Surfacing System Perspectives to Guide Action and Improve Collaboration in Comprehensive Community-based Suicide Prevention

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Dynamic Problem: Community rates of suicide death have increased in this millennium across the U.S. [1], while rates in other countries continue to decline [2]. Suicide emerges from many interacting individual, community and interpersonal factors affecting risk and protection from suicide as well as other forms of injury [3-4]. As such, many interdependencies in causes exist at community levels. For instance, a decline in life expectancy in the U.S. is now attributed to the 70,000+ drug overdose deaths recorded in 2017 [5-8]. Drug overdose deaths continue to increase: the 2017 U.S. age-adjusted death rate was 3.6 times the 1999 rate (now 29.1 or 14.4 per 100,000 men or women, respectively) [7-10]. As overdose deaths rates rise precipitously, so does the count of suicide deaths as coroners classify deaths due to intent [11-12].

Suicide and drug overdose-related injurious deaths are particularly vexing public health problems individually; that causes intersect requires a broader prevention focus around *self-injurious mortality behaviors* (SIM) especially as cases are increasing across *many* differing socio-economic groups in the U.S. However, such broadly defined prevention initiatives are not yet present. Rather, the rising rates of SIM deaths is resulting in new resources dedicated to either suicide or overdose death to reverse increases seen in each form of injurious death found across U.S. communities. That the SIM death rates and counts continue to increase despite increasing investments and in some cases exponentially, this suggests a failure of health care and public health systems to affect underlying interacting causes driving rate increases within U.S. communities. For instance, community level suicide burden reductions resulting from collective community prevention efforts (that have increased in this millennium) such as the federally funded Garett Lee Smith program are short lived to under two years. The increased regulation of access to prescription opioids, rather than reducing overall overdose deaths, is thought to be a major factor responsible for the surge in deaths from illicit fentanyl and heroin - and thus a cause of the rise in suicide deaths. Such continued attention to technical solutions but not system dynamics (complex interdependencies among causal factors) means local systems continue to be "addicted" to intervention, and not fostering lasting rate decreases.

Ultimately, preventing suicide at the community level is a "wicked" and "complex" problem: causes of suicide rates are complex, driven by intersecting socio-ecological, contextual, interpersonal and individual features such as those linked to substance use. Reducing suicide burdens locally will require a mosaic of evidence-based prevention and interventions supported by interactions across many community systems. The application of system-thinking perspectives can strengthen such efforts. We seek this learning to avoid both unintended consequences when different agents affecting communities take action, as well as intervention dependent community systems that fail to address underlying structural causes driving rising rates. Systems science methods can help build insights about the complexity of causes and multiple intervention consequences as health, behavioral health, justice and community services each generate a mosaic of responses to reduce opioid intoxication, addiction, injury and ultimately death from suicide.

Contributions relative to existing literature: To date, most comprehensive prevention efforts tested and promulgated are within single service systems or sectors hierarchically managed, and produce effects on suicide that are fleeting or hard to replicate. Premature deaths typically occur one by one, so prevention efforts predominately strive to reach individuals in or near crisis. Thus, what is thought to be currently relevant to the definition of "comprehensive suicide prevention" (target populations, component interventions) remains limited. Such limitations reinforce "isolated impact" actions (single sectors or agencies deciding action), generate unintended consequences (or miss opportunities to act), and limit learning from actions taken (e.g., the "know how" to address disparate but related upstream determinants). U.S. communities often lack knowledge, relationships, and resources to best import experimentally designed programs or to address comprehensively even a single mortality burden. Without specific collaborative processes that promote learning and working together (e.g., training, data), reductionist thinking also remains. Our project seeks to generate actionable knowledge to support how public health and prevention leaders and community stakeholders collaborate across sectors in the design of broadly effective suicide prevention from a broader SIM perspective. This work-in-progress aligns with a new "public health 3.0" model to engage multiple community sectors and partners in striving for a collective impact approach. Such cross-sector collaboration goals highlight the need for system dynamics methods for planning that help broaden system boundaries to hold multiple sectors accountable to these interdependent outcomes.

