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## A systemic approach to achieving population-level impact in injury and violence prevention

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### Abstract

The contemporary public health model for injury and violence prevention is a four-step process, which has been difficult to fully actualize in real-world contexts. This difficulty results from challenges in bridging science to practice and developing and applying population-level approaches. Prevention programmes and policies are embedded within and impacted by a range of system-level factors, which must be considered and actively managed when addressing complex public health challenges involving multiple sectors and stakeholders. To address these concerns, a systemic approach to population-level injury and violence prevention is being developed and explored by the Division of Analysis, Research, and Practice Integration in the National Center for Injury Prevention and Control at the Centers for Disease Control and Prevention. This article makes the case for and provides a high-level overview of this systemic approach, its various components, and how it is being applied in one governmental unit.

### Keywords

adaptive action; collaborative inquiry; injury; public health; systems thinking

## 1 | INTRODUCTION

Intentional and unintentional injuries continue to be the leading cause of death and disability for Americans between the ages of 1–45 (Centers for Disease Control and Prevention, 2010). In 2015, more than 200,000 people died from unintentional injuries and violence, and approximately 27 million people suffered nonfatal injuries (Centers for Disease Control and Prevention, 2010). Public health scientists and practitioners are charged with achieving and measuring community and population-level impact in injury and violence prevention. Our primary approach to date has been the public health model (Sleet, Hopkins, & Olson, 2003). The contemporary model used in injury and violence prevention is typically a four-step process: (a) defining the problem, (b) identifying risk and protective factors, (c) developing and testing prevention strategies, and (d) ensuring widespread adoption

(Hanson, Finch, Allegrante, & Sleet, 2012; Mercy, Rosenberg, Powell, Broome, & Roper, 1993). Public health practice has, for the most part, successfully applied the first two steps in this model, which predominantly focuses on high-quality surveillance systems and etiological research. However, the model's latter steps—development and testing of effective interventions and widespread adoption—have proven difficult to actualize for injury and violence prevention in “real world” contexts (Hanson et al., 2012). That is, whereas injury and violence's public health approach was developed with an assumption that practitioners, policymakers, and communities would be engaged throughout the process of developing, testing, and implementing injury and violence prevention approaches, (Mercy et al., 1993) this broad scale engagement is challenging and inconsistently applied (Hanson et al., 2012). Practitioners and communities are often not embedded as “full” partners within the process of developing and testing prevention strategies, which contributes to the “research-to-practice gap” between the development of injury and violence prevention approaches and their wide scale adoption. Translation research and implementation science have emerged as disciplines dedicated to bridging this gap by studying the implementation, replication, “scaling-up,” and dissemination of evidence-based programmes across contexts and populations (Wandersman et al., 2008; Woolf, 2008). Numerous frameworks, tools, and resources draw from the findings of these emerging fields to aid communities with implementing evidence-based prevention programmes (Hawkins, Catalano, & Kuklinski, 2014; Wandersman, Imm, Chinman, & Kaftarian, 2000). These resources help communities engage in and apply the research generated in the “third step” of the public health model; however, broad scale implementation and replication of evidence-based strategies continues to be a challenge (Hanson et al., 2012). Additionally, it is not clear whether simply scaling-up evidence-based programmes will create population-level change (Frieden, 2010). Interventions most likely to result in population-level impact are often difficult to evaluate, replicate, and scale-up because of their complexity (Schorr & Farrow, n.d.; Green, 2014).

Increasingly in public health and related fields, there has been movement toward a more systems-science approach to addressing the complexity of most health and social issues (Leischow et al., 2008; Leischow & Milstein, 2006; Luke & Stamatakis, 2012; Mabry, Olster, Morgan, & Abrams, 2008). For example, Hanson and colleagues propose that closing the gap in the contemporary public health model will require the adoption of a transdisciplinary approach that integrates the knowledge and expertise of diverse stakeholders to develop shared understandings of the problem and novel solutions for achieving impact (Hanson et al., 2012). They challenge the injury and violence prevention field to acknowledge the limitations of historic approaches and move toward understanding these issues as intertwined within complex systems (Hanson et al., 2012). The knowledge, adoption, and implementation of effective prevention programmes and policies are only components of the full process for community-level injury prevention (Hanson et al., 2012). Prevention programmes and policies are embedded within and impacted by a range of system-level factors, including organizational hierarchies and capacity, relationships among key stakeholders, leadership priorities, values and preferences, and available resources. Key contextual factors must be considered and actively managed when addressing complex public health challenges involving multiple sectors and stakeholders. This is where the “rubber meets the road” in applying an impactful and sustainable approach to injury and

