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Overview

Tobacco control and public health have evolved into a complex set of interconnected and largely self-organizing systems. Their components include international, national, and local governmental agencies; individual advocacy groups; policy makers; health care professionals; nonprofit foundations; and the general population itself. The issues require the exploration of approaches and methodologies that speak to the evolving, dynamic nature of this systems environment.

This monograph focuses on the first two years of the Initiative on the Study and Implementation of Systems (ISIS), which was funded by the National Cancer Institute to examine the potential for systems thinking in tobacco control and public health. ISIS explored the general idea of a systems thinking rubric encompassing a great variety of systems-oriented methodologies and approaches. Four approaches have particular promise for their applicability to tobacco control and public health and thus were chosen as areas for initial investigation: (1) organizing and managing as a system, (2) system dynamics and how to model those dynamics, (3) system networks and their analysis, and (4) systems knowledge and its management and translation.

As a transdisciplinary effort that linked both tobacco control stakeholders and systems experts, ISIS combined a number of exploratory projects and case studies within these four approaches with a detailed examination of the potential for systems thinking in tobacco control. Its end product was a set of expert consensus guidelines for the future implementation of systems thinking and systems perspectives for tobacco control and public health.

Introduction

Tobacco use remains a leading cause of preventable death. Even though reductions in the prevalence of tobacco use and cigarette consumption over the past four decades have been substantial, tobacco use continues to be a major challenge for public health.[1–3] With the recent development of clear, evidence-based best practices in tobacco control, along with funding new research to better understand the complex and changing tobacco environment, the potential exists to improve public health outcomes substantially in the future.

However, the promise of implementing demonstrably effective tobacco control initiatives to achieve greater gains in health outcomes remains only partly realized. Strong scientific evidence exists for effective tobacco control practices. Nonetheless, desired outcomes remain at levels far lower than what is achievable in areas such as the prevalence of tobacco use and product consumption and related morbidity and mortality.[2,4] This situation is attributable to numerous factors, ranging from multiple diverse stakeholders, to declining funding, to the systematic efforts of the tobacco industry to undermine the efforts of the tobacco control community.

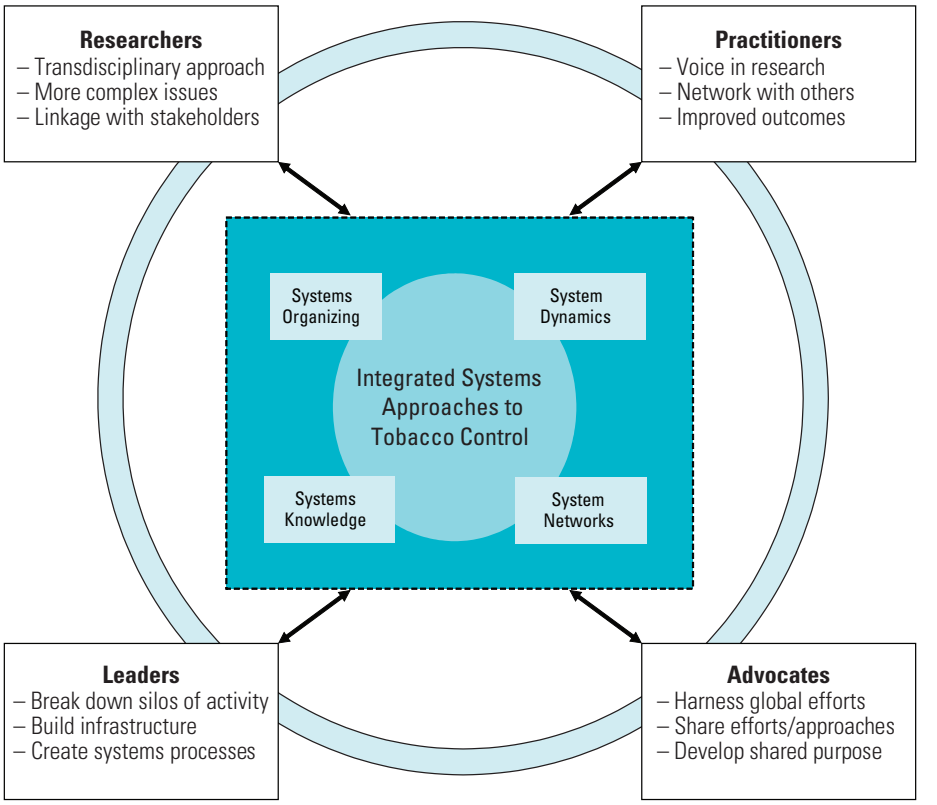
It is increasingly apparent that the implementation and, more important, the integration of systems approaches (e.g., systems organization, system dynamics, system networks, and systems knowledge) have the potential to significantly enhance the efforts of groups of tobacco control stakeholders to improve outcomes associated with tobacco control initiatives (e.g., increased smoking cessation, reduced initiation to tobacco use, and above all, reduced morbidity and mortality associated with smoking).[5] These efforts, applied to tobacco control practices, can be an essential foundation for creating a new, scientifically credible framework for future public health efforts.

