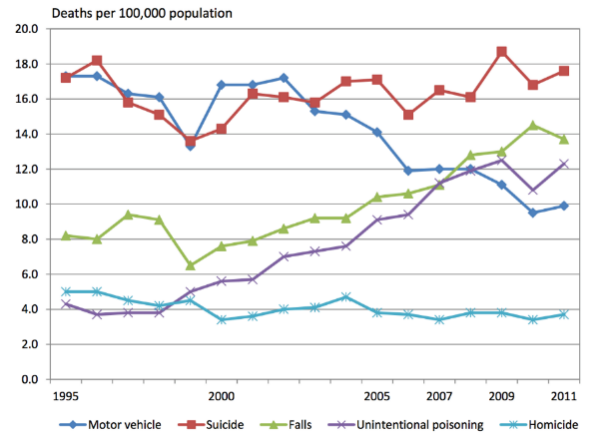


Learning About Shared Risk and Protective Factors to Promote Comprehensive and Collaborative Approaches to Prevent Suicide and Other Forms of Premature Death by Injury

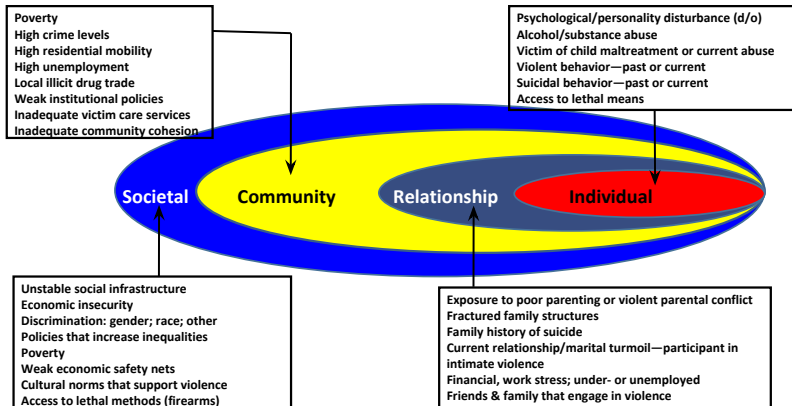
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Dynamic problem. We aim in this session to discuss the application of system dynamics simulation modeling, borne from stakeholder and modeler input. We aim to create new knowledge and tools for communities seeking to organize collaborative suicide prevention systems with those working to prevent other risk-related forms of injury. Today, suicide is a leading cause of death across the US. As rates of death rise, the system of supports that prevent suicide are increasingly unable to meet the needs of people in crisis; we lack effective means to stem the tide. This failure generates enormous costs for states, other public systems, and immeasurable human suffering. At the same time, re-occurring, stunning mass tragedies confront the U.S., leaving troubling questions about linkages between suicide, violence, public safety, firearms, mental illness, privacy and personal liberties. Determinants (largely tied to underlying behavioral distress) interact, directly, indirectly, and in delayed ways, to produce any of these deaths in communities. Rates and burdens of premature death linked to injurious behavior change over time. Resulting population patterns in suicide and risk-related injurious death like overdose poisonings causes great concern – suicide rates are rising in states across the U.S. (see figure: age-adjusted rates in Colorado by year) [1,2]. In 2010, more than 30,000 firearm deaths, 19,000 suicides and 11,000 homicides occurred, leaving a wake of suffering and cost for survivors and communities in the U.S. [3].



Several ecological features are well documented contributors to underlying community burdens of suicide, as well as to other forms of injurious mortality such as drug overdose or violence. Epidemiological evidence depicts an ecology of common risk and protective factors across individual, relational, community and societal levels can determine suicide and other behavioral forms of injury like violence (see figure) [4,5]. Research on risk and protective factors demonstrates equifinality with suicide, and multifinality to other forms of injurious behavior and death, resulting in community trends in each outcome that can be similar or at times different.

Ecological model: Shared risks for interpersonal violence and suicide in the U.S.
(modified by Caine from Krug et al, eds: *World Report on Violence and Health*. WHO, 2002)



fractured with a focus on singular programmatic approaches. Premature deaths typically occur one by one, so community response predominately strives to reach individuals in or near crisis. Surveillance focuses narrowly on factors proximal to the death event, despite personal histories that could have resulted in other mortality.

A new theme for action is to transform “isolated impact” approaches into more deliberate and synergistic collaborative, linked and preventative interventions across public health practice areas to enhance change [8]. Simultaneous population-level impacts on a host of outcomes (e.g., suicide, violent offenses, and family violence, etc.) have been observed when members of a singular prevention system increase collaboration [9-13], such as military units or health systems [10,14]. However, lacking are replicable methods and tools to build community prevention inputs and risk profiles that respond to both equifinal (i.e., different factors lead to same result) and “multifinal” (i.e., same factor leads to different results) patterns of causation.

