-implementation suicide attempt and death rates returned to pre-implementation levels.

Garraza, L. G., Walrath, C., Goldston, D. B., Reid, H., & McKeon, R. (2015). Effect of the Garrett Lee Smith Memorial Suicide Prevention Program on suicide attempts among youths. *JAMA Psychiatry*, 72(11), 1143-1149.

Challenges to Current Risk Identification

- Current prediction relies on individual judgement:
 - Relies on past behavior– ignores 1st time self-injury
 - Does not account for the nature of suicidal behavior which is rapidly fluctuating, fluid, and state-dependent
 - Clinicians rate as highly stressful and prediction is poor
- Patient-generated data could provide the information needed to drive improvement in prediction
- Strategies that automate suicide risk identification may be effective, scalable, and continuous

Fowler, J. C. (2012). Suicide risk assessment in clinical practice: pragmatic guidelines for imperfect assessments. *Psychotherapy*, 49(1), 81.

Social Media Data May Improve Prediction

- Access to social media data may improve suicide risk prediction by applying machine learning algorithms
- SM is a core communication strategy for AI/AN youth and young adults
 - In Native youth, 80-92% of teens endorse having a profile on social media.
 - 24% report “almost constant” use
 - Information on SM appears to be a valid indicator of wellbeing

Lenhart, A., & Page, D. (2015). Teens, social media, and technology overview 2015. *Pew Research Center*.

Moreno, M. A., Christakis, D. A., Egan, K. G., Brockman, L. N., & Becker, T. (2012). Associations between displayed alcohol references on Facebook and problem drinking among college students. *Archives of Pediatrics & Adolescent Medicine*, 166(2), 157-163.

Fluid Vulnerability Theory (Rudd, 2006)

- Suicidal intent is a cognitive state that fluctuates widely over time in response to triggering events and background predispositions
- A person might be at a slight risk for suicide one day, but become very high risk the next day in response to a new life event

Rudd, M.D. (2006). Fluid vulnerability theory: a cognitive approach to understanding the process of acute and chronic risk. In Ellis, T.E. (ed.) *Cognition and Suicide: Theory, Research and Therapy*. Washington, D.C.: American Psychological Association, p. 355 – 368.



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Measurement Feedback Systems (Bickman 2008)

- A measurement feedback system (MFS) uses valid, reliable, and standardized measures to supplement informal feedback from clients and families during treatment
- As shown in this presentation, the Durkheim Project is a type of measurement feedback system in that it provides valid feedback through monitoring social media postings

Bickman, L. (2008). A Measurement Feedback System (MFS) Is Necessary to Improve Mental Health Outcomes. *J Am Acad Child Adolesc Psychiatry*. 47(10) p. 114 – 119.



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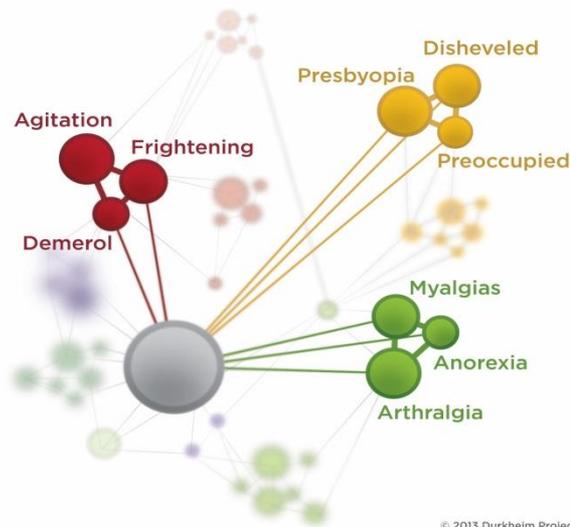
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- ❖ The project is named in honor of Emile Durkheim, a founding sociologist whose 1897 publication of *Suicide* defined early language analysis for suicide explanations.
- ❖ Our team is / was comprised of a multidisciplinary team of artificial intelligence (machine learning and computational linguistics), and medical experts (psychiatrists).
- ❖ Sponsored by DARPA DCAPS program from mid 2011- early 2013
- ❖ Now a lapsed medical non-profit data effort
- ❖ More @ www.durkheimproject.org

Durkheim Project: A virtual gatekeeper

Durkheim Project uses participant-generated social media data to detect and alert behavior patterns predictive of suicide risk



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Box 1. DPA Technical Specifications.

