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Systems Thinking in the Healthcare Professions: A Guide for Educators and Clinicians

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Introduction

Across the healthcare professions, trainees are expected to provide patient-centered care, and to do so they must develop competence in systems-based practice (Accreditation Council on Graduate Medical Education, 2011; American Academy of Physician Assistants, 2012; American Association of Colleges of Nursing, 2006, 2008, 2011; American Speech-Language-Hearing Association, 2015; Association of American Medical Colleges, 2014; Commission on Accreditation in Physical Therapy Education, 2016; Liaison Committee on Medical Education, 2016). They are expected to work effectively in various delivery settings; coordinate care in and across different delivery settings and with inter-professional teams; consider costs and risks vs. benefits in care decision-making; advocate for optimal delivery and quality; and participate in error detection and prevention (Canyon, 2013; Johnson, Miller, & Horowitz, 2008; Institute of Medicine, 2000, 2001, 2003). More broadly, today's trainees are also expected to improve healthcare delivery and help transform the health sector from a focus on disease to prevention and population health (Sandhu, Garcha, Sleeth, Yeates, & Walker, 2013; Trbovich, 2014).

Effective systems-based care requires an understanding of the features and characteristics of a "system" coupled with an understanding of how to think about that system, analyze it, and approach enhancing it (Johnson et al., 2008). The foundational construct that needs to be applied in systems-based practice is systems thinking (Johnson et al., 2008; Miles, 2004; Trbovich, 2014). Systems thinking is a body of knowledge, theory, and techniques applied to enhance understanding of the interrelationships among elements, patterns of change, and structures underlying complex situations (Three Sigma, 2002).

This monograph was created to help faculty, in the classroom and clinic, educate healthcare professionals as systems thinkers who will appreciate, navigate, and improve the systems within which they care for patients and populations. This monograph provides a basic understanding of the metacognitive process of systems thinking and some of the tools available to assist you in the design and assessment of educational activities, courses, and curricula.

This monograph has three specific aims:

1. Facilitate the development of a common definition and understanding of systems thinking for health professions educators.
2. Provide ideas and approaches to teaching and assessing systems thinking, including
   a. A taxonomy of sample topics
   b. A taxonomy of learning objectives
   c. Sample assessment strategies
3. Present common tools that develop systems thinking ability.

Chapter 1 discusses what systems thinking is and how it is valuable for understanding complex environments. Chapter 2 provides concepts for teaching systems thinking in the classroom and clinical settings. Those chapters are followed by a detailed discussion of the most common systems thinking tools and ideas about how they may be applied in a healthcare setting. Using these tools in designing learning activities and assignments will prepare learners to take a more comprehensive, well-informed systems approach to their problem identification, data collection, data synthesis, and, finally, decision-making.

The tools are divided into the following five categories:

Chapter 3: Tools to define and describe the system
Chapter 4: Tools to analyze and understand the system
Chapter 5: Tools to measure performance
Chapter 6: Tools to identify and test change
Chapter 7: Tools for simulation, modeling, and games

These chapters do not need to be read in their entirety but serve as a reference for you to draw on depending on the situation. Care should be taken to select the appropriate tool, one that meets your specific classroom or clinical objective. In other words, objectives drive tool selection, and not visa-versa.

Chapter 8 discusses strategies for assessing your learners, again linking back to your overall objectives. Finally, in Chapter 9, our goal is to help you pull it all together, taking what some may consider more abstract or theoretical information and applying it to real-world case scenarios. We provide a typical case scenario learners may encounter at each level of healthcare delivery. In doing so, we offer exemplary questions and tools they might use to deconstruct and analyze each case scenario from a systems perspective.

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Chapter 1:
Understanding Systems Thinking

Healthcare is one of the most complex sectors of the economy and hospitals the most complex human organization ever devised (Drucker, 2002). For decades, those providing care have been admonished to reduce cost, increase quality, and enhance access. More recently, coordinated interprofessional care and error prevention have been encouraged as part of effective healthcare delivery, as well as a concern for disease prevention and population health. These activities are the aims of systems-based practice, now considered a core competency across the health professions (Accreditation Council on Graduate Medical Education, 2011; American Academy of Physician Assistants, 2012; American Association of Colleges of Nursing, 2006, 2008, 2011; American Speech-Language-Hearing Association, 2015; Association of American Medical Colleges, 2014; Commission on Accreditation in Physical Therapy Education, 2016; Liaison Committee on Medical Education, 2016).

To be effective at systems-based practice, one must understand the interrelated parts of the complex whole (Batalden, 1997; Bowe & Armstrong, 2017). The National Academy of Engineering and the Institute of Medicine of the National Academies, among others, have identified four major levels of systems in healthcare delivery: the patient, the care team (including family members, significant others, and healthcare professionals), the organizations in which care is delivered (the infrastructure and resources of hospitals, clinics, nursing homes, etc.), and the environment (regulatory, market, and policy framework, including wholesale purchasers, regulators, insurers, research funders, etc.) (Ferlie & Shortell, 2001; Proctor, Compton, Grossman, & Fanjiang, 2009). All levels interact with one another. Thus, systems thinking is key to understanding the interrelationships shaping the behaviors of the various levels of systems as well as the interactions across the levels (Phillips, Stalter, Dolansky, & Lopez, 2016; Reineck, 2002; Senge, 2006). Systems thinking has been identified as the foundational construct underlying systems-based practice, without which the behavioral expectations of systems-based practice cannot be achieved (Colbert, Ogden, Ownby, & Bowe, 2011; Johnson, Miller, & Horowitz, 2008). Applying systems thinking in health contexts has been valuable to preparing for complex events, such as crises and disasters (Canyon, 2013); detecting, disclosing and preventing errors (Faughnan & Elson, 1998; Singh et al., 2009); enhancing quality and safety (Johnson et al., 2008; Voss et al., 2008); and facilitating the implementation of process changes (Colbert et al., 2012).

Medicine and the health sciences have always valued systems thinking when approaching the diagnosis and management of disease. In managing complex multisystem health conditions, we would never solely isolate the cardiovascular system from the neuromuscular or musculoskeletal systems when making a differential diagnosis; understanding functions, structures, and interrelationships is critical. As noted earlier, the Institute of Medicine and the National

Academy of Science (Ferlie & Shortell, 2001; Proctor et al., 2009) encouraged educators and clinicians to move beyond body systems to use systems thinking strategies and processes to solve some of the more complex healthcare delivery problems facing our society today. Systems-based practice requires healthcare providers to work collaboratively in teams to provide high-quality, patient-centered care and to minimize both risks and costs. Students and healthcare professionals alike must be prepared to recognize the full context within which patients exist and engage effectively and efficiently in interacting with the healthcare system on multiple levels from the micro level, with respect to specific patients and care teams, to the macro level, comprising organizations, as well as broader societal issues. They must learn to see and anticipate interrelationships between and among systems—from body systems and care teams to organizations and social systems—and how all impact the quality, cost, and efficiency of individual patient care.

Systems thinking provides the science, theory, knowledge, and skills learners need to see interrelationships, patterns of change, structures, and processes underlying complex patient scenarios. Systems thinking provides strategies and tools to help clinicians recognize different perspectives; question personal assumptions; identify structural and functional relationships, drivers of change, and change processes; and recognize the impact of social and environmental factors on patient care.

Current literature on systems thinking in the health professions remains limited, providing little guidance to clinicians and educators trying to build content to address this gap in curricula. Systems thinking means different things to different clinicians (Plack et al., 2018). When asked, clinicians describe systems thinking using concepts such as recognizing the context within which the patient exists, interprofessional education, quality improvement, and error mitigation. When asked about teaching and learning systems thinking, clinicians describe learning as occurring primarily informally and experientially rather than through formal and systematic didactic instruction (Plack et al., 2018). The challenge we face is that clinicians are often not trained in the theoretical underpinnings of systems thinking or systems-based practice (Colbert, Ogden, Ownby, & Bowe, 2011; Whitehead & Scherer, 2013). This does not mean they are not systems thinkers or that they are not applying some of the concepts that undergird the systems thinking process. Rather, often clinicians learned to think from a systems perspective on the job out of necessity. As clinicians become experts, often the steps, tools, and strategies they use to make decisions become somewhat tacit (Tennant & Pogson, 1995). It is these same expert clinicians who often become our clinician-educators, and the challenge they face is making their tacit knowledge of systems thinking explicit for their learners.

Origins and Applications of Systems Thinking

Developed in the 1940s, systems thinking was a major departure from industrial models of logic and reductionism, which reduced problems to their simplest form and analyzed each to understand both individual and organizational behavior (Senge, 2006). In contrast, systems thinking looks at interactions (vs. linear cause and effect), patterns and processes (vs. single events), and underlying structures to inform how things work. It focuses on the dynamic interaction of people, processes, and technology (Trbovich, 2014).

Today, there are many schools of systems thinking; some emphasize qualitative methods, and others stress formal modeling. As such, they draw on fields as diverse as anthropology, biology,

complexity science, cybernetics, engineering, linguistics, psychology, physics, and Taoism (Ramage & Shipp, 2009; Sterman, 1994). Their common ground includes considering the relationship between systems and behavior; understanding mental models; identifying system properties that the parts don't possess individually; and appreciating the interactions and interdependencies among system components (Moore, Dolansky, Palmieri, Singh, & Alemi, 2010).

Concepts of systems thinking have been applied to understand a wide range of ecological, economic, political, and organizational systems and issues (Senge, 2006). Systems thinking facilitates problem-solving, decision-making, and change by unearthing mental models and underlying assumptions, pinpointing root causes, visualizing interacting elements, and illuminating patterns over time—all necessary activities for maximizing organizational performance. Identifying systems, analyzing systems behaviors, and reflecting on individual and collective views of system performance and potential for change are common in schools of business, computer science, engineering, liberal arts, policy, and even divinity.

