12

Systems Thinking for Knowledge Integration: New Models for Policy-Research Collaboration

Allan Best, William K. Trochim, Jeannie Haggerty, Gregg Moor and Cameron D. Norman

Systems thinking is attracting great interest in public health as a conceptual orientation to solving complex challenges around health care renewal in developed countries. Our approach is based on the tenet that effective systems thinking relies on the development of a transdisciplinary knowledge base integrating traditional complex adaptive systems theory with community development, social ecology, social networks, and public health theory and practice (Best et al. 2003).

This chapter offers three case studies, showcasing concept mapping and social network analysis, knowledge integration, and multilevel analysis to compare and contrast primary health care models and resulting system performance in different contexts.

Case #1: The Initiative for the Study and Implementation of Systems (ISIS)

The US NCI ISIS project began as a means of exploring whether systems thinking could serve as a foundation for more effective public health efforts to combat tobacco use in the face of countervailing forces such as the tobacco industry. The first two years of ISIS brought together a transdisciplinary group of thought leaders in system dynamics, network analysis, knowledge management and informatics, tobacco control, management sciences, health policy, and several other fields to develop an action framework. This network of thinkers considered some core questions: How can the flow in *both* directions between research and practice be optimized? How can systems structure and function be best characterized to be useful to the public health community? In

what ways can networks be better understood and optimized? In what ways do information and knowledge become the currency by which change occurs? The ISIS team concluded that systems thinking in public health cannot be encompassed by a single discipline or even a single 'systems thinking' approach (for example, system dynamics), but instead represents a transdisciplinary integration of approaches to public health which strive to understand and reconcile linear and non-linear, qualitative and quantitative, and reductionistic and holistic thinking and methods into a federation of systems thinking and modeling approaches (Trochim et al. 2007).

The ISIS team also recognized that the complexity of systems thinking might be dismissed as being too complicated. To the current public health stakeholder approaching the issue of systems thinking for the first time, the depth and breadth of systems science can be bewildering. Just consider a few of the topics associated with the general area of systems thinking: causal feedback (Sterman 2000); stocks and flows, open and closed systems (Sterman 2000); centralized, decentralized, hierarchical, and self-organizing systems (Kauffman 1995; Sterman 2000); non-linear systems and chaos (Strogatz 1994); complex adaptive systems (Gell-Mann 2003; Waldrop 1992); silo effects (Côté 2002); emergence (Holland 1998); general systems theory (Bertalanffy 1995); cybernetics (Francois 2004); computational simulation (Stacey et al. 2000); decision and game theory (von Neumann and Morgenstern 1944); system dynamics (Forrester 1997; Richardson 1996; Sterman 2001); evolution, biology, and ecology (Capra 1997, 2002) and set, graph, and network theory (Strogatz 2003; Watts 2003).

Contemporary public health itself can be quite bewildering. Indeed, public health can be viewed as a complex adaptive system (Trochim et al. 2007) of international, national, regional, and local public health governmental entities, a broad array of non-governmental organizations and foundations, advocacy and special interest groups, coalitions and partnerships, for-profit and non-profit medical systems, business and industry, and the public at large. The broad array of threats to well being, ranging from obesity and tobacco to bioterrorism and the threat of epidemics, can also be most aptly portrayed as a complex and adaptive system. Yet, despite the growing cognizance and support for 'systems thinking' in public health, implementation of effective systems approaches remains challenging (McKelvey 1999; Plsek and Greenhalgh 2001; Plsek and Wilson 2001; Stacey et al. 2000).

In order for the public health community to value systems thinking as a guiding approach, it must be presented in ways that are practical,

manageable, and accessible. The ISIS collaborators hoped that by showcasing systems methods we believed to be particularly promising, we could break down some of this apprehension and encourage the applied transdisciplinary work vital to the advancement of public health.

A recent study on challenges of the implementation of systems thinking in public health (Trochim et al. 2006) used concept mapping methodology (Trochim 1989) to identify 100 challenges and eight clustered challenge areas. The authors propose that the eight clusters represent 'simple rules' to managing systems-based public health initiatives that behave like complex adaptive systems, and that leaders and managers of systems-based initiatives in public health could use the eight clusters to help guide the system to overcome the challenges of implementation.