- *Bayesian counter* (B-count) framework to allow for real-time model building and prediction
- Underlying technology is *Apache Hbase*: a Hadoop database distributed storage system for scalable, big data storage/analysis.
- Prediction algorithm is *Naïve Bayes* and extended by Nearest Neighbors and general Bayesian Network
- Predictive word and word-pairs derived from the VA records study (Poulin et al., 2014) are the basis for prediction



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Technical Underpinnings Continued

- *Emotion states concept classification* is based on words and synonyms of these via natural language processing strategies of information retrieval and extraction as well as lexical and sentiment analysis to allow for text mining.
- *Privacy controls* are enabled and controlled by the user at the DPA interface of each SM platform
- *Gigya content aggregator* pulls SM data and populates a *Cassandra database* design to handle large amounts of data. These data is then transferred to a HIPAA compliant, firewall-protected final storage destination at UW.

Goal: Cultural Appropriateness for AI/AN populations: First thoughts based on military, veteran, and teens

- The Durkheim Project was developed for military and veteran populations addressing the communication gap resulting from conflicting values instilled in those populations: self-sufficiency, suppressive coping, fearlessness of death, as compared to values of the mental health system, e.g., emotional vulnerability and help-seeking
- Many in the military, or veterans, do not communicate suicidal ideation to their providers, which was one of the motivations for developing the Durkheim Project

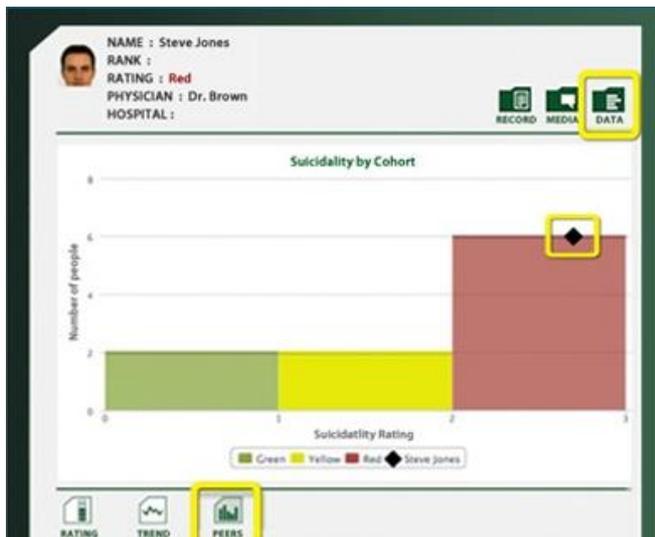


Adapting the Durkheim Project for AIAN Populations

- Adaptation of the Durkheim Project would need to be done with the participation of each community
- Some insight might be gained from the RISING SUN Initiative (Reducing the Incidence of Suicide in Indigenous Groups)
 - A project of the Arctic Council, 2015 - 2017
 - Traditional Healing and Life-style
 - Evidence-based Approaches



Dashboard Solution (for DARPA)