violence. It requires a shift from the “top-down” or “science push” applications of the public health model toward more substantial inclusion of practitioners, policymakers, and local stakeholders as learning partners and “owners” in the process. This article provides a high-level overview of a systemic approach<sup>1</sup> to population-level injury and violence prevention and how it is being developed and explored by the National Center for Injury Prevention and Control (NCIPC) at the Centers for Disease Control and Prevention (CDC). We first describe a successful systemic approach to population-level health from the field of tobacco-use prevention, then outline the core components of the NCIPC’s systemic approach to injury and violence prevention for achieving population-level impact, and conclude with examples of its preliminary application through internal work in NCIPC’s Division of Analysis, Research, and Practice Integration (DARPI)<sup>2</sup> and with funded external partners.

## 2 | A SYSTEMIC APPROACH TO POPULATION-LEVEL HEALTH: LESSONS LEARNED FROM TOBACCO CONTROL

Although injury and violence-related examples are still emerging, other areas of public health have demonstrated success in reducing morbidity and mortality through systems change (Trochim, Cabrera, Milstein, Gallagher, & Leischow, 2006). Smoking reduction and prevention, for instance, has seen tremendous success over the past 20 years with rates of smoking for U.S. adults decreasing from 42.4% in 1965 to 15.1% in 2015 (Jamal et al., 2016). This population-level impact was not achieved just through scaling-up particular evidence-based programmes, but rather through comprehensive state and national efforts addressing social, economic, health, educational, and policy system “levers,” including state laws increasing cigarette taxes and prohibiting smoking in public and private establishments, institutionalizing cessation interventions within healthcare systems and routine clinical care, and mass distribution of innovative media and public relations campaigns to change social norms around smoking (Centers for Disease Control and Prevention, 2000; National Cancer Institute, April 2007; Services, 2014; Zaza, Briss, & Harris, 2005). These approaches required understanding and addressing the tobacco-use problem with multiple stakeholders working toward a larger, common goal.

CDC’s Office on Smoking and Health offers a “Component Model of Infrastructure,” which identifies state and local infrastructure as a key aspect of effective, comprehensive state tobacco control programmes (Services, 2014). This model provides communities and states with resources, skills, partnerships, and processes through detailing the infrastructure components required for supporting, implementing, and sustaining comprehensive systems change: “networked partnerships,” “multilevel leadership,” “engaged data,” “managed resources,” and “responsive planning.” For example, networked partnerships between organizations and across different content areas enable many partners to perform particular tasks or fill distinct roles that further a common mission. Similarly, “responsive planning

<sup>1</sup>Throughout this paper, we use the term “systemic approach” to differentiate our approach from traditional systems or systems thinking approaches. Rather, our use of the term “systemic approach” refers to our three-component approach, which includes systems thinking as well as the other two crucial components described in the paper. In this way, the “systemic approach” is meant to be inclusive of and more comprehensive than a systems approach.

<sup>2</sup>Note: In July 2019, the National Center for Injury Prevention and Control underwent a reorganization. The work of the DARPI discussed in this paper will be housed within the Division of Injury Prevention moving forward.

ensures that strategic plans are “evolving” and adjusting in response to changes in state and local contexts (e.g., changes in science and funding) through a collaborative planning process that includes diverse stakeholders and viewpoints while fostering shared ownership across partners. “Engaged data” requires that data and information result in action: informing and refining strategic planning, engaging partners, and demonstrating impact (Services, 2014). Overall, this “component model of infrastructure provides an adaptive, responsive, and actionable approach to support, evaluate, and sustain comprehensive tobacco control initiatives via systems change (Lavinghouze, Snyder, & Rieker, 2014).