Based on this empirical research into the challenges of systems thinking in public health, the authors recommended two related projects that build incrementally toward more refined research that answers why systems thinking can be so difficult to implement and how one might be more successful in doing so. The first project addresses the need for training and development in systems thinking, as well as clarification as to the construct of systems thinking. It proposes a mixed method, multivariate statistical methods approach to identify the major components of a comprehensive systems thinking curriculum for public health professionals. The second project would investigate and develop a new systems thinking methodology for understanding and improving leadership and management of public health systems.

Case #2: knowledge integration: from research to policy and practice

The second case example draws from an initiative of the National Cancer Institute of Canada, in collaboration with the US National Cancer Institute, to develop a common language and logic for the use of all researchers, decision makers, and practitioners in cancer control, as they work together to develop effective national strategies for evidence-based planning, decision-making, and practice. The environment for cancer research in Canada is changing in profound ways; there is a greater focus on research-based programs and services, evaluation and outcome measurement, interdisciplinary research, and collaboration. Research funding organizations, like the National Cancer Institute of Canada, consider these integral components of strategic planning. Terms such as 'evidence-based health care', 'translational research', 'knowledge transfer', 'research uptake', and 'dissemination science' are widely used in planning documents. However,

there is little consensus on their definition or the processes by which they take place (Kerner et al. 2005).

Lack of clarity in the language and logic of research transfer creates significant obstacles to effective action (Lomas 1997, 2000; Mankoff et al. 2004). Interdisciplinary and interprofessional research application is complicated by the use of different terms to describe the same thing and ascribing different meanings to the same term, making it impossible to develop benchmarks to guide initiatives to put knowledge into practice, or indicators to evaluate them.

Vertical organizational structures in the cancer control system that separate research, clinical and preventive practice, service programs and policy areas also are barriers to effective collaboration (Lomas 2000). The explosion of discovery in the basic or fundamental sciences (for example, genomics and proteomics, imaging technologies for early detection) and maturation of the behavioral and social sciences has created a bottleneck of knowledge that is limited because of the failure of its translation across these vertical silos.

It has become clear that an understanding of the social and environmental determinants of health, and how they operate through both behavioral and biologic pathways, is a critical key to the prevention of cancer (Ellis et al. 2005; McKinlay and Marceau 2000; Singer and Ryff 2001; Smedley and Syme 2000). Thus, it is important to understand the research to policy and practice cycle as encompassing not only the transfer of basic science discoveries into clinical applications ('bench to bedside'), but also the transfer of knowledge into effective interventions producing measurable outcomes at the population level, with active community participation in the process ('bench to trench') (Crowley et al. 2004; Sung et al. 2003). Collaboration between research producers and research consumers in this translational approach is critical to reduce the cancer burden at the population level, the ultimate measure of benefit to all (Mankoff et al. 2004).

Unfortunately, current models for research transfer are not working well (Ellis et al. 2005; Greenhalgh et al. 2004); one reviewer concluded that it takes 17 years to turn 14 % of original research into benefit for patient care (Balas et al. 2000). The problem is that different stakeholders – research producers and end users – frequently operate in isolation rather than collaboratively throughout the knowledge production, synthesis, and integration cycle.

We need a framework that will facilitate improvements in the process of moving knowledge into action. Individual-focused efforts have not been highly successful (Greenhalgh et al. 2004; Grimshaw et al. 2001),

and while organizational approaches have shown some promise, there is recognition that a systems approach is required given the complexity and breadth of the field (Greenhalgh et al. 2004). A consistent set of definitions and terms, reliable indicators to monitor successes in transitional research and knowledge transfer at a systems level, and a framework to guide thinking and activities are required.

The need for clear language and frameworks is not unique to cancer control. For example, public health in Canada faces similar challenges, as elegantly discussed in a *Canadian Journal of Public Health* (CJPH) report of work by the Canadian Institute of Health Research's (CIHR) Institute of Public and Population Health (Kiefer et al. 2005). The report was based on an environmental scan, literature review, and consultation with researchers, practitioners, and policy makers, to identify priorities and strategies for evidence-based decision-making in population and public health. The assessment by Greenhalgh et al. (2004) for the UK National Health Service provides a comprehensive literature review of diffusion in health service organizations.

The CJPH and Greenhalgh et al. papers offer definitions that provide a useful clarification of how some of the more common terms are used (Table 12.1).