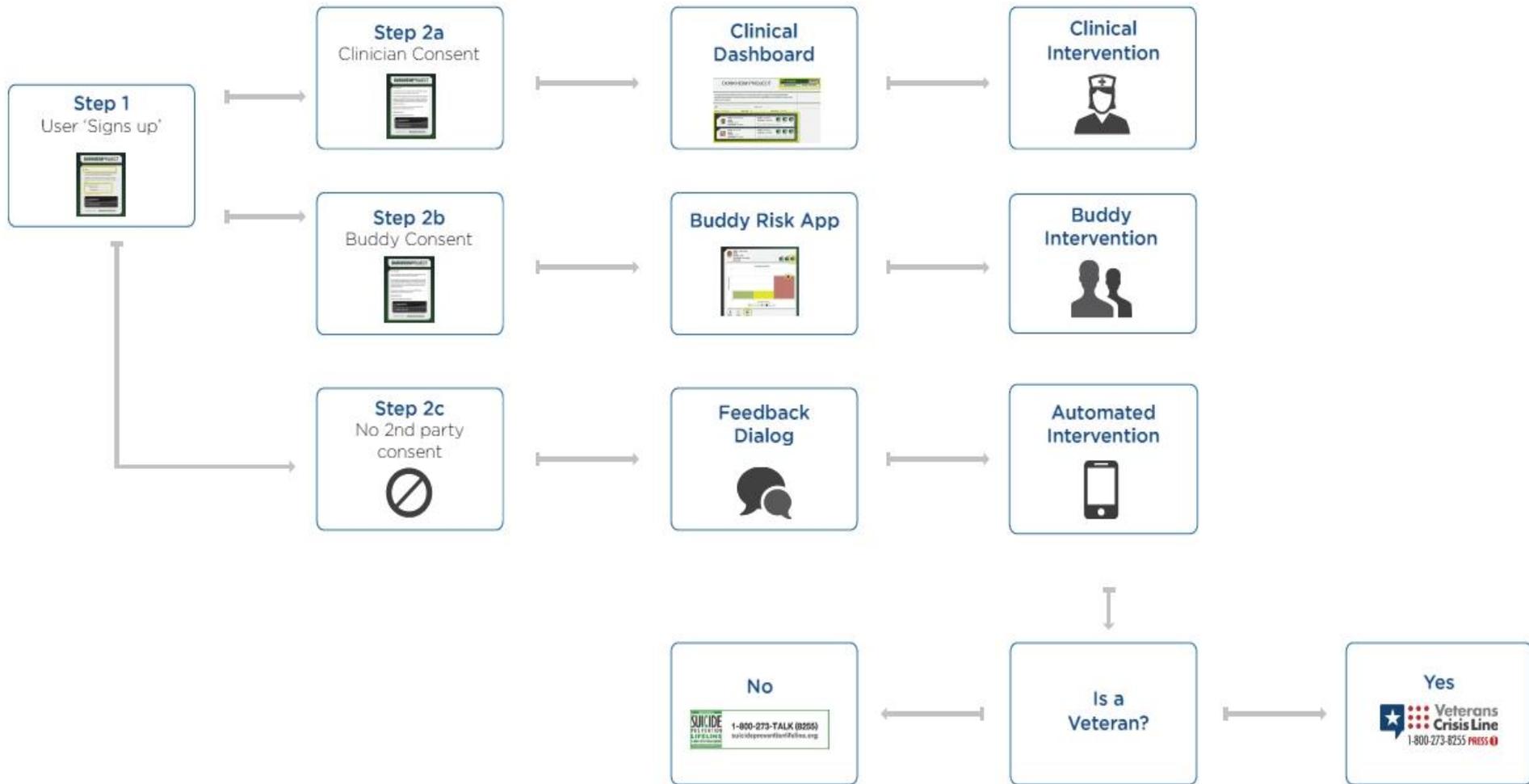
Dashboard

- Provides real-time monitoring of patients by Clinical Professionals
 - Also enables a buddy-system
- (Prototyped at Dartmouth Hitchcock Medical Center)

Comparative Risk Monitoring

- By Cohort
- Daily Tracking (think Fitbit™ for mental health)

Intervention Workflow



Durkheim Results In...

- Provides risk status of participating individuals with opt-in links to identified social supports
- Highly responsive to individual variation
- Provides guidance to individuals in times of need
- Maximizes reach at relatively low cost when whole communities opt in
- Has potential for large public health impact
- Remains “awake” and less affected by human judgement errors

AIMS for Possible Use with IHS

The objective is to apply the Durkheim Project to AI/AN population in order to examine if participant-generated SM data provide the information needed to accurately predict and manage suicide risk.

Aim 1: Evaluate the sensitivity of the DPA in detecting self-injury and make as-needed adjustments to the risk-prediction algorithm