### 3 | SYSTEMIC APPROACH TO POPULATION-LEVEL INJURY AND VIOLENCE PREVENTION

The tobacco control example suggests that approaches to injury and violence prevention that focus on changing systems—and building the capacity of communities to develop, implement, evaluate, and sustain these changes—offer tremendous promise for achieving population-level impact (Schorr & Farrow, n.d.; Wilkins et al., 2019). A systemic framework supplements the public health model by framing the problem of injury “within,” not outside of, the community or societal context in which it occurs (McClure, Mack, Wilkins, & Davey, 2015). Communities are complex, self-organizing, adaptive, and evolving. Achieving effective, sustainable changes within these systems requires a shift toward a “learning orientation” that prioritizes engaging stakeholders as agents of change through ongoing action and inquiry (i.e., not top-down and research-to-practice orientations) (Kania & Kramer, 2011; Leischow et al., 2008; Smith, Saunders, Stuckhardt, & McGinnis, 2013). However, achieving full, continuous collaborative learning is challenging with partners who may have conflicting perspectives about the problems and needed solutions. Furthermore, public health standards for evidence tend to privilege traditional research methodologies (e.g., experimental and quasi-experimental designs) that necessitate taking a reductionist approach to the complexities of “real world” injury and violence issues and are not well suited to studying community-based, comprehensive, systems-focused approaches (Schorr & Farrow, n.d.; Luke & Stamatakis, 2012). As done in tobacco control, effectively supporting this type of work will require state and local infrastructure for managing, supporting, evaluating, and sustaining systems approaches and a shift toward fostering new mindsets, methods of discovery, collaboration, and facilitation skills through learning (Kaufman et al., 2014).

To address this need, CDC’s NCIPC, through DARPI, is delineating and exploring applications of a systemic approach to enact and evaluate population-level injury and violence prevention, including a systems thinking mindset, collaborative inquiry and adaptive action, and a learning orientation (see Figure 1 and Table 1). Though the components overlap and occur simultaneously, they are explicitly named and differentiated. This has been critical to our emerging work and the process of building internal and external capacity for systems change.

### 3.1 | Systems thinking

Originating and developed in many disciplines, systems thinking is a “mindset” that considers and sees the parts, the whole, and their interconnections (Peters, 2014; Senge, 1990; Trochim et al., 2006). Systems thinking considers multiple perspectives and vantage points as key for understanding an issue. It surfaces and examines the underlying structures, values, and assumptions that drive and influence broader behaviour (e.g., organizational-level and societal-level) responsible for an issue and its associated outcomes and considers the possible consequences—including unintended ones—of actions taken on a part or the whole of a system (Peters, 2014; Senge, 1990). Systems thinking considers boundaries and how the system (and issue of concern) is defined or “bounded”—a critical aspect of determining which observations and judgements are relevant in guiding decisions and actions. Systems thinking is necessarily multi and interdisciplinary and nonreductionist, representing a different paradigm that actively engages complexity and offers that challenges cannot be solved effectively by isolating parts of a system (separated and decontextualized) from the whole. Rather, systems thinking embraces the process of working with and addressing the complex interconnections within the whole system. In practice, there are variety of available “soft” and “hard” tools and methodologies that support a systems thinking approach to addressing complex problems (Hummelbrunner, 2015; Luke & Stamatakis, 2012). However, systems thinking is basically a way of seeing and thinking holistically about the component parts and interrelationships within a specifically-bounded system (and issue), including the multiple perspectives, underlying assumptions, and values that influence the system.

For scientists and practitioners to move toward a systems-thinking, population-level approach, it is crucial to first recognize the difference between technical and adaptive challenges. Technical challenges (sometimes called “routine challenges”) are typically easy to identify, are already understood, have known solutions that can be solved by an expert or authority, and may only require minor changes (Heifetz, Grashow, & Linsky, 2009). Technical challenges may be either simple or complicated but always can be solved with existing knowledge or expertise. For example, a broken leg presents a technical challenge to a physician. Tools and knowledge already exist to diagnose and address the problem. It requires no significant change from the patient or physician to fix. Well-known and traditional injury prevention strategies (e.g., education, environmental design/engineering, and enforcement) have been successful for addressing pressing and persistent technical challenges by applying knowledge learned through previous research (e.g., the use of helmets to reduce motorcycle injury deaths) (Christoffel & Gallagher, 2006). Alternatively, adaptive challenges (sometimes called “wicked problems” (Kreuter, De Rosa, Howze, & Baldwin, 2004)) are typically difficult to diagnose or define, do not have a known solution, are continuously evolving, and usually require new discoveries or the creation of new knowledge to solve (i.e., learning) (Heifetz et al., 2009; Heifetz & Laurie, 1997). Because of their complexity, the people experiencing adaptive challenges must be intimately involved in generating solutions. Often, including these perspectives requires changing values, relationships, roles, and approaches for everyone involved. Frequently, traditional injury prevention strategies are insufficient for adaptive challenges. Instead, a learning orientation is required of stakeholders as they grapple with uncertainty and the limits of their