Characteristics of Systems and Relevance to Systems-Based Practice

An essential component of systems thinking is defining the system, identified generally by Bertalanffy (1968), author of *General Systems Theory*, as a set of interacting, interrelated, or interdependent elements that work together in a particular environment to perform the functions that are required to achieve the system's aim. Defined in this manner, systems have certain characteristics that define their behavior:

- Each part affects the whole.
- Each part is necessary but insufficient for achieving system aims.
- The effect of any part on the system as a whole depends on the behavior of at least one other part (Ackoff, 1974, 1994).

Systems have been discussed in healthcare as they apply to systems-based practice. Early views of systems-based practice related it to care delivery systems—e.g., ambulatory care centers, physician office practices, inpatient hospital units, home healthcare, laboratories, and pharmacies—all interacting with one another (Van Cott, 1994). Each of these systems is connected via individuals and teams, regulations and rules, and technology. This suggests that competence in systems-based practice requires medical and health science professionals to understand how patient care and other practices relate to the healthcare system as a whole and how to use the system to improve patient outcomes, safety, and quality.

The metaphors of "a village" and of "a mirror" have been used to illustrate and differentiate the concepts of systems-based practice and medicine's practice-based learning and improvement: Systems-based practice is identified as the village within which a physician must work with other providers. Practice-based learning and improvement is the mirror individuals hold up to themselves to document, assess, and improve their practice (Ziegelstein & Fiebach, 2004). Further differentiation is provided by the following comparison of two separate but related questions:

- Practice-based learning and improvement asks: "How can I improve the care for my patients?"
- Systems-based practice asks: "How can I improve the system of care?" (Johnson et al., 2008).

More recently, systems-based practice has taken a broader perspective, inclusive of socioeconomic, political, and cultural systems external to care delivered in the aforementioned care delivery systems (Johnson et al., 2008). This view sees systems-based practice as care that is sensitive to and attempts to change the context in which it is delivered. This broader perspective is consistent with the four major levels of systems defined by the National Academies: the patient, the care team, the organization, and the environment (Proctor et al., 2005). Systems-based practice aims to reduce the fragmentation of service delivery in healthcare (Kohn, Corrigan, & Donaldson, 1999) and therefore leads to better outcomes for patients (Johnson et al., 2008).

Requirements for Applying Systems Thinking and Being a Systems Thinker

Given the above views on systems in healthcare, it has been suggested that graduating medical and health science professionals need to be able to define, describe, and assess systems and their interactions and identify required changes and participate in their implementation (Bingham & Quinn, n.d.; Miles, 2004).

Individuals performing these functions effectively are skilled at identifying structural relationships, determining drivers of output, anticipating the impact of external forces, predicting changes, and challenging mental models (i.e., current ways of seeing things) (Richmond, 1993; Sweeney & Sterman, 2000). These skills are developed through study and application of relevant systems thinking tools and techniques, coaching, and experience seeing interrelationships among elements, patterns of change, and structures underlying complex situations (Three Sigma, 2002).

Systems thinking tools and techniques—discussed in detail in chapters 3 through 7—surface the identification of system structures and processes to identify possible leverage points, facilitate changes in perspectives to increase understanding of system behaviors, foster the understanding of the bigger picture within which a given system exists, and enable performance monitoring over time (Waters Foundation, 2010). By studying and applying these tools in practice, individuals develop the "habits of mind" of a systems thinker, described as someone who:

1. Strives to understand the big picture
2. Discerns how elements within the system change over time to generate interdependencies, patterns, and trends
3. Considers how individual and collective mental models affect views of the current reality and possible futures
4. Identifies complex cause-and-effect relationships, including the role of feedback, time delays, and the circular nature of interactions
5. Identifies connections both within and between systems
6. Recognizes how a system's structure influences its behavior
7. Alters perspectives to increase understanding
8. Pinpoints and tests underlying assumptions

9. Applies understanding of the system's structure to surface possible leverage points for change
10. Thinks through short-term, long-term, and unintended consequences of actions
11. Resists the urge to come to a quick conclusion without thinking things through
12. Monitors results and changes actions as required

Thus, systems thinking is a body of knowledge with associated theory, tools, and techniques (Three Sigma, 2002) but is as much a way of seeing and thinking about reality as a web of relationships (the whole rather than the parts) continuously unfolding over time (Waters Foundation, 2010).

Summary

To be an effective healthcare provider in our current healthcare delivery system requires complex thinking processes that move beyond the individual patient. Effective care requires one to understand and navigate the interrelationships that exist across all levels of the healthcare system. Medicine and the health professions have begun to recognize and embrace the concept of systems thinking as essential to developing practitioners adept at navigating the interdependencies that exist in the system. In this chapter, we have described the complexity of the healthcare system and linkages between system-based practice and systems thinking. Finally, we have identified those "habits of mind" we need to develop in our learners to become systems thinkers. In the next few chapters, we discuss how you might design a longitudinal curriculum and begin to teach systems thinking in the health professions from the classroom to the clinic.

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Chapter 2:
Teaching Systems Thinking

To become systems thinkers, our learners must begin to think holistically, rather than in reductionist terms; seek the root cause(s)/problems(s), not just the symptoms; recognize their own biases; and critically examine possibilities before converging on a single cause or solution. Complex challenges often have their origins not in a single cause or problem but rather in multiple causes or problems across a system. Our learners must learn that if they manage the symptoms rather than the root cause, they may end up with unintended consequences; they may manage the most evident problem but miss the most important problem.

So, the question becomes where to start: How and when is systems thinking best taught? Scholars across all domains have considered this question. Some advocate for instruction to begin early in elementary grades (Dawidowicz, 2012) and include identifying, describing, and analyzing systems; appreciating behaviors of complex systems; and applying systems approaches and methodologies to real-world issues (Kay & Foster, 1999). Advocates in medicine and nursing believe instruction should begin at the premedical or prelicensure levels and continue through residency and into practice (Whitehead & Scherer, 2013; Stalter, Phillips, & Dolansky, 2017). Just as there is no consensus around the definition of systems thinking in the medical and health professions, no clear curricular models have been identified as evidence-based or best practices. Grounding our educational processes in sound theoretical and pedagogical principles is a good place to start. In the professions, the principles of andragogy, communities of practice, and reflective practice can provide a pedagogical framework from which to scaffold students' learning of complex topics such as systems thinking.

Theoretical/Pedagogical Underpinnings

Andragogy

Malcolm Knowles identified several important characteristics of adult learners that form the basis for andragogical principles of learning (Knowles, Holton, & Swanson, 1998). He described how adults want to know what they will learn, how they will learn, and why that learning is important. Relevance is critically important for the adult learner. Adults are busy, especially learners in medicine and the health professions, so if they do not see the relevance of learning systems thinking concepts, they may fail to do so. It is important to actively engage our adult learners in applying concepts to real-world problems, which provide context where learners can see the immediate application and relevance of what some may describe as abstract concepts. We can build on our learners' prior knowledge and experience of body systems and how they interact and interrelate to perform various bodily functions to scaffold their learning and begin to

broaden their thinking. Adult learners are also more motivated and self-directed when actively engaged in the learning process. Providing them with the tools, skills, and self-efficacy to independently solve complex problems both in the classroom and the clinic gives them ownership over their learning and will likely enhance their motivation to learn. Actively engaging students in the classroom to solve authentic problems they will see in practice will help them recognize the relevance and application of the content being delivered, potentially calling into question some of the assumptions they bring with them to the learning environment.

Communities of Practice

However, classroom learning is not enough. As much as we try to use real-world cases and simulations, many of these abstract concepts will remain elusive for our students if we do not give them the opportunity to apply these theoretical concepts to real-world practice. Applying or seeing these systems thinking concepts applied in practice provides feedback, reinforcing the relevance of what they are learning. While we strive to engage students through simulations and authentic learning experiences in the classroom and through interprofessional educational experiences, engaging with peers and mentors in the community of practice of the clinical setting cannot truly be replicated in the classroom. In medicine and the health professions, it is not enough to have foundational knowledge and skills; our students must learn to adapt and apply that knowledge and those skills as they engage directly with patients, families, and colleagues across complex health system. Each community of practice, each health system, each patient and family unit is unique. Becoming facile at solving problems at all levels of the healthcare delivery system requires students to engage and interact effectively interpersonally across each community of practice (Lave & Wenger, 1991; Wenger, 1998).

Reflective Practice

Learning about complex ideas such as systems thinking requires learners to first fully understand themselves, their own thinking processes, and what might be influencing their thinking, decision-making, and problem-solving. The reflective process provides the foundation for critical thinking, clinical reasoning, and systems thinking. Before learners can begin to see cross-linkages and relationships, they must understand their own perspectives, the perspectives of others, and the assumptions each brings to the table.

Evidence-based practice and client-centered care require healthcare providers to integrate best evidence with personal values and assumptions vis-à-vis the values, beliefs, and goals of each patient and in the context of a complex delivery system (Sackett, Straus, Richardson, Rosenberg, & Haynes, 2000). Reflection enables trainees to examine their own assumptions (Cranton, 1994; Mezirow, 1991) and recognize how those assumptions might be impacting both the therapeutic relationship and their clinical decisions. Reflection also helps practitioners develop a questioning attitude and recognize gaps in knowledge, and it provides the skills needed to continually update their knowledge and skills (Westberg & Jason, 2001).

Using the reflective process can enable you to scaffold learning, starting with understanding the self, to understanding the perspectives of others, and finally to understanding the interrelationships among perspectives and systems. Helping students recognize what they know (content reflection) and how they know it (process reflection) helps them begin to identify gaps, assumptions, and misperceptions in their own thinking (premise reflection) (Cranton,

1994; Mezirow, 1991). Reflecting on what they know (reflection-on-action) and refining this knowledge while engaged in authentic and clinical experiences (reflection-in-action) can prepare learners for their future role as practitioners (reflection-for-action) (Schön, 1983,1987).

Using questions to facilitate reflection and deeper thinking. Questions are at the heart of the reflective process. Questions help us think more broadly, consider different perspectives, understand our own biases, and facilitate deeper learning. Asking the right questions is key to helping our learners hone their thinking skills both in the classroom and in the clinic. It is also important to teach our students to develop the skill of asking good questions, as this will help them obtain not only richer and more detailed patient histories but also more comprehensive and nuanced understandings of the complex issues facing our healthcare system today.

