National Institutes of Health Pathways to Prevention Workshop: Advancing Research to Prevent Youth Suicide

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The National Institutes of Health (NIH) Pathways to Prevention Workshop “Advancing Research to Prevent Youth Suicide” was cosponsored by the NIH Office of Disease Prevention, National Institute of Mental Health, National Institute on Drug Abuse, and National Center for Complementary and Integrative Health. A multidisciplinary working group developed the agenda, and an evidence-based practice center prepared an evidence report that addressed data systems relevant to suicide prevention efforts through a contract with the Agency for Healthcare Research and Quality. During the workshop, experts discussed the evidence and participants commented during open forums. After considering the data from the evidence report, expert presenta-

tions, and public comments, an independent panel prepared a draft report that was posted on the NIH Office of Disease Prevention Web site for 5 weeks for public comment. This abridged version of the final report provides a road map for optimizing youth suicide prevention efforts by highlighting strategies for guiding the next decade of research in this area. These strategies include recommendations for improving data systems, enhancing data collection and analysis methods, and strengthening the research and practice community.

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Suicide is the second leading cause of death in youth (aged 10 to 24 years) and young adults (aged 25 to 34 years) and has claimed the lives of 12 073 persons in these age brackets in 2014 (1). Many risk factors (for example, depression, mental disorders, substance abuse, prior suicide attempts, family history of suicide, family violence, exposure to suicidal behavior, or incarceration), precipitating events (such as shame, loss, or relationship disruption), and environmental circumstances (for example, access to lethal means) contribute to suicidal behavior. Although prevention is daunting, the obstacles created by the complex factors involved in suicide are surmountable. New coordinated research strategies that embrace this complexity are necessary.

To address these issues, the National Institutes of Health (NIH) convened the Pathways to Prevention Workshop “Advancing Research to Prevent Youth Suicide” in March 2016. The overarching goal of the workshop was to summarize youth suicide prevention efforts. The workshop was cosponsored by the NIH Office of Disease Prevention, National Institute of Mental Health, National Institute on Drug Abuse, and National Center for Complementary and Integrative Health. A multidisciplinary working group developed the agenda, and an Evidence-based Practice Center prepared an evidence report that addressed data systems relevant to suicide prevention efforts through a contract with the Agency for Healthcare Research and Quality. During the workshop, experts discussed the evidence and participants commented during open forums. After considering the evidence report, expert presentations, and public comments, an independent panel prepared a draft report that was posted on the NIH Office of Disease Prevention Web site for 5 weeks for public comment. This abridged version of the final report (<https://prevention.nih.gov/programs-events/pathways-to-prevention/workshops/binders/2016/suicide-prevention/workshop-resources>) highlights strategies for guiding future research on youth

suicide. These strategies include recommendations for improving data systems, enhancing data collection and analysis methods, and strengthening the research and practice community.

IMPROVING DATA SYSTEMS

Table 1 shows recommendations for improving data systems that focus on better identifying persons at risk for suicide and advancing knowledge of risk factors. The availability of effective data systems for examining risk and outcomes is limited. For example, the accompanying systematic evidence review (2) identified only 6 of the 153 suicide prevention studies that linked suicide data from multiple sources, which limited researchers' capacity to study determinants, mediators, and moderators of suicidal behaviors and suicides. Poor documentation of interventions (for example, scarcity of usable data dictionaries and comprehensive clinical records) compounds the problem of inadequate data systems. The lack of comprehensive linked data resources makes it difficult to identify at-risk persons.