knowledge. Continuing with a medical example, a patient with symptoms of widespread pain and body aches, fatigue, cognitive difficulties, and depression represents an adaptive challenge. This health dilemma is not easy to diagnose, is likely difficult to understand with its multifactorial symptoms, requires active participation from the patient and other experts (i. e., perspectives) in diagnosing and generating solutions, and requires new learning and continued exploration from the physician and patient. Real world challenges often exist along a continuum between technical and adaptive, sharing aspects of both. For example, motorcycle helmets are a technical solution to a technical problem, but their successful implementation (e.g., ensuring individuals use the helmets) is more adaptive in nature. Understanding these two types of challenges allows differentiation between a group/system that is experiencing a predominantly technical problem or one that is experiencing a more adaptive problem requiring deeper engagement via a systemic approach.

### 3.2 | Collaborative inquiry and adaptive action

This mindset shift toward systems thinking not only changes how we understand adaptive public health challenges, but also fundamentally shifts the processes by which “solutions” for challenges are generated. “Collaborative inquiry and adaptive action” provide the necessary skillsets and practices for enacting systems thinking. These include recognizing adaptive challenges: facilitating active and continuous individual, team, and organizational learning; promoting dialogue and consideration of multiple, sometimes conflicting, perspectives; and conducting iterative cycles of experimentation (action) and reflection (inquiry) that promote deeper learning. Collaborative inquiry is crucial for enabling diverse stakeholders to consider the multitude of perspectives, system parts, and related issues that constitute systems thinking. Key capacities of collaborative inquiry include the willingness and ability to have difficult but effective conversations around contentious topics, soliciting and incorporating disparate viewpoints, and pursuing mutually beneficial problem-solving and action. It means learning how to learn through both individual and collective experience (Kolb, 2014).

While collaborative inquiry encourages collective learning, adaptive action moves beyond asking “are we doing things right?” (single-loop learning) to asking “are we doing the right things?” (double-loop learning) (Argyris & Schon, 1978; Hummelbrunner, 2015). Adaptive learners use feedback from past actions and outcomes to challenge and change underlying strategies, mental models, and decision rules that influence behaviour (Argyris & Schon, 1978). Adaptive action requires engaging in iterative cycles of action, (e.g., experimentation and course corrections in the midst of grappling with knowns and unknowns) followed by periods of reflection (or inquiry; e.g., “ongoing disciplined inquiry” and reflective practice (Schorr & Farrow, n.d.; Schön, 1983)). Adaptive action urges openness to ongoing testing and revision of underlying assumptions, perspective, and strategies. As such, adaptive action supports individuals and systems in learning their way through complex, ambiguous adaptive challenges. Related problem-solving tools, processes, and approaches that feature collaborative inquiry and adaptive action (e.g., action research) exist. These tools facilitate surfacing and working with multiple perspectives and underlying mental models while engaging in action-reflection cycles. They provide a different way of taking action that privileges learning with stakeholders in the problem solving process and a “ground up”

approach to generating buy-in and “solutions” rather than standardized approaches that may be a poorer fit.

### 3.3 | Systemic science and methods

Applying and evaluating systems approaches at the population-level requires scientific tools, methods, and evidence that allow for complexity. This includes, but is not limited to, methods from systems science (e.g., systems dynamics, network analysis, and agent-based modelling) and requires the use of tools beyond what is currently considered rigorous and valid (Schorr & Farrow, n.d.; Gates & Dyson, 2017; Luke & Stamatakis, 2012). It means shifting values around “ownership” of knowledge-production and evidence-building. Historically, traditional intervention research has been privileged when determining “what works” in injury and violence prevention. A systemic approach instead prioritizes knowledge production, evaluation, and collective learning from stakeholders across research, practice, policy, and communities. In the field of evaluation, there has been vigorous discussion about “hierarchies of causal evidence and methods” and the various approaches for determining causality of intervention and programme effectiveness (Gates & Dyson, 2017). Part of this discussion has called for expanding approaches and methods that establish causality beyond experimental designs only, particularly when evaluating the effectiveness of complex, community-based interventions (Briggs, 2007; Gates & Dyson, 2017; Luke & Stamatakis, 2012).