Questions can encourage our learners to uncover their own assumptions and biases and consider different perspectives and solutions. Good questions facilitate in-depth analyses of situations from multiple perspectives, enabling our learners to synthesize different viewpoints in posing solutions (Marquardt, 2005; Plack & Driscoll, 2017).

Donald Schön's work can help our learners, both in the classroom and the clinic, think on their feet (e.g., reflect-in-action), review their performance (e.g., reflect-on-action), anticipate outcomes, and develop plans for improving future performance (e.g., reflect-for-action)—both their own and the system's. This will lead to a more comprehensive analysis of any given situation and result in more fully informed decisions (Goldman, Plack, & Scott, 2014; Plack & Santasier, 2004; Schön, 1983). Developing questions based on the work of Jack Mezirow can help learners explore situations from multiple perspectives (e.g., content reflection), develop strategies to manage different situations (e.g., process reflection), and begin to recognize the assumptions they might hold about a given situation (e.g., premise reflection) (Cranton, 1994; Goldman et al., 2014; Mezirow, 1991; Mezirow & Associates, 1990; Plack & Santasier, 2004). Finally, developing questions linked to Bloom's taxonomy can help ensure our learners are gathering the pertinent facts (Level I) and thoroughly analyzing those facts (Level II) before drawing conclusions (Level III) (Bloom, 1956; Plack et al., 2007; Plack, Driscoll, Marquez, & Greenberg, 2010).

Table 2.1 provides sample questions from each of these frameworks that can be used to prompt the reflective process in our learners. The questions provided are simply exemplars upon which to build. Using a variety of questions from the different reflective frameworks can provide learners with multiple opportunities to broaden their view and sharpen their thinking on any situation.

Table 2.1
Sample Questions Based on Three Common Reflective and Cognitive Frameworks

	Reflective element	Typical questions
I. Time Dependent (Schön, 1983, 1987; Killion & Todnem, 1991)	Reflection-in-action occurs while the novice is in the midst of an activity.	• What do you want to happen now? • How might you change what you are doing to make it more effective? • Are you achieving your desired outcome?
	Reflection-on-action occurs after the novice has completed the action/encounter.	• What happened? Where was the breakdown? • How effective was this interaction? • What was the impact of your actions on the situation? • Was the outcome what you wanted? Why/why not?
	In Reflection-for-action, the novice begins to anticipate situations before being faced with them and/or begins to plan for the future to improve the present situation/ outcome.	• What might you do differently if you were faced with that situation again? • What might you change about the system to improve the outcome? • What would happen if . . . ? • What plan can you put in place so that it does not happen again? • What did you learn from this situation that will help you in the future?
II. Content dependent (Mezirow & Associ-ates, 1990; Cranton, 1994)	In Content reflection, the novice attempts to explore the problem to better understand it.	Typically answers "What" questions: • What is the real problem here? • What do you know about the problem? (describe the problem) • What do you know about yourself in this situation? • What do you know about others in the situation? • What would you like to change about this situation?
	In Process reflection, the novice begins to explore the strategies and/or processes involved in an experience or problem-solving situation. The novice might begin to explore other possible strategies.	Typically answers "How" questions: • How do I learn best? How did I solve the problem? • How effective was the solution I chose? • How else could I have solved this problem? • How else can I look at the problem? • How did my actions influence the outcome? • How did I decide I needed to do something?
	In Premise reflection, the novice recognizes and begins to explore or critique his or her own assumptions, values, beliefs, and biases. The novice may begin to seek multiple perspectives and alternative explanations.	Typically answers "Why" questions: • Why do you think you reacted so strongly? What made you think that (i.e., what assumptions did you make about this situation)? • Why did you choose that solution? (what influenced your decision making?)
III. Bloom's taxonomy (Bloom, 1956)	In Level I: Knowledge and comprehension, the novice might describe the experience for the purpose of understanding or making meaning; explain what happened; describe his/her thoughts, feelings, actions; state the results of his/her actions. The more skillful reflector would begin to articulate gaps in knowledge (i.e., surprise, confusion, etc.).	• Describe your encounter with the last patient. • Describe what you know about the situation. • Explain the rationale for your chosen solution. • List the stakeholders involved. • Describe the interrelationships among the different units.

Reflective element	Typical questions
In Level II: Analysis and application, the novice may attempt to deconstruct the experience; analyze what happened; differentiate between perceptions, feelings, thoughts, facts, etc.; examine alternative explanations; explore something about the experience that stands out as interesting, different, confusing, unique; raise questions; explore why this particular experience stands out for him/her. The more skillful reflector may analyze the experience from multiple perspectives beyond the self.	• What else might be impacting this situation? • How might your feelings be impacting the situation? • What have you ruled out in this situation and why? • How might the family situation impact the outcome? • What other stakeholders are involved in this patient's care? • How is this problem different from the last one you encountered? • How has the patient's behavior changed over time?
In Level III: Synthesis and evaluation, the novice may begin to draw conclusions based on an analysis of the experience; hypothesize different strategies for the future; recognize learning beyond the description of the experience; articulate personal learning from the experience. The more skillful reflector may base conclusions on a synthesis of multiple perspectives.	• What conclusions might you draw from having analyzed this situation? • Based on your analysis, what is the root cause of this error? • What would you predict about the outcomes of your planned solution? • Based on your analysis, what alternative solutions might you suggest?

Note. Adapted from Plack and Driscoll (2017).

Asking questions might seem intuitive; we all use questions. However, are we asking the right questions at the right time and in the right way to facilitate reflection and deeper, more complex thinking? Using the frameworks mentioned above can help our learners become more effective at answering and ultimately asking the breadth and depth of questions essential to viewing problems from a systems perspective.

Grounding our educational approach in pedagogical theory means engaging our learners by building on their prior knowledge with relevant case material where they see the immediate application of skills to real-world practice. Helping our learners broaden their thinking by asking effective questions to facilitate reflection will enable them to develop a mindset with a strong focus on collaboration and a willingness to challenge the status quo rather than a reliance on autonomy and hierarchy. Teaching and modeling collaborative inquiry and creating a culture where questions are essential, and welcomed, will empower learners and clinicians to identify problems and propose innovative solutions. These are the skills our learners will bring into the clinic with them, where they will ultimately be responsible for solving complex problems in the healthcare delivery system.

Approaches to Teaching

Topics. So where do we begin our educational process? In helping learners acquire the skills needed to solve complex problems, we want to start with the micro level and move to the macro level; start with the simple and move to the more complex; and start with foundational knowledge upon which our learners can begin to build the analytical and evaluative skills essential to systems thinking. Table 2.2 provides some nice examples of topics in healthcare that

address systems at each level of healthcare delivery. As our learners are adults, it can be helpful to start with something they know (build on prior knowledge) and that is very relevant to them as healthcare providers—such as the body system—before moving on to healthcare teams, the

Table 2.2 *Systems Thinking Taxonomy by Topic (Exemplars)*

	Patient, Family, Community Body structure and function, personal and contextual factors	**Care Team**	**Organization** Clinic, hospital, nursing home, etc.	**Environment/Society** Regulatory, market, and policy
Knowledge/ comprehension	• Body structure and function, body systems • Barriers and supports to care • Patient and family values and perspectives	• Roles/functions/interrelationships • Principles of effective teamwork • Structural/organizational aspects • Issues impacting team learning and performance • Recognizing dysfunction	• Structure/components • Functioning/inter-relationships • Communication and decision-making processes • Value/belief systems • Key metrics	• Environmental (sociocultural, political, regulatory, and economic) influencers on healthcare delivery • Types of delivery models • Trends in population health • National and local policy development processes • Methods of advocacy
Application	• International Classification of Functioning model	• Tools to examine team behavior and performance • Problem-solving/decision-making methods • Strategies to address communication and cooperation • Strategies to address conflict • Strategies to address team dysfunction	• Tools to examine malfunctioning of organizational components • Tools to enhance performance and learning • Tools to enhance quality	• Tools to identify environmental factors in a given situation • Mental models underlying policy decisions
Analysis	• Key functions, interactions, communication pathways, and feedback loops • Root cause analysis	• Impact on patient care • Impact on organization • Mental model in use • Impact of structure and power • Causes of error	• Information flows • Resource consumption/ activity costs	• Impact of environmental factors in a given situation • Comparison of various delivery models
Evaluation	• Impact of dysfunction on patient, family, and community • Factors influencing patient care	• Team functioning • Team learning • Team performance • Team impact on organization • Error resolution	• Impact of quality improvement changes • Impact of proposed changes to policy, procedures, etc.	• Impact of proposed changes to policy, regulations, etc. • Program impact on population
Creation	• Plan of care • Patient and family perspectives on plan of care	• Policy modifications • Error prevention • Methods to enhance care delivery • Tools to optimize functioning	• Suggest policy/procedure/ structure modifications	• Advocate for changes to meet needs • Develop new program • Suggest policy modifications • Create new delivery model

organization, and the environment or society. By building on our learners' foundational knowledge of body systems, we can use various models to help them better understand the complexities of interconnections, communication pathways, and feedback loops. As we discuss body systems, we can layer on clinical decision making to help our learners begin to recognize their own biases and how these biases can influence their decision making as they analyze patient scenarios seeking the root cause of their patient's problem—not solely focusing on symptoms—and developing an effective plan of care. Layering on complications from the various body systems will help learners recognize the interconnectedness and complexities of the system in a given patient**.** Similarly, layering on complications of team function, organizational dysfunction, and societal challenges will further enable our learners to analyze and provide solutions for complex problems at all levels of healthcare delivery.

Within the table, complexity increases as you work your way down the table from knowledge to application, analysis, evaluation, and creation. Similarly, as our learners begin to fully grasp the interconnectedness of the human body, we can begin to move from left to right in the table, again building complexity through context.