The ISIS project was undertaken to examine the value and potential impact of systems thinking for tobacco control, both to improve its outcomes and as a template for strategies to apply these methods to other public health issues. This monograph describes the findings of the first two years of this project and their potential implications for tobacco control and public health. The monograph examines the synthesis of four key systems approaches applied to the fundamental problems of tobacco control (figure 1.1):

1. **Systems organizing** to understand and foster the development of participatory, complex, and adaptive collaborative systems in tobacco control; ensure their effective facilitation and management; and encourage productive system action and learning
2. **System dynamics** to understand and model the complex dynamic interactions involved in the tobacco control system and among the factors influencing tobacco use, including political actions such as taxes and legislation, research advances, tobacco control activities, industry forces, and social and cultural factors
3. **System networks** to understand and analyze effective collaborative relationships among stakeholders, improve collaboration strategies, and help reduce duplication of effort
4. **Systems knowledge** to develop and manage the knowledge infrastructure required for effective dissemination and evolution of scientifically credible, evidence-based practices, together with an effective strategy to package, deliver, and maintain this knowledge

Most important, integration of these systems approaches promises to help in the creation

Figure 1.1 Model of Stakeholder Groups and Systems Approaches in Tobacco Control



of a more consistent and adaptive research-based infrastructure for effective tobacco control and, by corollary, for public health in general. The ISIS project is an important step in bringing such an environment to fruition and, in turn, changing the practice of tobacco control to take the next step to improve health outcomes.

Monograph Framework

This monograph is structured as a discussion of the core issues in systems thinking for tobacco control, followed by detailed consideration of specific systems approaches and their potential synthesis, together with consensus guidelines for future systems efforts in tobacco control and public health. The monograph's core areas include

- An overview of the state of tobacco control and the potential for using systems thinking approaches to address future tobacco control issues;
- A detailed examination of four initial systems thinking approaches chosen for potential applicability to tobacco control and public health: systems organizing and management, system dynamics and its modeling, system network analysis, and systems knowledge management and translation; and
- A look at the potential areas of synthesis among these and other systems approaches and methods. The general rubric of systems thinking is used, together with guidelines for exploring how a future systems thinking environment for tobacco control can affect each of the major stakeholders

in tobacco control and potentially improve public health outcomes.

Chapter 2, "Tobacco Control at a Crossroads," examines the state of tobacco control, the immediate context for exploring systems thinking within this area, and the evolution of tobacco control efforts. It tracks the development of current views of tobacco use and discusses systems approaches as the logical next step in addressing tobacco use.

Chapter 3, "Systems Thinking: Potential to Transform Tobacco Control," then lays out the case for the four broad systems thinking approaches examined within this project. The chapter summarizes the value of systems thinking, the approaches and issues that drive systems thinking, and the potential of systems thinking to change outcomes in tobacco control. In the process, the chapter examines the research underpinnings of a variety of systems thinking methods, including system dynamics modeling, network analysis, knowledge management, systems organizing and management, and the synthesis of these and other approaches.