To facilitate this, it is necessary to further develop and incorporate scientific methods that (a) capture the process and details of change in complex systems, (b) support “ongoing, disciplined inquiry” and action within local contexts, and (c) document and offer “inspired examples” for other contexts grappling with similar issues (Schorr & Farrow, n.d.; Taylor, Schorr, Wilkins, & Smith, 2018). Specifically, the use of case studies and other qualitative designs (e.g., comparison analysis and stakeholder-based and narrative approaches) that capture local, contextualized knowledge as well as stories of micro-changes and impact may be more suitable. Certainly, experimental and quasi-experimental designs may be applied where feasible and appropriate. However, these may not be the de facto gold standard over other designs that are more appropriate for complex, community-level interventions and applied social science. Although experimentally rigorous methods are helpful (and sometimes necessary), they are not sufficient at capturing the nuance and complexity at the systems-level. Rather, systemic approaches require a more expansive application of mixed methods and other rigorous methodologies. Some such approaches already exist with extensive use in disciplines adjacent to public health, (Gates & Dyson, 2017) including community psychology (Foster-Fishman, Nowell, & Yang, 2007) and social services (Wolf-Branigin, 2012). For example, community-based participatory research is a research approach that is used across a number of disciplines and incorporates principles of collaborative inquiry and adaptive action into its methodologies (Israel et al., 2005; Israel, Schulz, Parker, & Becker, 1998). The field of systems science also offers methods that better enable measurement of complex phenomena such as emergence and are already being applied in some cases within the field of public health (Luke & Stamatakis, 2012). In other cases, innovations in methods are needed to address current knowledge gaps. The Friends of Evidence offer a useful framework that outlines components of an expanded

understanding of what “evidenced-based” means.<sup>3</sup>(Schorr & Farrow, n.d.) The framework encourages fuller consideration of science and methods for evaluating systemic approaches to population-level injury and violence prevention.

### 3.4 | Limitations

Although a systemic approach to prevention has potential, it is not without limitations. It is an emerging and complex approach that has not been widely implemented and evaluated; requiring a commitment to learning and refinement. Further testing is needed to determine its feasibility and utility in the injury and violence prevention context. As a paradigm shift, this approach will also require injury and violence preventionists to develop new skills and capacities that are not part of typical public health training, such as knowledge of systems science study designs and analytic methods, and collaborative learning principles and practices (Luke & Stamatakis, 2012).

## 4 | NCIPC’S CURRENT AND EMERGING APPLICATION OF A SYSTEMIC APPROACH

Within CDC’s NCIPC, DARPI explicitly is structured to integrate scientific and practice efforts related to injury and violence prevention, making the division a natural place to explore systems approaches related to both intentional and unintentional injury. Working across injury and violence topics, DARPI’s portfolio is focused on four main functions: (a) contributing to the collection of timely injury/violence burden data, (b) advancing innovation and practice improvements, (c) implementing quality, relevant interventions, and (d) strengthening prevention efforts through evaluation and improvement. DARPI’s functions map onto a systemic perspective (data and innovation with “science and methods,” practice and evaluation with collaborative inquiry and adaptive action, and a cross-cutting lens with “systems thinking”). DARPI is beginning to incorporate collaborative inquiry, adaptive action, associated scientific methodologies, and systems thinking in its work both externally with partners and grantees and internally to support population-level injury and violence prevention work at the federal level. These external and internal applications of a systemic approach to DARPI’s injury and violence prevention focus, described in detail below, offer a tremendous opportunity for testing and learning about the broader value of this approach throughout public health.