As we layer on complexity and move from foundational knowledge and skills to higher-order thinking, it is essential that the process be made explicit to our learners. As educators, we must clearly articulate answers to a variety of questions: How did we make our decisions? What information did we gather? Why was that information necessary? How did we gather that information? What tools did we use to gather information? How did we interpret that data? What influenced our thinking process? What assumptions did we need to recognize in ourselves that may have influenced the outcome? Asking and encouraging questions can help learners unpack the problem considering various stakeholder perspectives (content reflection), explore various approaches and processes to solving the problem (process reflection), and identify their own biases and assumptions that may be influencing their decision making (premise reflection).

It is important to remember that being a systems thinker is not a linear process, so teaching systems thinking cannot be a linear process either. Engaging students in self-directed learning may take our learners on tangents that further their understanding of the issues, and continually applying the concepts to real-world applications ensures relevancy for our students.

Objectives. Having a list of topics, while helpful, is still not sufficient for building a curriculum. As with any educational process, we must begin with the end in mind! That means starting with objectives. We need to turn our topics into clear outcomes—outcomes we expect our learners to achieve as they progress within and across the curriculum.

Table 2.3 uses a modified Bloom's taxonomy framework coupled with the four levels of healthcare delivery (Proctor, Compton, Grossman, & Fanjiang, 2005) to provide examples using the published literature (Stave & Hopper, 2007) and our experiences in healthcare and academic medicine to provide some sample objectives. Similarly, as with the topic table, moving from top to bottom and from left to right adds complexity and requires our learners to process increasing levels of complexity and higher-order systems thinking.

Table 2.3
Taxonomy of Learning Objectives (Exemplars)

	Patient, family, community	Healthcare team	Organization	Environment/society
Knowledge/ compre-hension	• Identify body structures and functions • Recognize the potential impact of family and community perspectives, assumptions, and biases on patient care • Describe the contextual factors impacting a patient's current function • List intended and potentially unintended outcomes of interventions • Discuss short-term, long-term, and unintended consequences resulting from failure to address a body structure and function issue • Recognize a patient's values and beliefs related to healthcare • List family and community supports and barriers to a given patient's care	• Discuss individual and team behaviors that may positively and negatively impact patient care • Describe the roles and functions of various healthcare team members • Discuss interdependencies across team members • Recognize common team errors • Identify types of communi-cation and feedback that might enhance team function • Identify strategies to address various team dysfunctions	• Describe the information flow across units of a healthcare system • Discuss the various units of a healthcare organization and how each functions • Describe systems theory and characteristics of high-functioning organizations • Identify trends impacting organizational decision-making • List key organizational metrics	• Recognize inter-connections among the sociocultural, political, economic, legal, and regulatory factors influencing healthcare delivery (e.g., six hats analyses) • Describe the socio-cultural, political, economic, legal, and regulatory influences on healthcare delivery • Describe the types of service-delivery models across the globe • Identify causes and effects of trends in population health • Explain the policy development process on a macro and micro level • Identify strategies to facil-itate advocacy activities
Analyze/ apply	• Diagram interdependencies across body systems (e.g., causal loop diagrams) • Deconstruct systems (key functions, interactions, communication pathways, and feedback loops) • Relate outcome of changes/ treatments in one body system to other body systems	• Distinguish among errors, near misses, and sentinel events • Apply feedback to optimize communication and collaboration • Distinguish among the roles of various healthcare team members for a given patient	• Analyze organizational dysfunction from multiple perspectives • Diagram interdepen-dencies to optimize efficiencies and mini-mize errors in organi-zational structures, functions, and flow	• Compare strengths and weaknesses of different service-delivery models on healthcare delivery • Compare the potential mental models underlying healthcare policy decisions

	Patient, family, community	Healthcare team	Organization	Environment/society
	• Analyze the potential impact of patient values and beliefs on the delivery of healthcare • Relate the barriers, supports, and gaps in family and community resources to patient outcomes • Apply the International Classification of Functioning model in developing a plan of care	• Debate impact of various healthcare providers' perspectives, mental models, assumptions and biases on patient care • Implement solutions to errors • Implement changes in problem solving and decision-making processes that will enhance team performance • Illustrate power dynamics and their implications on team function	• Critique the impact of policies, procedures, and practices on minimizing risk and managing resources efficiently	• Debate the impact of sociocultural, political, and economic factors on healthcare delivery and its outcomes • Illustrate the impact of legal and regulatory policies on the health and wellness needs of society
Create/ evaluate	• Create a plan of care to address identified body system issues • Hypothesize causes of adverse events based on a root cause analysis • Appraise the impact of body system dysfunction on a patient's social role • Evaluate the influence of culture, values, and belief systems on a patient, family, and community • Evaluate the influence of sociocultural, political, and economic factors on health outcomes for a patient, family, and community • Revise a plan of care to integrate patient, family, and community values and beliefs • Propose alternatives to address barriers and gaps in family and community support • Propose a plan to coordinate resources for optimal care	• Propose systematic methods to enhance coordination of care • Revise existing policies to address emergent medical errors • Create tools to optimize team communication, coordination, and function • Integrate reflection and self-assessment to ensure accuracy of current mental model	• Appraise trends in organizational usage/ activities to optimize systemic efficiencies, minimize costs, and provide high-quality healthcare (e.g., behavior over time graphs) • Determine the root cause of system malfunctions • Propose organizational changes to structures and policies that minimize cost, minimize errors, and maximize the patient experience • Test potential solutions to complex healthcare problems with targeted interventions	• Propose changes in laws, regulations, standards, and guidelines to address the Triple Aim and the health and wellness needs of society • Develop a policy proposal based on an evaluation of current evidence • Hypothesize the impact of ongoing changes in laws, regulations, standards, and guidelines on patient care

Assignments and activities. Having determined our topic and objectives, we then need to think about what types of assignments and activities we will use to help our learners achieve those objectives. It is important to remember that becoming a systems thinker is a cognitive process. While systems thinking requires the development of specific skills such as selecting, applying, and interpreting different types of tools to help us unearth mental models, assess changes over time, or see interrelated functions more effectively, the focus cannot solely be on the development of skills but must incorporate ways of thinking and the development of cognitive processes. All too often, curricula focus on micro skills such as quality improvement projects or root cause analyses and fail to help our learners develop the cognitive skills needed to diverge and think broadly to identify innovative solutions to complex problems (Plack et al., 2018)

Therefore, we cannot teach this skill in one session or one course and expect that our learners will be skilled systems thinkers, nor can we wait to start the process during residency. Colbert et al. (2011) suggested that the first step in the process is having residents or other postprofessional learners identify the components of the system they work in, including functions, stakeholders, and pathways, for communication and feedback. We believe the process should begin much earlier. For us, it is important that first-year medical and health science learners begin to understand systems; as noted earlier, starting with body systems and how they function and interact can provide the context needed to help them understand this abstract construct. Rather than waiting until residency, assignments and activities should be integrated across the curriculum, from the very early preclinical courses focused on body systems through residency and beyond.

As Colbert et al. (2011) also suggested, there is a need for an "educational trajectory for systems thinking" (p. 183) such as the Dreyfus's (2004) novice to expert model, although the use of this model in developing clinical skills has been questioned (Pena, 2010). Other frameworks have been suggested as well (Bowe & Armstrong, 2017; Stave & Hopper, 2007). We believe Bloom's taxonomy as presented in Table 2.3 offers a framework that can be applied from novice learners to more expert residents and clinicians. A wide variety of strategies can be used to facilitate this process, such as the use of visuals, discussions, simulations, case analyses, debates, critiques, projects, and portfolios. The "staircase" in Figure 2.1 provides some nice examples of strategies you can use to develop a curriculum of activities that fosters the development of higher-order systems thinking skills.

For example, we may start our learners at the knowledge level of body systems, identifying structures, functions, and feedback loops within and across body systems by giving them examples and providing illustrative visuals showing those linkages. We could then use case examples and simulations to move our learners into application and analysis, expecting them to begin to use different tools to diagram interdependencies across body systems (causal loops) or to identify the sociocultural, political, and economic factors affecting health outcomes for a patient, family, and community (concept map). Always remember that the more authentic the case example, the more relevant it will be for learners. Finally, as learners gain the knowledge and skills to effectively collect information about body systems and about the individual patient, we could move them to the level of creation and evaluation, where again, using case studies, they would be expected to appraise the impact of body system dysfunctions on a patient's social role and develop and critique various options for plans of care. Simultaneously we could add complexity for novice learners by moving to the right in the table and asking them to describe the roles and functions of various members of the healthcare team they might interact with in developing an effective plan of care and discuss the interdependencies that exist across team