The existence of common community sites for hosting a broad public health approach to prevent injury and suicide drive an imperative for more knowledge of dynamics to understand linkage [4]. Intentional decision-

Models of how community exposure to one form of “injury or violence” may cause other forms are lacking, yet these behaviors spread, cluster, and morph into other forms of distress [6]. How risk or protective factors function causally (simultaneously influencing suicide and relatable avoidable death at community levels) is not well understood via system dynamics (SD) due to designs of previous studies in the literature (i.e., correlations of individual risks) [7]. Studies on how various community factors influence one another are needed in the field of suicide prevention. Similarly, public health practice remains

making around collective actions is compromised as each component action can have inadvertent or negative consequences on related determinants. Given incomplete understanding of the system of forces driving risk of preventable death [15-17], collaborative prevention remains complex and limited in uptake and implementation. **Contributions relative to existing literature.** Most research has failed to integrate SD designs into studies of suicide or its risk-related outcomes of violence and injury. Suicide is typically studied as a singular outcome, with individual-level causation. Two recent studies model suicide as an individual behavior that can be influenced by specific modalities of suicide-focused intervention [18-19]. Alternatively, we aim to discuss new SD models to explain how *'common' risk or protective mechanisms of communities* inter-operate to produce suicide and its risk-related outcomes. In our current study, we are addressing the challenges by studying the complexity of interconnections among common upstream risk and protective factors (R/P). We extend SD literature that draws on disconnected or singular policies and intervention-based evidence focused on suicide.

Research hasn't often broadened the scope to linked outcomes, resulting in little knowledge of how factors interact to produce equifinality with suicide, or multifinality with other forms of death; neither have simulation models of suicide based on fine-grained county-level risk and protective features yet emerged. We seek to advance knowledge to help sustain the bevy of behavioral health-directed prevention, a great challenge to address by understanding the "value-add" of preventing one mode of death while aiming at another.

Method used to be discussed. Our project goal is to develop SD simulation models of suicide at county levels in the State of Colorado (CO), to produce greater understanding of how shared ecologic factors influence rates and prevalence of injury, violence and suicide. We have examined feasibility and acceptability for assembling simulation models to learn with CO partners and its key public health stakeholders, as we collaboratively initiate comprehensive, integrated county efforts to prevent suicide and risk-related premature deaths. We have created causal loop diagrams (CLDs). We now are developing quantitative models of component inter-relationships (common community R/P and prevention system features that underpin changes over time in CO's premature mortality rates or burdens) to build SD models for population simulation.

SD methods identify linked hypotheses causing change. For instance, changes in risk factor exposures may accumulate, or mitigate in a community system, a change that can be operationalized as a "stock" (a quantifiable feature of the system that can go up and down over time). SD has yet to be applied adequately in suicide prevention, yet communities have complex dynamics produced by a web of interconnected factors that result in: variation in timing between change and ripple effects (immediate to generations), nonlinear relationships between factors (threshold effects, tipping points), and feedback loops [15]. We thus propose a discussion session to have frank consideration of strategic needs in model-building. We will seek to discuss utility of modeling choices when people are developing cross-cutting, singular prevention that recognizes equifinality in suicide cause. We will discuss how to layer multifinality— i.e., how R/Ps integrate with others and shape injury or violence more broadly. We recognize we can't just model equifinality due to multifinal effects. For instance, committing violence can lead to incarceration, which in turn can change risk of suicide or other self-injurious mortality as incarceration history reinforces multifinality. Or, a vicious feedback cycle can emerge when increases in community violence erodes connectedness: weakened social fabric can result in greater risk for suicide (but not be the single cause of any one suicide) as well as further violence.

To understand the interactions among R/Ps, we have conducted CLD-building interviews to learn CO stakeholders' divergence in mental models or dynamic hypotheses about how suicide can be comprehensively prevented. We have collectively reviewed linkages across the hypotheses. We are now working to translate these aggregate causal models into concept models useful for generating estimates of possible community system response, via simulation methods that can become future decision tools for planning. We are converting CLDs into stock and flow diagrams to enable simulations of system behavior over time to test consistency with county trend data on suicide and risk-related mortality in CO. We have identified secondary data sources to inform model assumptions, quantify relationships, and test consistency of alternative models [20-21]. State data on county burdens and characteristics with published literature on R/P effect sizes comprise our data to create and test these concept models (of causal hypotheses about how community features interact to produce county system behavior over time). We are now creating "light" quantitative models of the dynamic interplay of causes for comparison with these community data, to learn how hypothesized dynamics behave. We use simulation to observe the hypothesized cause and effects for model iteration and refinement. We will discuss how we are utilizing the data in models of shared risk and protective determinants of suicide (see diagram), to advance learning about multifinality, or when toggling between outcomes.

Preliminary results. CLDs demonstrate that prevention system qualities (e.g., a focus on shared R/Ps) and community features (e.g., access to means for violence or suicide) are two example areas where causal paths

verge into equifinality or multifinality and lead to complex feedbacks. **Broader impacts.** Advancing these aims will prepare methods for use in: a) future local and state policy and program development, b) fostering comprehensive community involvement in suicide prevention, and c) predicting setting influences.

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