Because not all states mandate use of cause-of-injury codes, the ability to understand the magnitude of suicide, suicide attempts, and risk factors of suicide is hampered when they are not used by medical departments or on insurance claims. Obtaining a complete picture of suicide and related factors would require federal mandates for health care providers to use cause-of-injury codes. Improved standardization and consistent use of such codes would enable researchers to conduct more accurate studies of suicide risk and prevention. Without additional mandatory coding, it is not possible to determine whether the death was a ho-

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Table 1. Recommendations for Enhancing Data Systems to Improve the Ability to Identify Persons at Risk for Suicide

Develop and implement standardized measures generalizable across settings, communities, and cultures to identify high-risk persons.
Mandate use of cause-of-injury codes to identify suicides and suicide attempts that require medical attention.
Expand surveillance of suicide and suicide attempts by linking data from multiple sources (e.g., state all-payer databases, syndromic data from emergency departments, data from electronic health records, health information exchanges, accountable care organizations, and research data).
Encourage and facilitate efforts to document implementation and measurement details (e.g., code books and data dictionaries).

micide, suicide, or accident. Implementing mandatory external cause-of-injury coding would enable public health officials and prevention science researchers to capitalize on these data to identify means of suicide. This recommendation is paramount because nearly half of reported suicides involve firearms as the means.

Additional surveillance on suicides is paramount to obtain a complete picture. The National Violent Death Reporting System provides an example of a surveillance system that could yield insights into the causes of and context for suicides by linking data from death certificates, law enforcement reports, crime laboratories, and medical examiner reports. These data are not available in all states, and the reporting only addresses deaths from suicide. However, surveillance systems should be expanded to capture suicide attempts and related behaviors. Linking surveillance and administrative data should be encouraged because it would better inform suicide risk and behaviors that could lead to suicide. Researchers need training to identify and obtain permission to use data sources found in school, municipal, state, and federal records (for example, to make sure consent forms explicitly ask permission to link with other data sources).

Policies at the state and community levels share a role in improving our ability to understand suicide and suicide attempts. State all-payer claims databases could provide communities with local data about suicide and suicide attempts. Under the Patient Protection and Affordable Care Act, accountable care organizations or health information exchanges could provide local communities with population data. Claims databases can be cumbersome, require extensive cleaning and specialized expertise to analyze, and are not always timely. Some of these limitations can be addressed through coordinated efforts at the state level. By improving these systems, states have the opportunity to be innovative with syndromic surveillance data, which could be used to identify patients who need better care management or to help target community-level interventions.

Some policy and practice issues are difficult to rectify because of social stigma, governance, conflicting legal goals, a fragmented death scene investigation system, silos of isolated research teams, and unique data systems. Until suicide and mental health issues are destigmatized, reporting will be inaccurate. Reporting

and tracking suicidal behavior and its precursors are hampered by disincentives embedded in policies and practices from the federal to the local level. Families and medical providers are often reluctant to label events as suicides or suicide attempts for many reasons, including legal concerns, cultural issues, community referral patterns, and the lack of standard procedures for investigating suicide death scenes.

IMPROVING RESEARCH DESIGN AND ANALYSIS

Table 2 depicts the panel's recommendations for improving research design and analysis of complex systems. Descriptions of several innovative and promising techniques follow.

Conduct measurement at multiple levels. Measurement is an especially ripe area for improving data systems in suicide prevention research. Measuring risk and protective processes at several levels—including the individual, family, peer group, school, and community—facilitates the process of investigating and understanding the complex factors central to suicide risk across diverse populations. At the lowest level, information on biomarkers and biological processes is important for advancing the continuum of suicide research, from surveillance to basic research and then prevention studies.

Novel ways of integrating neurobiological measures into the science of suicide prevention research are needed. Schools could collect electronic data on student head injuries, for example, and link these to school and health records to help identify youth at increased risk for suicide. Biological measures may improve the effectiveness of evaluation research. Evidence for the protective effects of mindfulness and meditation practices would be strengthened by including biological measures, such as cortisol. Incorporating these measures into studies of suicide risk and prevention will help identify potential treatment approaches for ameliorating the adverse effects that trauma and stress have on youth suicide risk.