Table 12.1 Terms commonly used in knowledge integration

Term	Definition
Dissemination	An active and strategically planned process whereby new or existing knowledge, interventions, or practices are spread (Kiefer et al. 2005)
Knowledge transfer	The imparting of research knowledge from producers to potential users (Kiefer et al. 2005)
Knowledge exchange	The interactive and iterative process of imparting meaningful knowledge between research users and producers, such that research users receive information that they perceive as relevant to them and in easily usable formats, and producers receive information about the research needs of users (Kiefer et al. 2005)
Knowledge uptake	The acquisition and review of research knowledge and its utilization, including incorporation into decision-making (Kiefer et al. 2005)
Implementation	Active and planned efforts to mainstream an innovation within an organization (Greenhalgh et al. 2004)

Table 12.2 Three generations of research application models

Time frame	Language	Key assumptions
Generation 1 1960-mid-1990s *Linear models*	• Dissemination • Diffusion	• Knowledge is a product • The key process is a handoff from research producers to research users • Knowledge is generalizable across contexts
Generation 2 Mid-1990s to present *Relationship models*	• Knowledge exchange	• Knowledge comes from multiple sources: research, theory, and practice • The key process is interpersonal: networks of research producers and consumers collaborating throughout knowledge production–synthesis–integration • Knowledge is context-linked and must be adapted to local setting • Degree of use is a function of effective relationships and processes
Generation 3 *Systems models*	• Knowledge integration	• The knowledge cycle is tightly woven within priorities, culture, and context • Relationships mediate throughout the cycle and must be understood from a systems perspective and the organization and its strategic processes • Degree of use is a function of effective integration with the organization(s) and its systems

However, the underlying model for how the research to policy and practice cycle works is still limited. Thinking about the problem is evolving rapidly, as detailed in the CJPH and Greenhalgh et al. papers; however, more appropriate models are needed. Table 12.2 summarizes what may be seen as three stages in thinking about core processes underlying effective knowledge integration and use.

Systems models seek to address the limitations of linear and relationship models by acknowledging that knowledge production and mobilization involve different systems, actors, and perspectives – each with their own rhythms and dynamics, world views, priorities and processes, language, time scales, means of communication, and expectations. These worlds may not naturally connect, and the focus for the knowledge mobilization enterprise needs to be on the major drivers in the system: organizational structure, processes, and contexts; funders'

timelines, expectations, and accountability; and decision-making and incentives for change.

Systems and networks research help clarify the logic of Table 12.2 and address the need for fresh thinking about organizational change necessary to support effective knowledge mobilization and integration. It is perhaps not surprising that this new science of knowledge integration and exchange is dependent upon transdisciplinary collaboration. These collaborations include a wide range of disciplines across the basic, clinical, and population health sciences, and those working in research, clinical practice, management, and policy areas. Given the uniquely close working relationships in the Canadian cancer research-application community, there is the opportunity to refine models for knowledge application that emphasize the powerful roles of organizations, systems, and networks in achieving evidence-based policies and practices. The transition from networks to organizations as the context for knowledge mobilization introduces the potential value of a new term: knowledge integration.

Knowledge integration is defined as the effective incorporation of knowledge into the practices and policies of systems and organizations so that it informs decisions and affects outcomes.

Starting with this framework, the NCIC designed a process to maximize the lessons learned and the strength of the knowledge integration framework, as a foundation for implementation of its strategic plan. A final report included a review of the literature to summarize evidence for effective research to policy across three settings (basic, clinical, and population research), at three levels of behavior change (individual, organization, and systems) (National Cancer Institute of Canada report 2006). The report included inputs from a series of four workshops to refine and validate the framework, producing a practical tool to guide researchers, decision makers, and practitioners as they collaborate to implement cancer control strategy.

Case #3: primary health care redesign

The third example of systems thinking in action builds on current initiatives in Canada to renew primary health care (PHC). They are broadly similar to concerns and initiatives in other developed countries including Britain, Australia, New Zealand and the USA.

PHC is the first point of contact when people initiate care for a new problem, where common and chronic problems are resolved or managed, and serious conditions are referred to more specialized care. For Canadians – 85% of whom seek primary care every year – it is the 'heart of health care' (Campbell 2005). There is good evidence that a strong PHC system improves the level and distribution of health at lower cost than systems that rely more extensively on secondary and tertiary care (Macinko et al. 2003; Starfield and Shi 2002). In Canada, since 1998, four provincial and two national health care commissions have concurred that renewing how PHC is funded, organized, and delivered is key to addressing problems in the health system related to prompt access to comprehensive, evidence-based services. In 2000, the federal government committed new funds to accelerate change in PHC This led to a flurry of demonstration projects and new initiatives to improve access, chronic disease management, and integration of services in PHC.