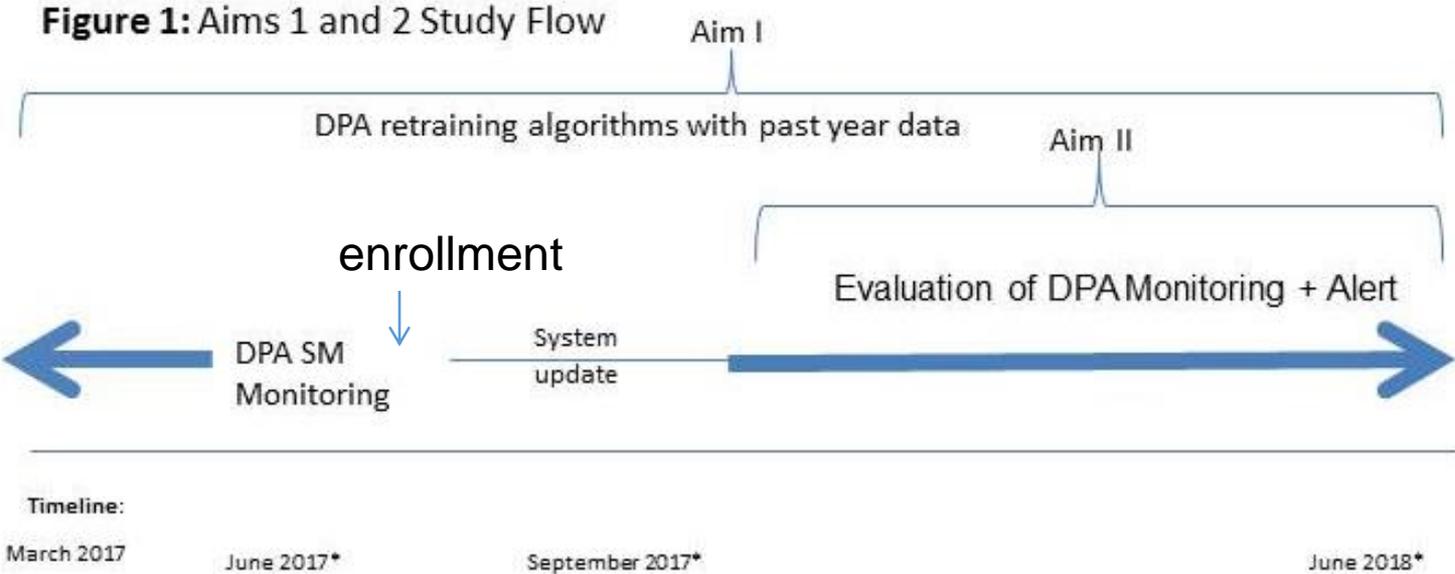
H1: The algorithm will increase in sensitivity over time as more data is analyzed.

Aim 2: Test the impact of the DP and follow-up supports on community outcomes.

H2: Suicide events will decrease, and connection with service supports will increase, with use of Durkheim Project.

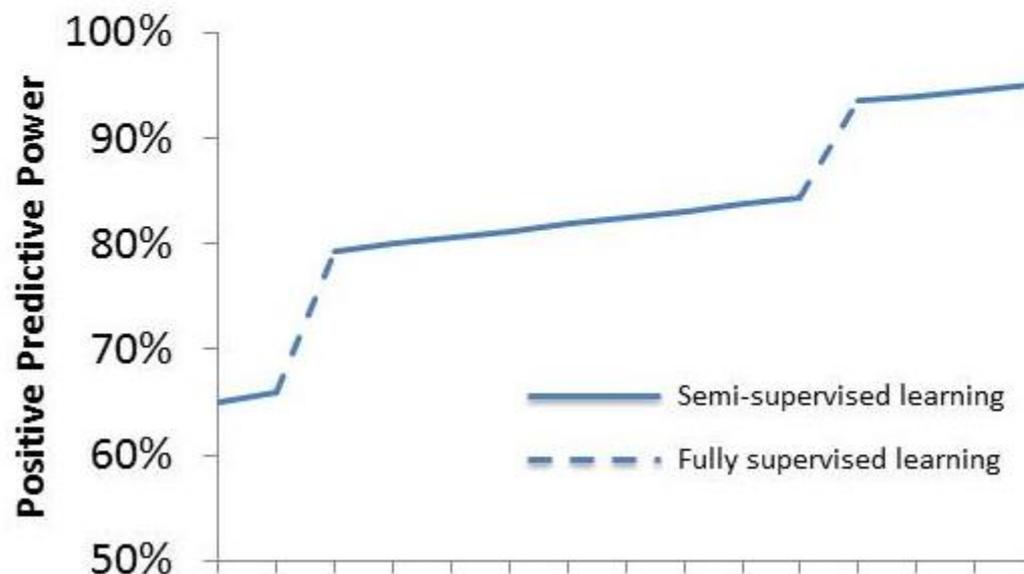


Study Flow



Aim 1: Accuracy of Durkheim over Time

Figure 2. Projected Increases in DPA Predictive Power with Machine Learning Retraining



Aim 2: Impact on Suicide Rates

60200 AI/AN aged 15-24 in the United States