Psychological and developmental processes also play key roles in suicide risk and prevention. Workshop participants noted the need for psychometric work addressing the measurement of personal characteristics, such as sexual orientation and identity, and for processes displaying universal prominence and culture- and context-specific importance across diverse populations. Rather than adapting existing measures to new cultural contexts, direct development of theoretically informed measures for a given cultural context is warranted.

For persons identifying as sexual and gender minorities, measures of peer and self behaviors and attitudes salient to gender identity and sexual orientation can help to better identify the correlates of suicide risk. Research indicates higher rates of suicide among transgender youth than gay or lesbian youth. General methodological improvements in measurement, such as visual analogue scales, computerized adaptive testing, and multiform questionnaire protocols to collect data, would increase the generalizability of findings.

Perhaps the least extensively investigated domain concerns measuring the settings and contexts beyond the individual and family levels. Ecometrics, the measurement of environmental contexts, is essential to accommodate the multilevel analytic approaches needed for this field of research. Innovation in this area includes direct assessment of constructs, such as climate and aggregate indicators that can come from linkable administrative data (for example, police records).

Assess developmental and longitudinal change. Despite the importance of dynamic change processes in youth suicidal behavior, few studies have addressed how changes and reciprocal influences among risk and protective factors influence youth suicidal behaviors across multiple time scales (short- and long-term changes). Longitudinal information is lacking about the processes and provider practices occurring among suicidal youth, particularly right before suicide. Our capacity to design interventions aimed at preventing suicide depends on longitudinal research that can better capture the complex interplay among imminent and long-term factors in predicting suicide ideation and attempts.

By incorporating a broader repertoire of predictors into a longitudinal context—whether in a single study or through the use of linked studies—we are better positioned to understand the mediating, moderating, and reciprocal mechanisms underlying suicidal behavior. Studies integrating qualitative and quantitative data on these mechanisms will then better inform approaches to optimally time and maximize prevention efforts. Children who question their gender identity, for example, may be rejected by parents, teachers, or peers; rejection, in turn, may increase a child's social isolation and depressive symptoms that can further escalate rejection behaviors.

Measurement and design strategies that facilitate the study of changes over time and across developmental periods will help inform the timing and targets for interventions that can interrupt the recursive cycle of negative social interaction. Growing evidence points to the potentially powerful effects of short-term predictors (for example, insomnia, exposure to coping or self-regulation skills, peer support, intervention efforts from teachers, and real-time sharing for care management) on longer-term suicidal prevention processes. Such cascading, multiple time-scale effects offer a renewed way to conceptualize and test mediation and moderation. To evaluate the long-term effects of intervention programs, we recommend that researchers collect and integrate measurements from multiple time scales, including measures of likely mechanisms of change. Integrating evidence-based results with theory and methods will help ensure high-quality, effective suicide prevention efforts.

These modeling efforts are enhanced by using latent variable approaches to test critical assumptions, such as the psychometric equivalence of constructs across time and subgroups, and adjust important estimates for various sources of measurement and sampling error. At group and network levels, powerful methods exist for modeling important effects, such as diffusion, contagion, selection, and socialization as well as propagation of risk or protective factors and associated processes.

Model multilevel structure. Compelling evidence exists for the multilevel nature of factors and processes tied to youth risk for suicidal behavior. Research rarely assesses or analyzes the interrelated and nested social processes and structures tied to suicide risk, particularly at higher levels of influence, such as the school, neighborhood, and community. Settings at a higher,

Table 2. Recommendations for Improving Design and Analysis

Design studies to ensure adequate coverage of data at multiple levels (e.g., family, school, and community) and longitudinally (across time and the life course).

- Move beyond a focus on individual-level data by collecting and analyzing multilevel data to represent effects over multiple levels of influence.
- Use appropriate analytic methods to study cross-level moderation and mediation.
- Use broad measurement strategies to improve measurement of ecometrics and psychometrics.
- Use longitudinal methods to study dynamic and potentially reciprocal effects over multiple time scales (e.g., the effects of short- and long-term risk factors) and developmental periods.
- Incorporate person-centered methods to identify and model unknown heterogeneity in risk and protective factors and processes over time.
- Explicitly represent known heterogeneity, such as sex and race (e.g., as fixed effects and multiple groups).
- Use latent variable approaches to test critical assumptions (e.g., measurement equivalence) and consolidate measures.