### 4.1 | See, do, and learn: Working with partners to apply a systemic approach

DARPI’s work with external partners and grantees is cross-cutting and embeds science and practice through its management of some of the NCIPC’s flagship programmes in surveillance (Web-Based Injury Statistics Query and Reporting System); public health practice (Core State Violence and Injury Prevention Program [Core SVIPP]); and research (Injury Control Research Centers [ICRCs]). Application of a systemic approach to injury and violence prevention is still emerging within DARPI. What follows are examples where

<sup>3</sup>Specifically, they posit the following five components: (a) Systematic learning is the foundation; (b) Accountability for results is an essential pillar; (c) Useful and usable measures are made more readily available; (d) Complexity is fully recognized; and (e) A full range of evidence is mobilized in decision-making. More detailed description and discussion of this framework is beyond the scope of this article. However, interested readers can read the full framework, which is cited in References.

one or two (but to date, not yet all three) components of the approach are being applied to prevent injuries and violence.

First, DARPI is working with partners to explore and apply a systemic approach to injury and violence prevention through the Core SVIPP and Regional Network Coordinating Organizations (RNCOs). The Core SVIPP funds 23 state health departments to implement and evaluate injury and violence prevention strategies addressing child abuse and neglect, traumatic brain injury, intimate partner/sexual violence, and motor vehicle injury. Core SVIPP also funds five state health departments as RNCOs to explore new ways of addressing the four programme topic areas using a systemic approach incorporating both a systems thinking mindset and focus on collaborative inquiry and adaptive action. One RNCO is leading a national collaborative specifically focused on developing a more in-depth understanding on applying and advancing systems approaches and collaborative inquiry in injury and violence prevention more broadly. Additionally, to advance injury prevention systemic approaches, DARPI has provided RNCOs with in-depth training, consultation, and coaching on identifying and mapping the adaptive challenges faced in each injury area and developing the skills necessary for engaging in collaborative inquiry and adaptive action. The NCIPC state support teams also received training to better provide technical assistance to states in these areas. To date, each RNCO has developed preliminary plans for applying a systemic approach to their injury topic areas and will implement and evaluate these plans over the next 2 years. For example, the RNCO led by the Massachusetts Department of Public Health is leading a national peer learning team focused on motor vehicle safety. Using a systems-thinking lens, and a commitment to collaborative inquiry and adaptive action, the Massachusetts RNCO team has developed a plan to explore the opportunities and potential unintended consequences posed to the public health by advances in automated motor vehicle technologies. The team will convene injury prevention professionals, researchers, engineers, and policymakers around the country and use tools, approaches, and principles from systems thinking and collaborative inquiry and adaptive action to gain a better understanding of this emerging public health issue and ways in which new technologies may facilitate a “tipping point” of drastic reduction in motor vehicle crash fatalities.

Whereas DARPI’s work with the Core SVIPP and RNCO grantees focuses mainly on systems thinking and collaborative inquiry and adaptive action, the division also promotes the development of science and methods necessary for supporting and testing the effectiveness of this approach through funding 10 ICRCs, universities, and medical centres that conduct injury and violence prevention research, training, and outreach nationwide. ICRCs have been increasingly encouraged to work collaboratively with Core SVIPP/RNCO grantees and other practice partners to develop and test innovative research methods, tools, and approaches that facilitate and measure the impact of comprehensive approaches to prevention. As one example, the ICRC for Suicide Prevention, based at the University of Rochester, has been working with the Colorado Department of Public Health and Environment to develop and implement an integrated, comprehensive approach to suicide prevention in the state of Colorado. This effort takes a systems approach by including diverse national, state, and local partners and perspectives to work collaboratively in addressing suicidal behaviour and risk factors across the lifespan (Caine, Reed, Hindman, &

Quinlan, 2018). Partners are using systems thinking and collaborative inquiry and adaptive action to develop and implement this approach. They are also actively considering the types of research approaches and methods that are appropriate and effective for evaluating the process and outcomes of such a comprehensive, collaborative approach. Within NCIPC, staff across multiple divisions are collaborating across organizational boundaries to more effectively provide technical assistance and support to the initiative particularly given its focus on one of NCIPC's key priority areas (suicide prevention). This effort has significant potential to not only serve as a national model for applying a comprehensive approach to suicide prevention, but it is a powerful test and demonstration of the systemic approach.