However, PHC renewal in Canada is proving difficult. The flurry of demonstration projects was layered on a system that was already in transition. Each demonstration project focuses on one piece of the puzzle – for example improved care for diabetics or enhanced health help lines – but it is unclear how action on one component of the system impacts directly, or indirectly, on another part. Nor is it clear how the knowledge gained from the experiments will be integrated, especially given the lack of consistency in the terminology, measures, and benchmarks used in evaluating such initiatives.

Underlying all this is the idea that there is One Right Model of Care. Only recently are both researchers and policy makers recognizing that there is no single 'right' organizational model of care, and that outcomes depend on contextual community factors (Lamarche et al. 2005). New research in primary care is providing information on mitigating contextual factors and different processes applied to apparently similar structures. There has been a huge interest in better understanding the interactions of the different sub-systems that characterize primary care: the provider–patient encounter; interactions between providers intra and extra-muros; and the interface with the community.

How might systems thinking help? Recent work is providing tools that conceptualize actions within primary care as part of a dynamic system. For instance, Watson et al. (2004) developed a comprehensive logic model that extends from sociocultural and policy factors including population characteristics, through a full range of policy and service strategies, to broad population health outcomes. Although the model was inspired by a linear results-based logic model for accounting

purposes, by making explicit all the components of the system and their potential areas of influence, the model sets the stage for understanding one component of care in the light of other factors.

Recently, Lamarche et al. (2005) used a configuration approach to identify which organizational features seem to cluster together in a variety of international and Canadian models of primary care. Using this approach led to a taxonomy of models that was rhetoric-free: a giant step forward in the field of PHC. They were able to apply the taxonomy to an analysis of effects and to show that no model is able to achieve all the desired outcomes at the same time. More recently, they have shown that performance of individual primary health care practices is associated not only with organizational structures within the practice, but also with the configuration of health care establishments in the immediate environment of clinics. These initiatives are challenging researchers to examine their areas of interest from the perspective of the whole health system or sociopolitical context.

As a better understanding emerges of key barriers to community strategies that link public health and health service strategies (Frisby et al. 2004), there is a crying need for measurement tools and research frameworks to enable researchers to examine problems from a holistic perspective. In addition to developing systems tools to conduct new research, we need ways of evaluating and synthesizing emerging evidence, both clinical and organizational, to generate systems learning that will guide change at the local, regional, and national levels. Furthermore, such learning needs to take into account differences both within and between jurisdictions, in order to provide responsive solutions to the challenges facing primary care reform at each level.

Summary and conclusions

We have illustrated the value of systems thinking by describing three recent policy-research examples from our work. In each case, we learned that a generic systems thinking approach added value, but that considerable work was needed to refine our understanding in the context of each example. We learned that systems thinking is an effective approach to foster deliberation across diverse disciplines and stakeholders. After an initial struggle with this diversity and the 'complexity of complexity' (the vast and varied literatures that inform this field), we found that common logic and language emerges from transdisciplinary dialogue. We found particularly useful the concept of 'simple rules' from complex adaptive systems – while each of our examples required a detailed

working through of the key constructs and measures, the most powerful tools to promote dialogue, and hopefully positive change, were the much simpler frameworks and 'thinking tools' that emerged. It was exciting and productive to adapt well-established methodologies in ways that provided a toolkit for each context we explored. We discovered an almost overwhelming enthusiasm among decision makers for new ways of thinking, and new tools that help them address what they already knew were more complex challenges than existing strategies could encompass. Finally, the work came together around the concept of knowledge integration as a platform to focus collaboration between researchers and decision makers, empowering participants from multiple stakeholder groups to solve the pressing priorities of health system renewal.

These case studies provide some groundwork. We must continue to move forward, engaging research producers and users in collaborative projects, so that we can further refine our thinking and tools. We encourage others to seek out and create opportunities for diverse disciplines and stakeholders to work together using systems perspectives. By doing so, we will be able to demonstrate and evaluate the impact of systems thinking approaches in public health and realize its full potential as a facilitator of progressive change.

References

Balas, E. A., Weingarten, S., Garb, C. T., Blumenthal, D., Boren, S. A. and Brown, G. D. (2000) 'Improving preventive care by prompting physicians', *Archives of Internal Medicine*, 160, 301–308.