Chapter 4, "How to Organize: Systems Organizing," examines the management, operational, and logistic aspects of working in a diverse systems environment involving multiple stakeholders. This section explores the view that systems thinking is becoming an integral feature of contemporary management. It presents a model for systems organizing that encompasses and extends the traditional management model around a systems framework of vision, structure, action, and learning. It also examines current thinking in cross-organizational systems, including the use of participatory mixed methods for planning and evaluation that integrate with a systems approach, together with the concept of effective complex adaptive systems for tobacco control and public health, illustrating systems organizing principles with several empirical case studies.

Chapter 5, "How to Anticipate Change in Tobacco Control Systems," follows this organization framework with a look at the specifics of modeling public health issues as a system to better understand them and plan more effective interventions. This chapter focuses on understanding the nature of system dynamics, including the development of dynamic models that include feedback processes and the use of system dynamics modeling as a technology for understanding tobacco control outcomes, together with results from a study developing a system dynamics representation of tobacco control variables and simulation of the aging chain of smokers.

Chapter 6, "Understanding and Managing Stakeholder Networks," explores system network theory and methods, examining the question of "who works with whom" in a system and how organizations are brought together based on concepts of network analysis and related approaches. It also examines applications of network analysis to improve community and public health collaboration, including a case study of network analysis for evaluation of tobacco control.

Chapter 7, "What We Know: Managing the Knowledge Content," focuses on the role of managing systems knowledge content, including research findings on knowledge management issues for health care environments, the results of a knowledge management review project to evaluate existing research dissemination efforts at the National Cancer Institute, recommendations for a general knowledge infrastructure for tobacco control efforts, and a systems-oriented conceptual modeling project used to develop the taxonomy for a tobacco control knowledge base.

The monograph closes in chapter 8, "Synthesis and Conclusions," by examining the critical issue of integrating component systems thinking disciplines within a

broader framework of systems thinking in tobacco control. The chapter explores synergies across the areas studied in this project, existing trends toward systems approaches, and common methodological elements, together with consensus guidelines summarized in the "Major Conclusions" section of this chapter.

Two appendices describe the project's history and its formative decisions, as well as a potential framework for implementing systems thinking approaches in the real world of tobacco control.

Summary

To work efficiently and effectively in today's tobacco control environment, the tobacco control community must explore the systems methodologies that drive the competitiveness of the private sector. Such methodologies have strong potential for successful translation of science into practice and the achievement of desired outcomes. The goal of the first two years of the ISIS project was to take a critical first step toward bringing this potential to fruition.

The ISIS project represents a significant step in investigating approaches for systems thinking to improve outcomes of tobacco control efforts. It also serves as the framework for a new, rigorous approach to other public health issues. The findings and lessons learned in the first two years of this project were synthesized by its core members as a set of consensus guidelines for the future exploration and implementation of systems thinking approaches in tobacco control. The following "Major Conclusions" section and chapter 8 summarize these guidelines, which emphasize systems thinking as an ecological process rather than a cluster of methodologies.

The benefits of an integrated systems approach to tobacco control can go far beyond dollars and cents, to the estimated 1,200 people per day in the United States who die prematurely from smoking-related causes, according to the Centers for Disease Control and Prevention.[2] The vision is that by integrating technologies that address systems organizing, system dynamics, system networks, and systems knowledge in a framework of systems thinking, tobacco control organizations will be able to work more effectively and collaboratively and use evidence-based best practices more effectively in the field. More important, this effort leverages current systems research to create a bold new approach to integrating science and practice to achieve desired health outcomes.

Major Conclusions

1. Tobacco control is at a crossroads because tobacco use is increasingly recognized as a complex adaptive system involving biological, behavioral, and environmental influences.
2. Systems thinking has the potential to transform tobacco control research, practice, and policy by improving collaboration and by providing a more dynamic and adaptive evidence base for practice and a deeper knowledge about the impact of tobacco prevention and control activities.
3. Systems organizing encourages the transformation to a systems culture by addressing the core issues: vision and paradigm, barriers, leadership, and the need for an ongoing learning environment for systems thinking. Such an environment encompasses a wide variety of structured group processes, many of which may involve quantitative frameworks. Systems organizing implies a synthesis of the classic linear management processes of planning, organizing, leading, and controlling with a more adaptive environment expressed

around concepts of vision, structure, action, and learning.