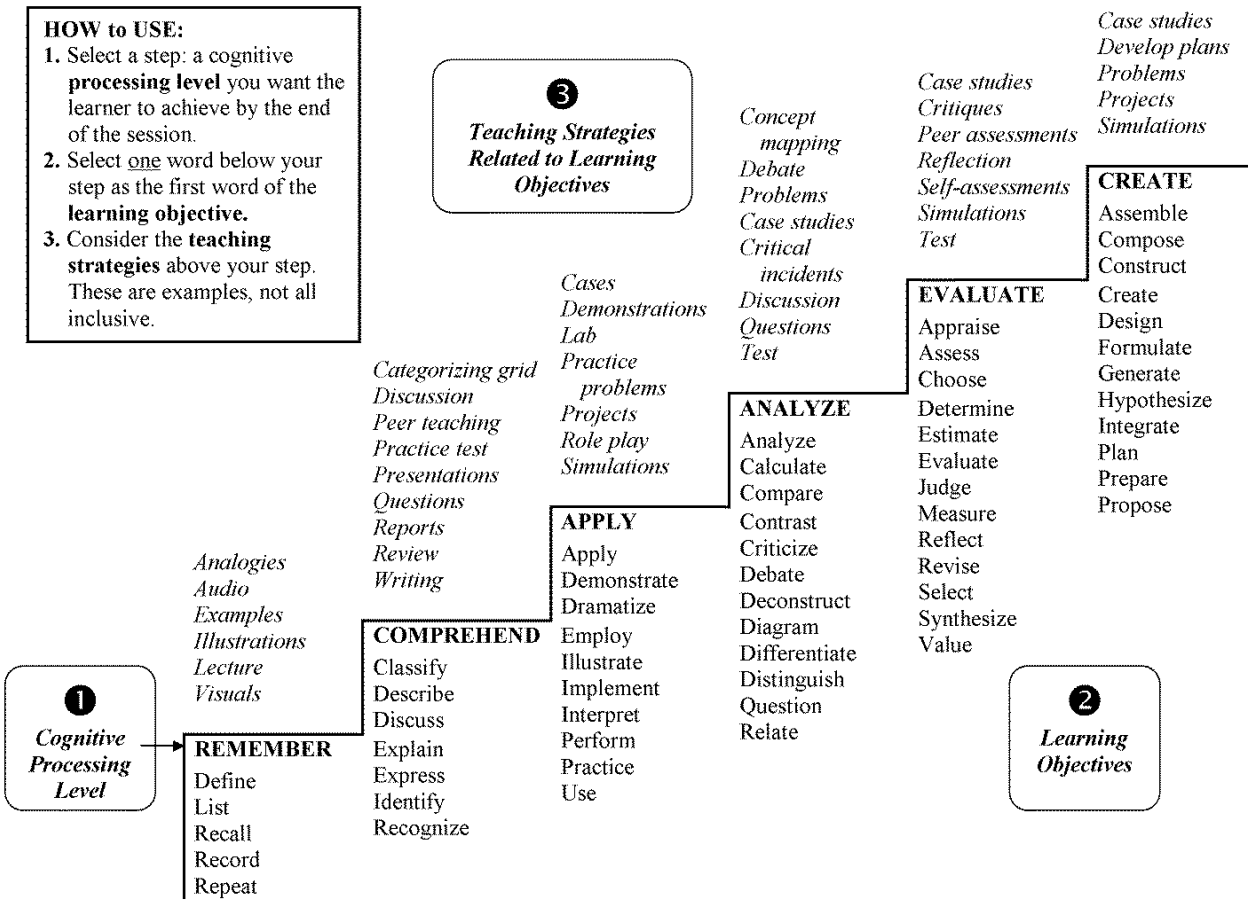

Figure 2.1. Interface of learning objectives and teaching strategies. Levels adapted from Anderson and Krathwohl (2001).

members or describe the sociocultural, political, economic, legal, and regulatory influences on healthcare delivery. Interprofessional simulations can be used to enhance the authenticity of the activity as well. This will be critical preparation for clinical practice, where our learners will engage with different communities of practice and will need to learn to navigate different systems.

As our learners continue to develop their expertise as systems thinkers and move into residency or clinical practice, they will need to learn to adapt their knowledge and skills to different communities of practice; patients and family units are different, clinicians are different, and practices are different across various communities, and therefore our learners must be prepared to engage and interact in these varying contexts effectively. As they mature in their thinking, we should expect that residents will be facile at using a variety of tools and techniques to inform their decision-making process, enabling them to appraise trends in organizational usage/activities that will optimize systemic efficiencies, minimize costs, and provide high-quality healthcare (e.g., using behavior over time graphs); determine the root cause of systemwide malfunctions (e.g., using tree diagrams); or propose changes in laws, regulations, standards, and guidelines to address the Institute for Healthcare Improvement's (n.d.) Triple Aim Initiative and the health and wellness needs of society based on their analysis of trends in the data they collected. As our learners move into residency and begin to engage with different communities, complexity increases, the stakes increase, and our teaching strategies must change to meet these challenges

as well. Workplace learning strategies, including self-assessments, reflective practice, team-based or collaborative work projects, work-related quality improvement projects, and portfolios, allow for more complex presentations of our learners' professional development as systems thinkers. It is critical for them to have interactions with expert clinicians who can articulate their own systems thinking strategies, provide just-in-time learning, and become role models for systems thinking.

Summary

Reflection, communities of practice, and andragogy provide a pedagogical grounding upon which we can begin to build our systems thinking curriculum. Framing topics and objectives around the four levels of the healthcare system and along the hierarchy of Bloom's taxonomy will help ensure the curriculum is comprehensive and systematically designed from classroom to clinic to develop learners who appreciate complexity and can begin to synthesize information from across the healthcare system in solving problems and planning for patient care. Assignments and activities should be goal oriented, relevant, and authentic, replicating real-world situations our learners will encounter. Developing the knowledge, skills, and attitudes of a systems thinker takes times. Thus, these activities should begin early in the curriculum and be threaded through the preclinical as well as clinical years and beyond.

In this chapter we provided the theoretical underpinnings for designing a systems thinking curriculum, which must always begin with the end in mind, the objectives. In the next chapters, we provide some of the common tools, unique to systems thinking, that will help you design both content and activities that facilitate the data gathering and synthesis of information necessary for well-informed decision-making and innovative problem solving.

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Chapter 3:
Tools to Define and Describe the System

In the previous chapter, we provided a general framework for building a curriculum to develop systems thinkers, including sample topics and objectives that span all four levels of the healthcare system and move from basic knowledge and skills to more complex thinking processes of synthesis, evaluation, and creation. In this chapter and the four that follow, we provide a detailed discussion of the most common systems thinking tools and ideas about how they may be applied in a healthcare setting. Using these tools in designing learning activities and assignments will prepare learners to take a more comprehensive, well-informed systems approach to their problem identification, data collection, data synthesis, and, finally, decision-making.

The tools discussed in this chapter—concept map, fishbone analysis diagram, tree diagram, force field analysis, spidergram, and spider-web diagram—describe the system based on processes and interrelationships. In contrast, organization charts, number of visits, bays in the emergency department, and number of beds in the facility are all ways to describe the system in a physical or structural way.

Concept Map

Description/purpose. A concept map is a visual representation (i.e., a picture map or a diagram) of key concepts related to a topic of interest. It shows visual connections between ideas or concepts. It is a flexible tool that organizes existing concepts into a logical structure and allows for the inclusion of new ideas into existing knowledge structures. The concept map is constructed by generating ideas and depicting the interrelationships between them (Trochim, 1989).

Concept mapping is a systems thinking tool that allows individuals or groups to create graphical representations or ideas on any topic (Trochim, Cabrera, Milstein, Gallagher, & Leischow, 2006). A concept map can be used to understand the relationship between concepts related to a particular topic of interest. It can be used by individuals or groups to represent structures of knowledge (White & Gunstone, 1992).

Suggested use. Concept mapping can be used for planning and evaluation (Trochim & Linton, 1986), teaching (All & Havens, 1997), planning and organizing patient care (Schuster, 2016), and knowledge externalization (Brüchner & Schanze, 2004).

Step-by-step procedure. Following is an outline of White and Gunstone's (1992) steps to constructing a concept map.

1. ***Write down ideas or concepts.*** On an index card (or using software such as Google Draw), record ideas or concepts that relate to your chosen topic. (See Figure 3.1 for an example of arranging concepts regarding asthma.) First, list the main concepts related to asthma (i.e., symptoms, triggers, diagnosis, treatment, and patient education).
2. ***Sort the cards and eliminate terms.*** Categorize like topics and remove any cards that you do not understand or that are not related to the other terms. In the asthma example, items related to triggers include indoor and outdoor allergens, irritants, certain medicines, certain medical conditions, sulfites in foods and drinks, and physical activity. Brainstorming for each category could reveal additional concepts. *Irritants* could include cigarette smoke, air pollution, chemicals, fumes/odors, and aerosol sprays.
3. ***Organize the related items.*** Lay out the cards so that they are close in proximity to each other while leaving space between each card.
4. ***Attach arranged items to a large sheet of paper.*** Secure the cards to the paper once you are satisfied with the arrangement, so they can be displayed for review.

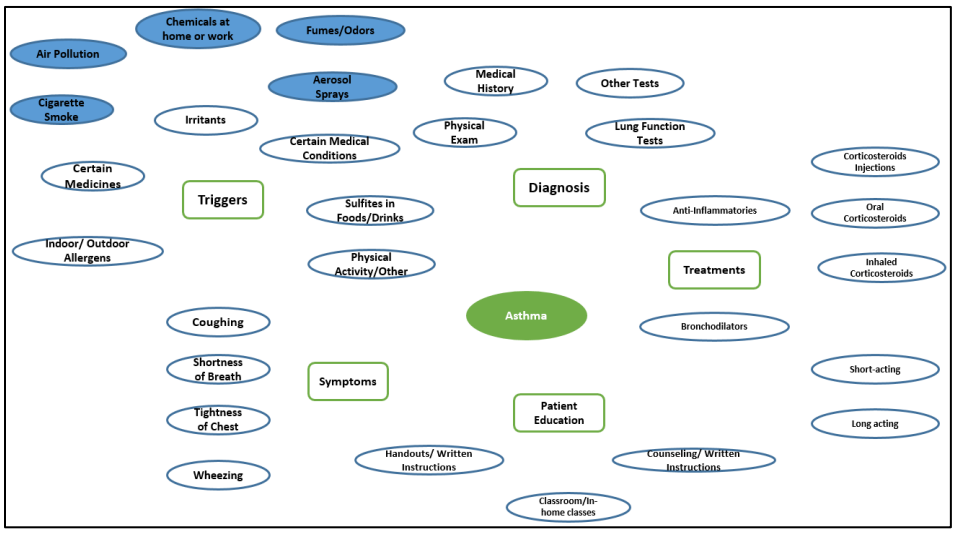

Figure 3.1. Arranging asthma concepts.

5. ***Draw lines between related terms*** (see Figure 3.2). The lines show the relationships between concepts.