Bertalanffy, L. V. (1995) *General system theory: Foundations, development, applications*, rev. ed., New York: Braziller.

Best, A., Stokols, D., Green, L. W., Leischow, S., Holmes, B. and Buchholz, K. (2003) 'Health promotion and community partnering: Translating theory into effective strategy (an integrative framework for community partnering to translate theory into effective health promotion strategy)', *American Journal of Health Promotion*, 18(2), 168–176.

Campbell, C. (2005) 'MPs expected to press Martin for tough stand on health care', *Globe and Mail*, (Aug 20), A4, http://www.theglobeandmail.com/servlet/ArticleNews/TPStory/LAC/20050820/LIBERAL20/TPNational/?query=strategic+counsel.

Capra, F. (1997) *The web of life: A new synthesis of mind and matter*, London: Flamingo.

Capra, F. (2002) *The hidden connections: Integrating the hidden connections among the biological, cognitive, and social dimensions of life*, 1st ed., New York: Doubleday.

Côté, M. (2002) 'A matter of trust and respect', *CA Magazine*, 135(2), 60.

Crowley, W. F., Sherwood, L., Jr, Salber, P., Scheinberg, D., Slavkin, H., Tilson, H., Reece, E. A., Catanese, V., Johnson, S. B., Dobs, A., Genel, M., Korn, A., Reame, N., Bonow, R., Grebb, J. and Rimoin, D. (2004) 'Clinical research in the United States at a crossroads: Proposal for a novel public–private partnership to establish a national clinical research enterprise', *JAMA*, 291, 1120–1126.

Ellis, P., Robinson, R., Ciliska, D., Armour, T., Brouwers, M., O'Brien, M. A., Sussman, J. and Raina, P. (2005) 'A systematic review of studies evaluating diffusion and dissemination of selected cancer control interventions', *Health Psychology*, 24, 488–500.

Forrester, J. W. (1997) *Roadmaps: A guide to learning system dynamics*, Cambridge, MA: MIT Press.

Francois, C. (2004) *International encyclopedia of systems and cybernetics*, 2nd ed. Munchen: K G Saur.

Frisby, W., Thibault, L. and Kikulis, L. (2004) 'The organizational dynamics of under-managed partnerships in leisure service departments', *Leisure Studies*, 23, 109–126.

Gell-Mann, M. (2003) *The quark and the jaguar: Adventures in the simple and the complex*, London: Abacus.

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P. and Kryiakidou, O. (2004) 'Diffusion of innovations in service organizations: Systematic review and recommendations', *Milbank Quarterly*, 82, 581–629.

Grimshaw, J., Shirran, L., Thomas, R., Mowatt, G., Fraser, C., Bero, L., Grilli, R., Harvey, E., Oxman, A. and O'Brien, M. A. (2001) 'Changing provider behaviour: An overview of systematic reviews of interventions', *Medical Care*, 39(8:2), 112–145.

Holland, J. H. (1998) *Emergence: From chaos to order*, Reading, MA: Addison-Wesley.

Kauffman, S. A. (1995) *At home in the universe: The search for laws of self-organization and complexity*, New York: Oxford University Press.

Kerner, J., Rimer, B. and Emmons, K. (2005) 'Dissemination research and research dissemination: How can we close the gap?,' *Health Psychology*, 24, 443–446.

Kiefer, L., Frank, J., Di Ruggerio, E., Dobbins, M., Manuel, D., Gully, P. R. and Mowat, D. (2005) 'Fostering evidence-based decision-making in Canada: Examining the need for a Canadian population and public health evidence centre and research network', *Canadian Journal of Public Health*, 96(3), I1–I19.

Lamarche, P., Pineault, R. and Hébert, M. (2005) 'The influence of primary care organizational models on continuity, accessibility and comprehensiveness of services', Presented at the annual meetings of CAHSPR, Montreal, QC, September 2005.

Lomas, J. (1997) *Improving research dissemination and uptake in the health sector: Beyond the sound of one hand clapping*, Hamilton, ON: McMaster University Centre for Health Economics and Policy Analysis.

Lomas, J. (2000) 'Using linkage and exchange to move research into policy at a Canadian Foundation', *Health Affairs*, 19(3), 236–240.

Macinko, J., Starfield, B. and Shi, L. (2003) 'The contribution of PHC systems to health outcomes within Organisation for Economic Cooperation and Development (OECD) countries, 1970–1998', *Health Services Research*, 38(3), 831–865.