For over a decade, the State of Colorado (CO) has explicitly promoted a shared risk and protective factor approach to both injury and suicide prevention [13-14]. Our team is facilitating a comprehensive and integrative approach to suicide prevention being developed across CO, that seeks to "bend the curve" on the increases observed in suicide at the county and state levels. National leaders in suicide prevention are partnering with CO's Office of Suicide Prevention (OSP) in what is referred to as the *Colorado National Collaborative* (CNC). The CNC offers a unique research opportunity to apply collaborative system dynamics modeling as the state embarks to reduce rates and burdens of suicide mortality in six high burden counties. In fostering local county-level stakeholder learning and collaboration with national partners, the CNC seeks a common comprehensive and integrative approach that also responds to local contexts with suicide prevention stakeholders in six counties. We leveraged this opportunity for stakeholder engagement from local county systems as well as the state level. We engaged a variety of local and state system actors (private and government sectors) interacting within and across county settings to collectively produce the state's suicide prevention public health system.

Methods and Preliminary Results: We adapted system dynamics group model building methods [15-16] towards achieving longer-term goals of supporting integrated use of systems and implementation science with community partners to select, pre-assess, plan, and implement synergistic best practices to reduce suicide and risk-related deaths. The process began with defining the dynamic problem (which largely involves defining the boundary and focus in this case on the increase in deaths due to suicide across six CO counties); developing the reference modes; and eliciting causal structures through model building, model presentation and validation – all on the pathway to model analysis and use. Structured facilitation guides were adapted as needed with our planning team [15-18].

We adapted the group model building method to a video-conferencing group model-building format (5 sessions, 90 minutes each). Our core modeling team worked with county and state stakeholder leaders representing three geographically dispersed counties across the State of Colorado, over five months, to complete these. Reference modes were drawn and displayed via Zoom (videoconferencing software) to guide the stakeholders in identifying critical trends/patterns and explaining dynamic behavior through annotation of trend lines and verbal storytelling [29]. Causal loop diagrams (CLDs) integrated stakeholder hypotheses about key dynamics regarding local factors driving increases in suicide over time.

Key feedback loops involved dynamics linked to: social contagion, social isolation and loss of community, loss of trust in crisis services and when seeking mental health treatment, normalizing support seeking, as well as effects of trauma that are short term (numbing) or sustained such as due to exposure to gun violence trauma or consequential long-term "trouble" (social distress). This method allowed stakeholders to see how work in suicide and other forms of injury (gun violence, substance use related) are part of a broader system, and helped them learn about how changes in different aspects of the system will impact other outcomes. A diversity of targets for action were developed by these stakeholders from different public and health systems looking to deliver a comprehensive evidence-based practice (EBP) bundle within and across CO county-based suicide prevention enterprises.

Participants reported this method helped them understand how local community-sited interventions intersect to affect outcomes (for example, supporting the identification of individuals with substance use and connecting them to treatment). Participants recognized the tripartite need to learn to: a) partner or cross-sector collaborate, b) see system complexity to understand what is most important and also most impactful in driving population change within their given community, and c) support action efficiently. While they learned how local suicide and injury prevention systems can grow to successfully prevent suicide in comprehensive strategies in their community (by leveraging other prevention stakeholders), they also noted that working at these broader system roles went beyond their current authority and resources.

We have begun converting the qualitative CLD diagrams to stock and flow concept models for simulating the "physics of the system" – to depict focal dynamics in county suicide rates over time in terms of the stocks (accumulations) and flows that determine the stocks over time. We now are next seeking to develop these models using clinical and other local data, research evidence, and expert opinion. We are now focusing on the core dynamic structure to parameterize and test next, as this work progresses.

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