#### 4.2 | Walking the talk: Internal application of a systemic approach

DARPI's natural bridging between unintentional and intentional forms of injury, and between scientific innovation and practice implementation, fosters an environment that not only allows for but actually encourages systems thinking. DARPI has established an internal transdisciplinary working group of staff with diverse backgrounds including state and local public health practice, adult education, computer science, and health informatics, among others. This group provides a mechanism for building a systems thinking culture and capacity at both the individual (i.e., staff) and organizational level. The group operates as a "learning lab," fosters a learning mindset and places high value on open, honest, and inquisitive dialogue necessary for collaborative inquiry and adaptive action. One of the key lessons learned to date from this learning lab is the importance of establishing organizational structures that facilitate cycles of both inquiry and action. Whereas the larger, multidisciplinary group provides a diverse set of perspectives to seed collaborative inquiry, smaller teams enable staff to more nimbly apply learnings through adaptive action on specific projects. Conversely, regular meetings with the larger group ensures that these smaller, project-focused teams continue to engage in collaborative learning, question underlying assumptions, and maintain sight of how each project, or "part" is connected to the larger "whole" of injury and violence prevention work across the division.

These are just a few examples of DARPI's work, which is ever-evolving to reflect the constantly changing landscape of relevant systems. Working with diverse partners, DARPI engages in collaborative learning, experimentation, and the development of new methods, tools, and processes to facilitate systemic approaches to injury and violence prevention in communities and states.

## 5 | CONCLUSION

The adaptive challenges we encounter in injury and violence prevention require continuous learning and adaptation; collaboration across organizational boundaries, sectors, and disciplines; and consideration of complexity and ambiguity. Although no large-scale, robust examples comparable with tobacco control currently exist for injury and violence, there are many promising instances where injury and violence prevention practitioners have been applying systems thinking principles or engaging in collaborative inquiry and action. Rarely, however, these activities are labelled as such or recognized as critical public health functions. NCIPC's DARPI is in the beginning stages of further delineating, applying, and

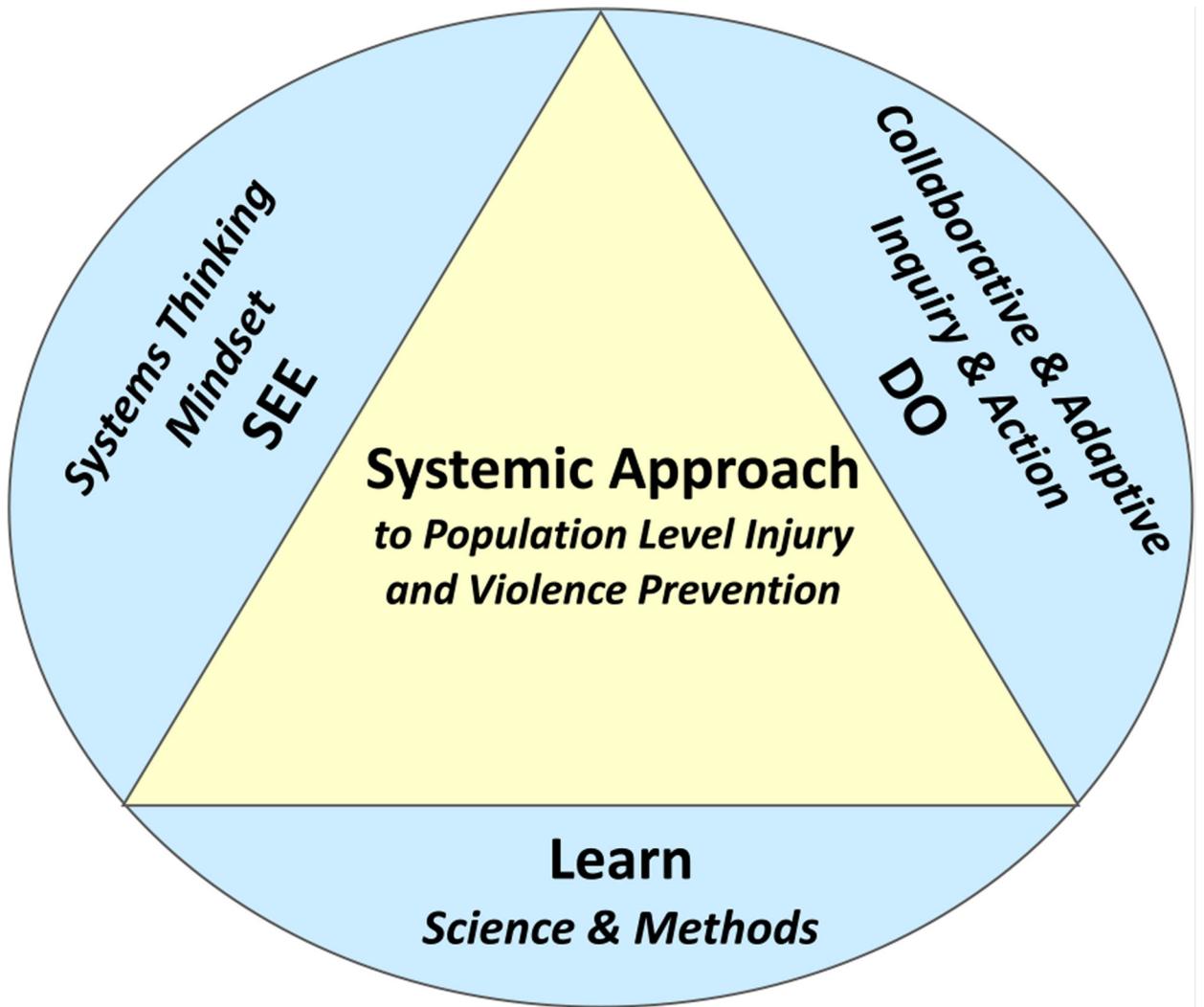
evaluating a systemic approach for population-level prevention. We offer this approach as a relevant, timely, and promising means to impact the intractable and adaptive injury and violence challenges we face. As an approach inherently grounded in scientific inquiry, next steps for the field of injury prevention are to develop key research and evaluation questions, measures, and appropriate metrics to investigate whether a more systemic approach to injury and violence prevention does in fact address existing “gaps” in more traditional public health approaches. This will require innovation and development of scientific tools, methods, and evidence that allow for complexity while harnessing the knowledge and collective learning of stakeholders across research, practice, policy, and communities.