Mankoff, S. P., Brander, C., Ferrone, S. and Marincola, F. M. (2004) 'Lost in translation: Obstacles to translational medicine', *Journal of Translational Medicine*, 2, 14.

McKelvey, B. (1999) 'Complexity theory in organization science: Seizing the promise or becoming a fad?,' *Emergence*, 1(1), 5–32.

McKinlay, J. B. and Marceau, L.D. (2000) 'To boldly go … ', *American Journal of Public Health*, 90(1), 25–33.

National Cancer Institute of Canada (NCIC) (2006) *The language and logic of research transfer: Finding common ground*, Final report to the NCIC Board from the Joint Working Group on Translational Research and Knowledge Integration of the Advisory Committee on Research and the Joint Advisory Committee for Cancer Control.

Plsek, P. E. and Greenhalgh, T. (2001) 'The challenge of complexity in health care', *BMJ*, 323, 625–628.

Plsek, P. E. and Wilson, T. (2001) 'Complexity, leadership, and management in healthcare organisations', *BMJ*, 323, 746–749.

Richardson, G. P. (1996) 'Problems for the future of system dynamics', *System Dynamics Review*, 12(2), 141–157.

Singer, B. H. and Ryff, C. D. (eds) (2001) *New horizons in health: An integrative approach*, Washington, DC: National Academy Press.

Smedley, B. D. and Syme, S. L. (eds) (2000) *Promoting health: Intervention strategies from social and behavioral research*, Washington, DC: National Academy Press.

Stacey, R. D., Griffin, D. and Shaw, P. (2000) *Complexity and management: Fad or radical challenge to systems thinking?*, New York: Routledge.

Starfield, B. and Shi, L. (2002) 'Policy relevant determinants of health: An international perspective', *Health Policy*, 60(3), 201–218.

Sterman, J. D. (2000) *Business dynamics: Systems thinking and modeling for a complex world*, New York: McGraw-Hill/Irwin.

Sterman, J. (2001) 'System dynamics modeling: Tools for learning in a complex world', *California Management Review* , 43(4), 8–25.

Strogatz, S. H. (1994) *Nonlinear dynamics and chaos: With applications to physics, biology, chemistry, and engineering*, Reading, MA: Addison-Wesley.

Strogatz, S. H. (2003) *Sync: The emerging science of spontaneous order*, 1st ed., New York: Hyperion.

Sung, N. S., Crowley, W. F., Jr, Genel, M., Salber, P., Sandy, L., Sherwood, L. M., Johnson, S. B., Catanese, V., Tilson, H., Getz, K., Larson, E. L., Scheinberg, D., Reece, E. A., Slavkin, H., Dobs, A., Grebb, J., Martinez, R. A., Korn, A. and Rimoin, D. (2003) 'Central challenges facing the national clinical research enterprise', *JAMA*, 289, 1278–1287.

Trochim, W. (1989) 'An introduction to concept mapping for planning and evaluation', *Evaluation and Program Planning*, 12(1), 1–16.

Trochim, W. M., Cabrera, D. A., Milstein, B., Gallagher, R. S. and Leischow, S. J. (2006) 'Practical challenges of systems thinking and modeling in public health', *American Journal of Public Health*, 96, 538–546.

Trochim W., Best, A., Clark, P. and Leischow, S. (eds) (2007) *Greater than the sum: Systems thinking in tobacco control*, NCI Tobacco Control Monograph, Bethesda, MD: US Department of Health and Human Services, National Institutes of Health, National Cancer Institute.

von Neumann, J. and Morgenstern, O. (1944) *Theory of games and economic behavior*, Princeton, NJ: Princeton University Press.

Waldrop, M. M. (1992) *Complexity: The emerging science at the edge of order and chaos*, New York: Simon and Schuster.

Watson, D. E., Broemeling, A.-M., Reid, R. J. and Black, C. (2004) *A results-based logic model for primary health care*, Vancouver, BC: Centre for Health Services and Policy Research, http://www.chspr.ubc.ca/research/phc/logicmodel.

Watts, D. J. (2003) *Six degrees: The science of a connected age*, 1st ed., New York: Norton.

Organizing and Reorganizing

Power and Change in Health Care Organizations

Edited by

Lorna McKee
University of Aberdeen, UK

Ewan Ferlie
Royal Holloway University of London, UK

Paula Hyde
University of Manchester, UK

palgrave
macmillan

Contents