Design studies and primary data collection efforts to facilitate data integration, linking, and pooling data across multiple studies.

- Include a subset of common measures or linking items to integrate and pool data across studies.
- Model linked data from multiple sources (e.g., administrative and surveillance data).
- Incorporate information from multiple sources (e.g., teachers, schools, families, and peers).

Use principled, valid, and current missing data techniques (e.g., full information maximum likelihood and multiple imputation) to adjust for the effects of missing data mechanisms.

- Design studies to ensure adequate coverage of baseline variables that may predict unplanned missing data.
- Use planned missingness designs as a cost-effective way to ensure adequate sampling and measurement coverage.

Broaden methods for drawing valid conclusions to inform policy and practice.

- Integrate information from randomized, controlled trials and observational data (bias-adjusted models, such as cross-design synthesis).
- Use techniques that improve the robustness and scientific rigor of studies in which randomization is not possible (e.g., modifications and extensions of quasi-experimental designs, such as regression discontinuity and interrupted time-series designs, and propensity score methods).
- Use meta-analysis to consolidate the strengths and identify the limitations of current intervention programs or implementation efforts.
- Use network and related methods to better understand group effects (e.g., diffusion, contagion, selection, and socialization) as well as propagation of risk or protective factors and associated processes.

Table 3. Recommendations for Building and Strengthening the Research and Practice Community**Encourage cross-sector collaboration—that is, communication and the exchange of information—among, for example, researchers, public health professionals, health care providers, law enforcement, policymakers, community organizations, and educators.**

- Increase research into policy and other approaches that restrict access to means of suicide (e.g., laws about open carry of firearms, state waiting periods and background checks before gun purchase, and gun safety locks).
- Increase research into policy guidelines restricting access to information about suicide events (e.g., Health Insurance Portability and Accountability Act and Family Educational Rights and Privacy Act).
- Facilitate practitioners' ability to identify effective programs for their target groups by creating a menu of evidence-based suicide prevention programs with guidelines and descriptions of persons/schools/communities that have benefited from the past prevention programs.
- Disseminate information on what works and what does not and to what extent and in what context.
- Disseminate aggregated data for use in community prevention planning and evaluation.
- Encourage collaborative efforts among researchers, methodologists, and practitioners.

Provide education, training, and dissemination of research findings.

- Promote awareness and understanding to reduce stigma associated with suicide.
- Educate health care professionals, parents, educators, and others who work with youth on current, new, and recurring issues related to youth suicide risk factors and prevention strategies.
- Provide training opportunities for researchers and practitioners interested in using advanced methods to test theories.

more distal level (for example, community) can have a cascade of effects on youth suicide risk by shaping family and individual functioning. Studies of multilevel effects on suicide risk suggest that interventions addressing community- and family-level factors may affect many persons to a greater extent than typical individual-level interventions alone. Variations of universal intervention programs sensitive to multilevel structures should be designed and evaluated to effectively target individual- and higher-level risk factors. Multilevel analytic techniques help adjust for issues of known clustering (for example, families nested in communities) and thus can capture the heterogeneity across multiple levels and cross-level mediation or moderation effects. Several methodological challenges must be addressed to estimate multilevel effects on youth suicide risk. These challenges also manifest in the measurement and design needs to adequately represent the various levels of a multilevel structure.

Examine known and unknown subgroups. Subgroups and subpopulations contribute to the heterogeneity of study cohorts. These subgroups can have differential effects and patterns of change. Methods to model known and unknown heterogeneity can identify and explicitly delineate these differential effects. When suicide risk groups are known (for example, those defined by gender identity and orientation), membership can be explicitly compared as multiple groups to examine various influences, including moderation by group membership. When not explicitly known, the various suicide risk subgroups that are often embedded in universal programs can be identified. Mixture modeling identifies subgroups of persons whereby predictors and outcomes of group membership can inform the differential effects and outcomes of suicide prevention research.