4. System dynamics encompasses qualitative and mathematical simulation approaches to model dynamic relationships that evolve over time, and can simulate behavior including possible unintended consequences and long-term effects. Efforts to develop and apply systems methods and processes involve theory and research development, mixed-methods systems thinking, and participatory assessment of systems needs. At a practical level, the infrastructure for system dynamics is addressed by fostering an ecological perspective on implementation, as well as a systems approach to evaluation.

5. System networks of tobacco control stakeholders form a foundation for a systems environment in tobacco control, replacing "silos" with linkages of people and resources that transcend geography and discipline. This process involves building and maintaining stakeholder relationships by creating networks of stakeholders for systems thinking, studying the dynamics and effects of these networks, linking disciplines of stakeholders in tobacco control, and preparing for the impact of demographic change.

6. Systems knowledge management and translation form a key component of systems approaches for tobacco control, examining purpose, people, process, and products within a broader knowledge infrastructure. This involves building system and knowledge capacity by expanding public health data, integrating information silos, fostering the skills and culture to affect processes and outcomes, and creating networks for knowledge translation.

7. Integration and synthesis of systems approaches are key to a systems thinking environment for tobacco control, moving toward a more adaptive system that changes public health outcomes. Approaches such as systems organizing, system dynamics modeling, network methods, and knowledge management contain synergies in areas ranging from participatory stakeholder networks to simulation and knowledge environments. Achievement of this goal involves creating a vision, developing capacity, building planning models, and establishing meaningful and adaptive evaluation measurements.

8. Capacity building for systems thinking touches on the resources needed for bringing a systems thinking environment to fruition in tobacco control. These include fundamental infrastructure issues such as creating networks and linking them with systems knowledge in other fields, as well as specific action items such as creating systems curricula for academia and national professional associations, and holding conferences for systems thinking in public health.

Chapter Conclusions

Chapter 2. Tobacco Control at a Crossroads

1. The prevalence of smoking among adults has been reduced by approximately one-half since 1950. However, tobacco use remains the nation's leading cause of premature preventable death. The success of efforts to reduce the prevalence of adult smoking to the Healthy People 2010 goals of 15% or less remains elusive.

2. Increasingly, tobacco use is seen as a population-level health problem that involves forces from the tobacco industry, current tobacco users and nonusers, and the environment.

3. Tobacco control efforts have evolved from a focus on individual interventions

toward population-level interventions, as the nature of tobacco use has become better understood. These efforts have evolved into a complex system involving multiple stakeholders and environmental factors, ranging from social attitudes toward smoking to the countervailing efforts of the tobacco industry.

4. Some research findings suggest that systems approaches are critical to further substantive gains in tobacco control. The success of early tobacco control efforts at the population level gives impetus to further exploration of this hypothesis.

Chapter 3. Systems Thinking: Potential to Transform Tobacco Control

1. The key challenges in tobacco control and public health today are fundamentally systems problems, involving multiple forces and stakeholders. Systems thinking is an innovative approach to address these challenges and improve health outcomes.

2. Numerous frameworks exist for systems thinking, a concept that encompasses a broad synthesis of systems approaches. These approaches provide a theoretical basis for applying specific systems methods, such as system dynamics modeling, structured conceptualization, and network analysis.

3. The Initiative on the Study and Implementation of Systems encompasses four key areas of systems thinking, and their integration: how people organize (managing and organizing as a system); how people understand dynamic complexity (system dynamics modeling); who people are (network analysis); and what people know (knowledge management and knowledge transfer).

4. Examination of systems approaches has the potential to address key questions and problems faced by the various stakeholder groups involved in tobacco control.

5. Potential benefits of systems thinking in tobacco control include improving collaboration among stakeholders; harnessing resources toward evidence-based practice; eliminating duplication of effort; and gaining deeper knowledge about the impact of tobacco control activities.