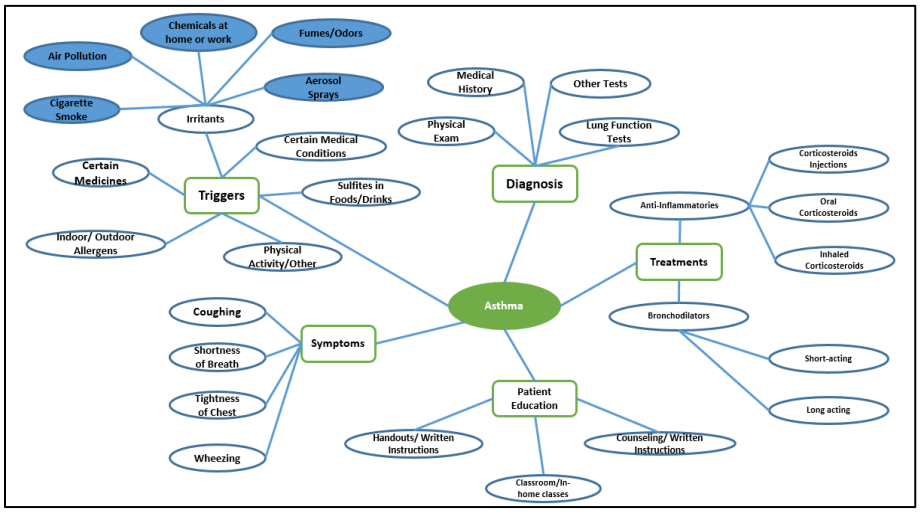

Figure 3.2. Linking related asthma concepts.

6. ***Explain the connections between separate parts of your concept map.*** If desired, label the lines with descriptions to help clarify the relationship. White and Gunstone (1992) suggested that writing the nature of the links and putting a directional arrow is useful for clarifying the relationship between concepts. A concept map becomes more complex with the addition of one-way and two-way arrows.
7. ***Revisit eliminated items.*** Review the eliminated items from step 2 to determine if they fit in any of the categories on the concept map.

While we used card sorting to brainstorm and organize the concepts in the concept map, a similar process can also be sketched out on paper. In addition, there are online or computer programs that aid in the creation of concept maps.

Resources

Canva Mind Map Maker: https://www.canva.com/graphs/mind-maps/
Mindup Free Online Mind Mapping: https://www.mindmup.com/
Lucidchart Concept Map Maker: https://www.lucidchart.com/pages/examples/concept-maps

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Trochim, W. M. K. (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., & Leischow, S. J. (2006). Practical challenges of systems thinking and modeling in public health. *American Journal of Public Health, 96*(3), 538-546.

Trochim, W. M. K., & Linton, R. (1986). Conceptualization for planning and evaluation. *Evaluation and Program Planning, 9*(4), 289-308.

White, R., & Gunstone, R. (1992). *Probing understanding*. New York, NY: Routledge.

Additional Resources Used

Rosenberg, S., & Kim, M. P. (1975). The method of sorting as a data-gathering procedure in multivariate research. *Multivariate Behavioral Research, 10*, 489-502.

Trochim, W. M. K., Milstein, B., Wood, B. J., Jackson, S., & Pressler, V. (2004). Setting objectives for community and systems change: An application of concept mapping for planning a statewide health improvement initiative. *Health Promotion Practice, 5*(1), 8-19.

Fishbone Analysis Diagram

Description/purpose. A fishbone diagram is a structured approach to brainstorming that is commonly used to conduct a root cause analysis of a given problem, particularly when the team is stuck in a rut. The analytical tool is called a fishbone diagram because the template's structure resembles the configuration of a fish's skeletal structure. The fishbone structure provides the template for categorizing the causes of the problem (Phillips, 2013). When used by a team, it allows for collaborative development of solutions based on team members' unique insights. According to Nathan and Kaplan (2017):

> A fishbone diagram has the following characteristics: (1) The focused problem or outcome to be improved is stated at the head of the diagram in a box. (2) The backbone of the "fish" consists of a long spine with an arrow pointing toward the head. The direction of the arrow implies that the items intersecting further along the spine might be causative of the main problem (shown in the head). (3) The large ones that attach to the spine reflect the key areas that the team feels are contributing to the problem. (4) More detailed causes are described by the smaller bones, as they relate to the major category (bone) to which they are attached. This series of bones takes the team through a cause-and-effect model from the deepest causes to the specified problem. (p. 144)

The effect (aka problem) is placed at the head of the fish and the causes are categorized through the body of the fish (see Figure 3.3).

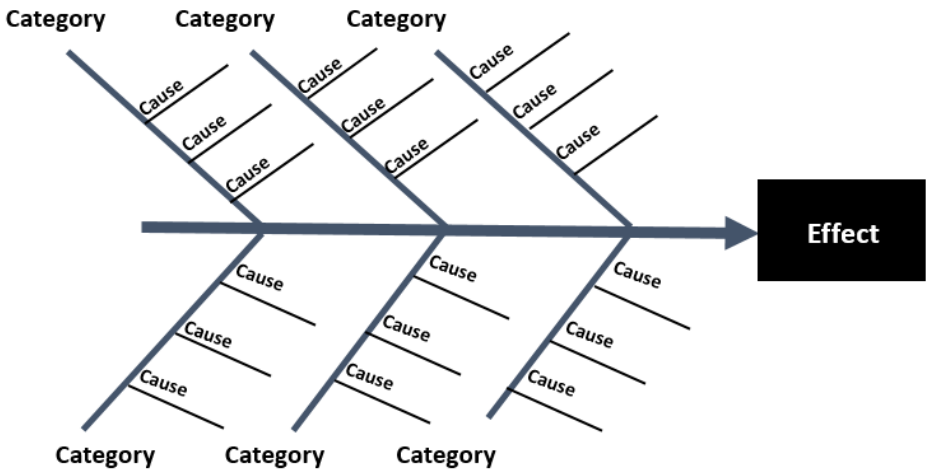

Figure 3.3. Fishbone diagram.

Suggested use. A fishbone diagram enables understanding of the cause-and-effect relationship in a particular situation. Individuals as well as groups can use a fishbone diagram to discover solutions by categorizing causes that contribute to a specified problem and discover solutions that were considered previously. Fishbone diagrams help to evaluate practice, risks, and mistakes. They are particularly helpful in analyzing the root cause of clinical problems (Phillips, 2013). When used in a healthcare environment, they allow the care team to improve the safety and quality of care and "minimize sentinel and adverse events" (Pearson, 2005, p. 141).

Step-by-step procedure

1. ***Determine who will participate in the brainstorming session.*** Select key participants to participate in a meeting designed to determine the root cause of a particular problem.
2. ***Define the problem and gain buy-in.*** Draft a clear problem statement and gain team members' agreement regarding the problem to be addressed.
3. ***Draw an arrow, which points to the problem that you will be addressing.*** For example, we can use the fishbone diagram to uncover the root cause of emergency department (ED) stays that are greater than 6 hours before admission or discharge (see Figure 3.4). According to Kheirbek et al. (2015), excessive ED stays trigger other problems such as "delays in diagnosis and treatment of time-sensitive conditions" (p. 162) such as heart attacks, strokes, and pneumonia.

Figure 3.4. Main problem or issue in the fishbone diagram.

4. ***Add lines emanating from the arrow to depict agreed-upon categories.*** For example, in this scenario, the categories might include causes related to providers/personnel, patients, hospital resources, processes/procedures, interfacility issues, and/or evaluation/results (see Figure 3.5).

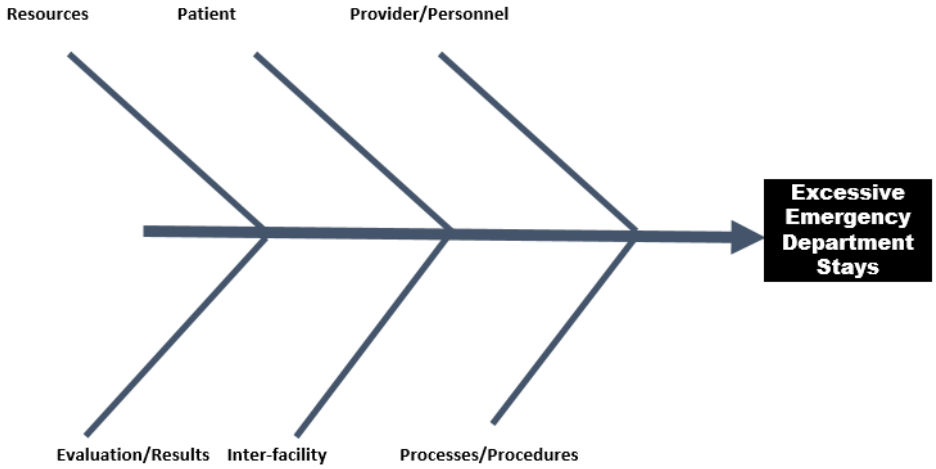

Figure 3.5. Categories in the fishbone diagram.

5. ***Add lines to each category to specify related causes.*** The cause identified for each category should be represented only once in the diagram. For example, causes in the interfacility category could include interfacility delay (i.e., transferring the patient), pharmacy (i.e., waiting for prescription medication), or surgery (i.e., waiting for a surgical unit). Figure 3.6 presents the causes for each category on a fishbone diagram.

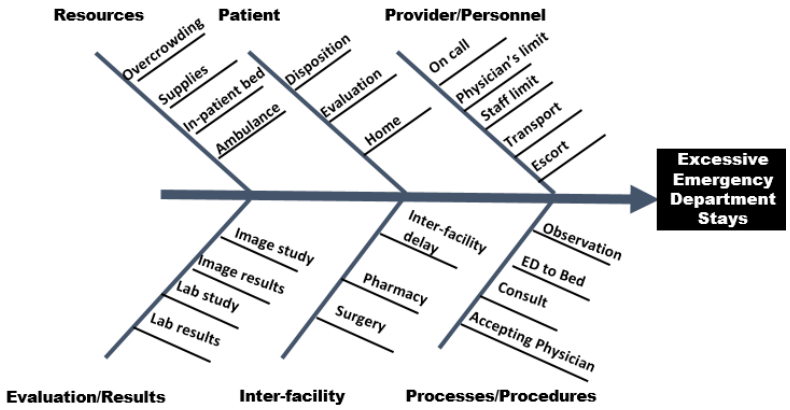

Figure 3.6. Causes in the fishbone diagram.