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**FIGURE 1.**  
Systemic approach to population-level injury and violence prevention

Systemic approach to population-level injury and violence prevention: Key terms and definitions

TABLE 1

Key term	Definition
Systems thinking	A “mindset” that considers and sees the parts, the whole, and their interconnections between the parts. <sup>29</sup>
Technical challenges	Challenges that can be simple or complicated but can be defined and solved with existing knowledge or expertise (Heifetz et al., 2009).
Adaptive challenges	Challenges that are difficult to diagnose or define, do not have a known solution, are continuously evolving, and usually require new discoveries or the creation of new knowledge to solve (Heifetz et al., 2009).
Collaborative inquiry and adaptive action	The skillsets and practices for enacting systems thinking through collaboration and conducting iterative cycles of experimentation (action) and reflection (inquiry) that promote deeper learning.
Collaborative inquiry	Learning through both individual and collective experience by soliciting multiple perspectives, being willing and able to have difficult but effective conversations around contentious topics, and pursuing mutually beneficial problem-solving.
Adaptive action	Using feedback and lessons learned through iterative cycles of action and reflection and collaborative inquiry to revise underlying assumptions and perspectives and to take action to address adaptive challenges.
Single-loop learning	Learning that is limited to addressing issues that arise without questioning underlying norms or assumptions. Single-loop learning provides solutions to implementation problems that tend to address “symptoms” rather than “root causes” and answers the question “Are we doing things right?” (Argyris & Schon, 1978; Hummelbrunner, 2015)
Double-loop learning	Learning that operationalizes and examines the norms, rules, and assumptions underlying a given situation or issue. Double-loop learning addresses the “root causes” and underlying structure of problems and can lead to more intermediate and long-term solutions. The core question answered through double-loop learning is “Are we doing the right things?” (Argyris & Schon, 1978; Hummelbrunner, 2015)
Systemic science and methods	Scientific tools, methods, and evidence that seek to understand systems-level challenges through “ongoing, disciplined inquiry,” and action in local contexts; allow for complexity; and prioritize knowledge production, evaluation, and collective learning from stakeholders across research, practice, policy, and communities (Schorr & Farrow, n.d.; Taylor et al., 2018). They also move beyond approaches that focus on proving causality through experimental designs only.