Chapter 4. How to Organize: Systems Organizing

1. Systems organizing implies a move away from the classical linear management processes of planning, organizing, leading, and controlling toward a more adaptive, participatory environment expressed here around the concepts of vision, structure, action, and learning:

   - Vision encompasses a move from an environment of leading and managing to one of facilitating and empowering.
   - Structure encompasses a move from organizing to self-organizing.
   - Action encompasses a move from delegation to participation.
   - Learning encompasses a move from discrete evaluation to continuous evaluation.

2. Two concept-mapping projects explored key areas of organizing as a system. One project, examining issues in accelerating the adoption of cancer control research into practice, yielded clusters of action items in areas of research, practice, policy, and partnerships. The other project examined components of strong local and state tobacco control programs and provided the framework for a logic model of process and outcome ranging from near-term to long-term objectives.

Chapter 5. How to Anticipate Change in Tobacco Control Systems

1. Tobacco control consists of dynamic relationships over time and requires

approaches, such as system dynamics modeling, that can address such dynamics.

2. Understanding of tobacco control and public health issues has evolved from simple cause-and-effect studies and logic models to more complex, ecological problems that involve feedback and evolving behavior.

3. System dynamics uses mathematical simulation approaches based on stocks, flows, and feedback loops, which can model system structures and simulate future system behavior, including possible unintended consequences and long-term effects.

4. Demonstration projects, such as the system dynamics simulation of tobacco prevalence and consumption developed for the Initiative on the Study and Implementation of Systems, show the potential to model and simulate future tobacco issues to design more effective interventions.

5. Opportunities are likely to surface for integrating system dynamics modeling and other systems thinking approaches at epistemological and methodological levels. Systems approaches can and should integrate within a larger systems thinking environment encompassing components such as systems organizing, networks, and knowledge management.

Chapter 6. Understanding and Managing Stakeholder Networks

1. Solving complex future issues in tobacco control will require replacing silos of information and activity with greater linkage of tobacco stakeholders through networks.

2. Networks of tobacco control stakeholders form a foundation of the systems environment envisioned for the future of tobacco control. Many components of a systems approach are built around the presumption of stakeholder networks that span multiple levels of tobacco control activity and transcend geography and discipline. These components include building organizational capacity; participatory approaches to planning, implementation, and evaluation; optimization of resources and effort; and dissemination of knowledge and best practices.

3. Network analysis holds the potential for facilitating understanding and strategic management of linkages between stakeholder groups.

4. Numerous theories of network behavior currently coexist, and core concepts that describe networks now have broad acceptance, particularly those related to network attributes and behavior.

5. Network applications in public health are at an early stage. However, they have shown promise in recent studies, particularly in areas where disparate organizations have a common goal. Recent tobacco control applications of networks include the North American Quitline Consortium and Global Tobacco Research Network.

6. Network attributes potentially serve as a measure of the health of tobacco control efforts, as evidenced by a case study correlating network centrality with the strength of political and financial support for tobacco control.

7. In the future, tobacco control programs could consist of multiple networks with specific functional objectives, linked in turn as part of a "network of stakeholders."

Chapter 7. What We Know: Managing the Knowledge Content

1. Effective knowledge management is based on a social context revolving around knowledge production, use, and refinement, as well as an ecological context based on audience, motivations, and mechanisms.

2. A formal strategy for knowledge management is essential to the creation of a consistent knowledge environment. One framework defines knowledge capabilities in terms of purpose, people, process, and products, together with a knowledge management and translation infrastructure defined in terms of its underlying organization, technology, information, and finance infrastructures.
3. A review of resources for tobacco control knowledge at the National Cancer Institute confirmed the existence of extensive resources for tobacco control, combined with growth areas for the future, such as integration, visibility among stakeholders, and knowledge gaps.
4. A concept-mapping project that engaged stakeholders to examine specific information needed for tobacco prevention, control, or research yielded clusters of knowledge categories that helped form the taxonomy for a planned knowledge base for tobacco control.

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