6. ***Prioritize key causes.*** To determine the root cause of the problem, prioritize each of the causes on the fishbone diagram. Ask: *Why did the cause occur?* Use the "5 Why" technique (see Figure 3.7) to identify the root cause of the problem (iSixSigma, n.d.).
   - Ask why the *problem* occurred and write the *cause* down.
   - If the answer does not identify the *root cause* of the problem, ask why the *cause* occurred and write it down. Keep asking *why?* until the *root cause* is revealed.

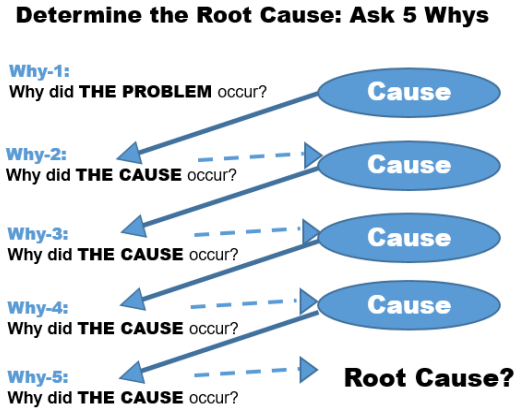

Figure 3.7. Five whys technique for root cause analysis. (Adapted from https://qualitytrainingportal.com/resources/problem-solving-tools/data-display-analysis/five-whys/)

7. ***Address the root cause***. Determine how you will handle the root cause of the problem.

Works Cited

iSixSigma (n.d.). *Determine the root cause: 5 whys.* Retrieved from https://www.isixsigma.com/tools-templates/cause-effect/determine-root-cause-5-whys/

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Phillips, J. (2013). Using fishbone analysis to investigate problems. *Nursing Times, 109*(15), 18-20.

Quality Training Portal. (n.d.). *Five ways. Retrieved from https://qualitytrainingportal.com/resources/problem-solving-tools/data-display-analysis/five-whys/*

Tree Diagram

Description/purpose. A tree diagram is an analytical tool that systematically moves your thinking from general to specific. It allows you to break down broad topics into increasing levels of granularity and categories into subcategories of greater levels of detail. A tree diagram is an orderly approach that begins with one item that branches out to two or more items. Each of these items branches out to two or more items. The tree diagram allows team members to have a common conceptualization of an issue or problem, expose gaps in their knowledge, and identify numerous causes of an issue or problem (U.S. Department of Health and Human Services, n.d.; American Society for Quality, n.d.).

Suggested use. Use the tree diagram when you want to probe for the root cause of an issue or problem, develop action steps to execute a solution, understand processes or issues relating to implementation, and/or communicate details to others.

Step-by-step procedure

1. ***State the problem clearly and write it in a box.*** The tree diagram starts with the box that defines the problem. Returning to the asthma example introduced with the concept map tool, we can create a tree diagram that homes in on asthma triggers (see Figure 3.8). The problem (i.e., asthma) is in the box on the left side of the horizontal tree.
2. ***Ask questions that will lead to the next level of detail*** (i.e., *What causes or triggers the problem? Why did this happen?).* Brainstorm to determine answers to your questions. Write the answers on the next level to the right. In this case, the brainstorm resulted in six asthma triggers (i.e., indoor/outdoor allergens, certain medicines, irritants, certain medical conditions, sulfites in foods/drinks, and physical activities/other causes).

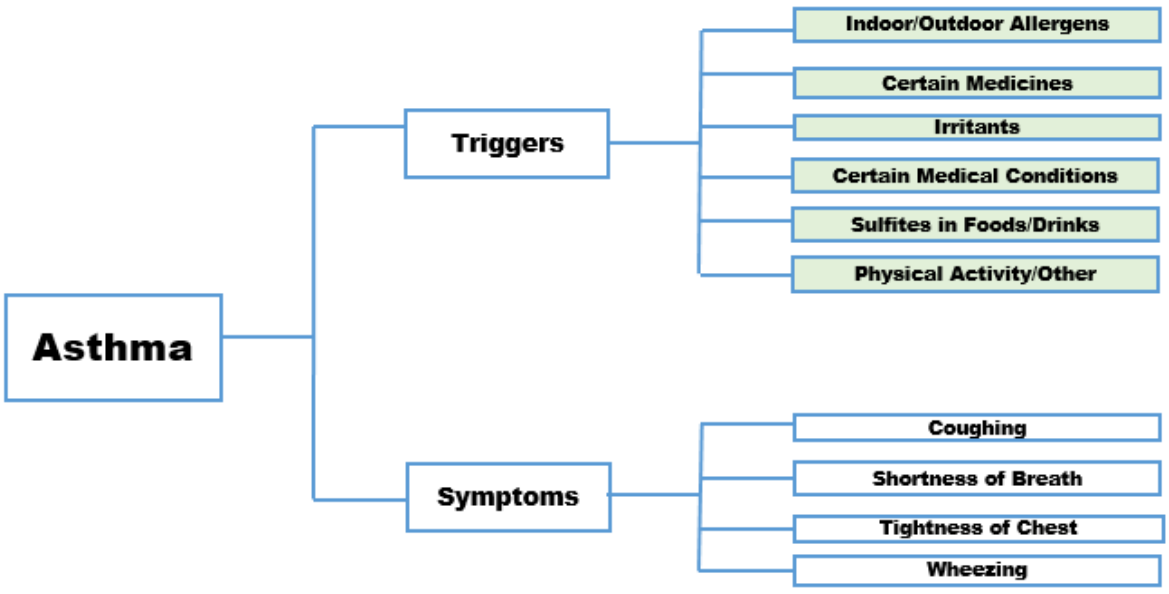

Figure 3.8. Tree diagram: Asthma triggers.

3. ***Check to make sure that you have captured all the items on the next level and that all items are necessary.***

4. ***Complete steps 2 and 3 to get to greater levels of detail.*** For example, in the asthma example, the question may be *what irritants are triggering an asthma attack?* The responses would populate the next level on the tree diagram. In this case, additional questions about irritants result in probable causes (i.e., cigarette smoke, air pollution, chemicals at home or work, fumes/odors, and aerosol sprays.)
5. ***Continue to create new levels of detail.*** Create additional details by asking questions until you reach a specific item that you can act on. For example, additional questions could reveal that the patient lives in a home with a chain smoker. Therefore, cigarette smoke may be the root cause of the asthma attacks that the patient experiences (see Figure 3.9).

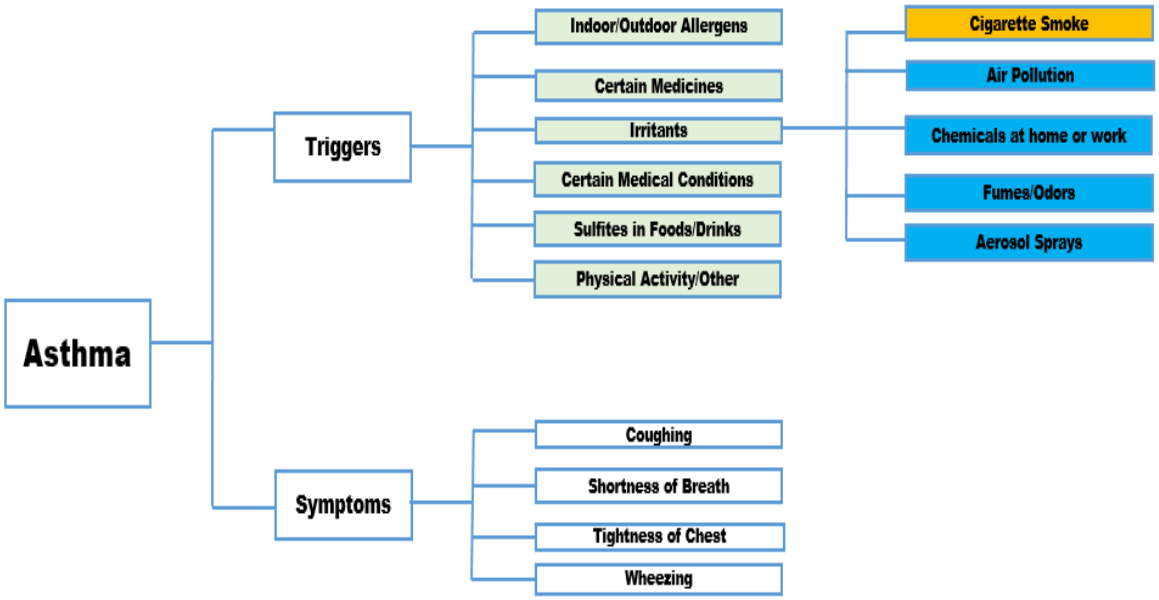

Figure 3.9. Tree diagram: Root cause.

3. ***Check the diagram.*** Review the diagram to make sure that everything is captured and that everything that is captured is necessary for the resolution of the issue.

Works Cited

American Society for Quality. (n.d.). *Seven new management and planning tools: Tree diagram.* Retrieved from http://www.asq.org/learn-about-quality/new-management-planning-tools/overview/tree-diagram.html

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Force Field Analysis

Description/purpose. A force field analysis identifies forces that support or hinder change. The forces most likely to foster change are called driving forces. The forces most likely to hinder change are called restraining forces. To ensure that change takes place as desired, you must develop strategies that foster change and reduce barriers to change. A force field analysis allows you to determine whether driving or restraining forces are stronger and determine appropriate strategies for change management (U.S. Department of Health and Human Services, n.d.). According to Productivity-Quality Systems (1992):

> Working through this process of identifying forces encourages creative thinking by forcing an improvement team to think together about the aspects of the desired change. The exercise also encourages the team to agree on the priority of the forces. This agreement provides a starting point for action. (p. 1)

Suggested use. When implementing changes (i.e., improving infrastructure, developing new processes, implementing new systems, engaging new people, creating new strategies), there are forces that desire to maintain the status quo. These two forces work against each other. A force field analysis allows you to understand the forces that have the biggest impact on the desired change. Tasked with improving processes, your challenge is to reduce or eliminate restraining forces while strengthening driving forces.