Integrate and link data across studies. Another recommendation involves coordinating efforts in the broader research community. Integrative data analysis uses a set of common measures across 2 or more studies to link the data. These linked studies can be combined as an integrated data set that allows greater overall power to identify hard-to-detect mediating and

moderating mechanisms and greater representation of suicides, which are infrequent in any given study or setting. Including common measures and linking items across projects, coupled with principled treatment of the missing data, would expand the power and validity of the larger research portfolio sponsored by funding agencies. The data archive of the National Institute of Mental Health (<http://rdocdb.nimh.nih.gov>) is an important sharing platform for integrative data analysis, but the linking information must be coordinated and highlighted.

Use stronger inference strategies. Most randomized, controlled trials (RCTs) are characterized by strict exclusion criteria that limit generalizability for suicide-related research. Recent methodological advances, however, offer alternative methods to strengthen valid interpretations from non-RCT data. Propensity score methods can be used to study group differences, probe for unmeasured confounding effects, control selection effects in mediation analyses, and infer aggregate effects in studies where random assignment is not possible. Further, quasi-experimental designs, such as the regression discontinuity design, are relevant for suicide prevention research. Cross-design synthesis also can be used to help combine RCT and observational data. These designs facilitate valid inferences based on targeted variables and can account for the effects of moderators across the range of studies. Of note, multidisciplinary collaborations can integrate the strengths of multiple techniques to overcome weaknesses and the restrictive assumptions of any single technique or study.

BUILDING AND STRENGTHENING THE RESEARCH AND PRACTICE COMMUNITY

Table 3 provides recommendations for building and strengthening collaborative efforts among researchers, methodologists, and practitioners. Building a coordinated research and practice community would foster data linking, translating research to practice, and disseminating aggregated data needed for community planning. The research community would need to co-

ordinate at multiple levels, including developing requests for proposals, having preaward discussions with program officers, and sharing across projects among various principal investigators of funded research. The practice community would also need to coordinate the coupling of administrative data.

Interdisciplinary collaboration is critical to identify highest-risk persons for inclusion in targeted prevention efforts (both universal and indicated approaches). Youth who die by suicide may not have had prior contact with mental health providers; however, they may have interacted with educators, coaches, medical providers, and other community members. Research identifying effective policies, such as gun control, to prevent the means to suicide events is needed. Similarly, population-based efforts can and should draw on cross-sector collaborations (for example, schools, law enforcement, parks and recreation departments, and faith-based organizations) to strengthen protective factors in individuals, families, and communities. Recognizing the broader costs and effects of youth suicide is a critical part of policy agenda that can be addressed only by strengthening the larger community of researchers, practitioners, and stakeholders.

Participation in education and training opportunities is also needed to build and expand the research and practice infrastructure. Providers, agencies, families, and communities need education on the importance of removing the stigma associated with suicide. Improving messaging and social norms around mental health and suicide may help destigmatize suicide and promote connectedness within families and communities. Training in the advanced design and analysis techniques described here must be made readily available, and all members of collaborative teams should be given access to these training opportunities. Broadening the understanding of the merits of using the workshop presenters' recommended procedures is critical to bringing these procedures into the realm of standard practice.

CONCLUSION

As researchers and practitioners, we must unite to stop youth suicide in order to circumvent its associated economic cost and devastating pain and suffering. We must build and strengthen both coordination and collaboration among all members of the larger policy,

practice, and research communities. We need to improve and coordinate the various surveillance and administrative data systems across these sectors. We must also elevate the level of rigor and breadth of methods used in studies of suicidal behavior. Adherence to the recommendations summarized herein provides us with a roadmap to our ultimate goal—eliminating suicide.

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