Step-by-step procedure

1. ***Write the proposed change at the top of a flip chart or piece of paper.*** Draw a large "T" using the vertical line to separate the driving forces and the restraining forces (see Figure 3.10). In this example, a force field analysis evaluates the change related to hiring a nurse practitioner to improve patient care in a busy diabetes center at an academic medical center.

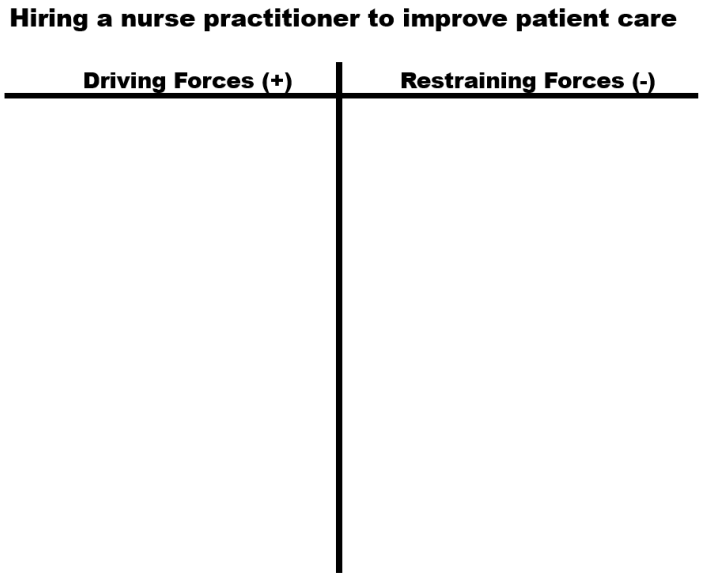

Figure 3.10. Force field analysis: Hiring a nurse practitioner.

2. ***Brainstorm all the internal and external forces.*** Think of as many internal and external forces that influence or work against change as possible. Place the forces that facilitate the

change on the left and the forces that inhibit action on the right (see Figure 3.11) (American Society for Quality, n.d.).

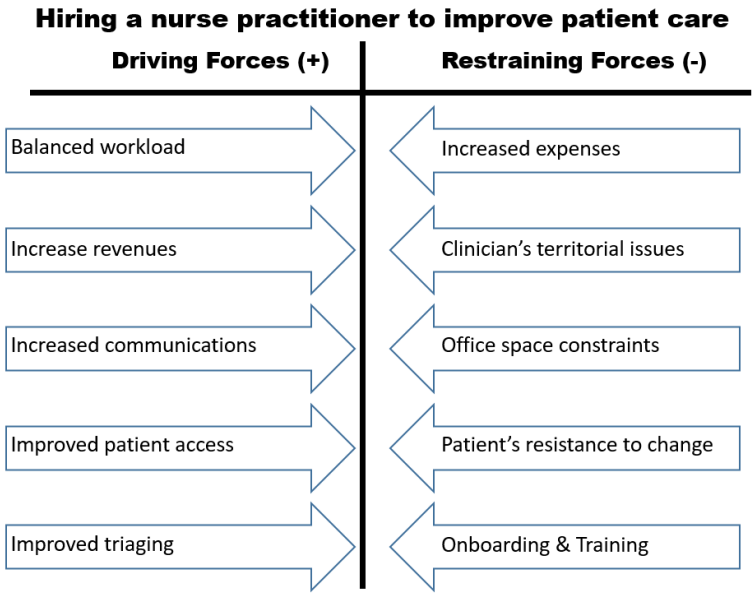

Figure 3.11. Force field analysis: Driving and restraining forces.

3. ***Eliminate the forces that are beyond your control***. Cross out the forces and score the remaining ones on a scale from 1 (least impact) to 10 (greatest impact). In this example, the driving forces (38) outweigh the restraining forces (27). Patient resistance to change is the greatest challenge, while improved triaging is the greatest benefit (see Figure 3.12).

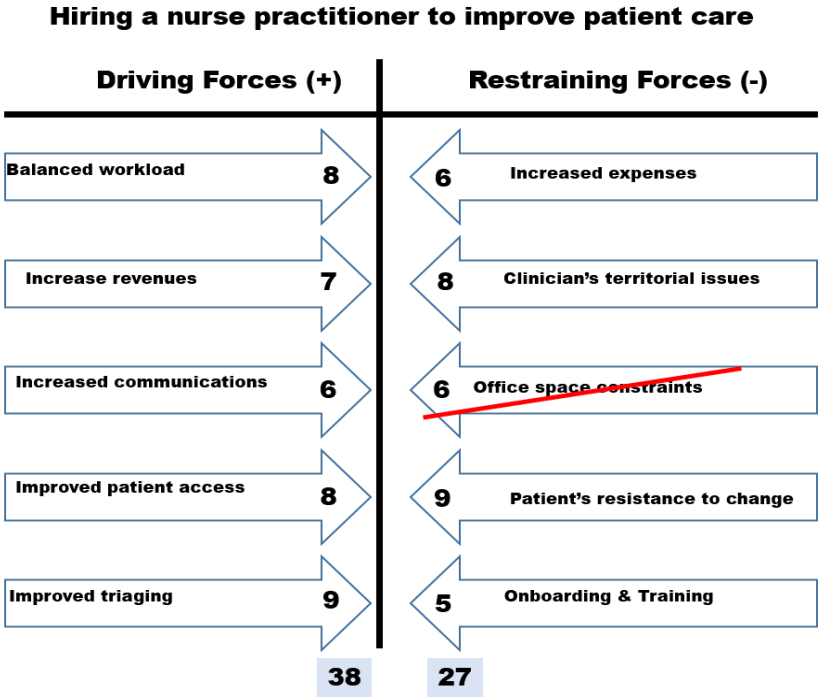

Figure 3.12. Force field analysis: Eliminating forces.

4. ***Prioritize the forces.*** Determine the top three driving forces (i.e., improved triaging, balanced workload, improved patient access) and restraining forces (i.e., patients' resistance to change, clinician's territorial issues, increased expenses) (see Figure 3.13).

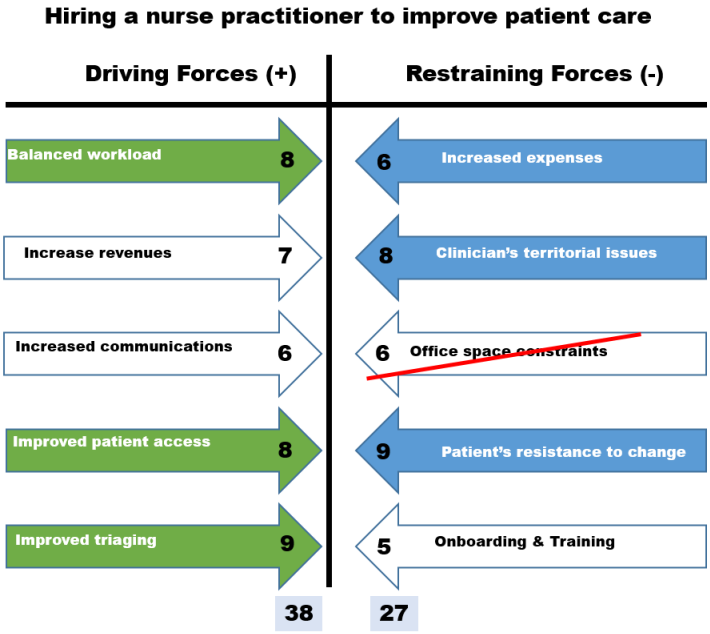

Figure 3.13. Force field analysis: Prioritizing forces.

5. ***Strategize solutions to manage forces.*** Develop strategies to strengthen driving forces and/or eliminate restraining forces.
6. ***Assign individuals to each change effort.*** Determine the action items required to accomplish proposed changes and assign individuals to each task. Add newly identified forces to the force field analysis (as appropriate), monitor progress, and update as necessary.

Works Cited

American Society for Quality. (n.d.). *Quality in healthcare*. Retrieved from http://asq.org/healthcare-use/why-quality/force-field.html

Productivity-Quality Systems. (1992). *Improvement tools for education (K-12): TQT, total quality transformations.* Miamisburg, OH: Author.

U.S. Department of Health and Human Services. (n.d.). *Force field analysis*. Retrieved from https://healthit.ahrq.gov/health-it-tools-and-resources/evaluation-resources/workflow-assessment-health-it-toolkit/all-workflow-tools/force-field-analysis

Spidergram

Description/purpose. A spider diagram, also referred to as a spidergram, is a graphical tool that helps you organize data in a logical manner and allows you to see interconnections more easily (Cunliff, 2018). The topic is represented at the center with lines emanating from the circle that represent key concepts or ideas (see Figure 3.14).

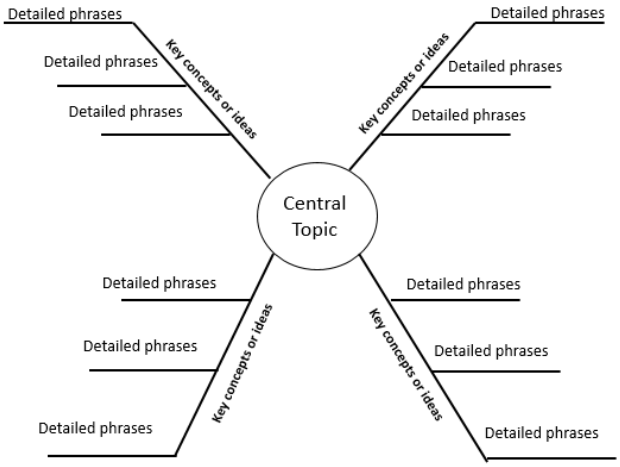

Figure 3.14. Spidergram.

Suggested use. A spidergram can be effective for brainstorming complex topics and improving the quality of the team's thinking. Use the spidergram to structure difficult or complex ideas, concepts, or issues into a graphical representation.

Step-by-step procedure

1. ***Place a complex concept or idea in the center of the spidergram***. Start by identifying the key focus area. For example, Liu, Kim, Chen, and An's (2010) study identified critical care attributes as the central issue influencing patient satisfaction (see Figure 3.15).

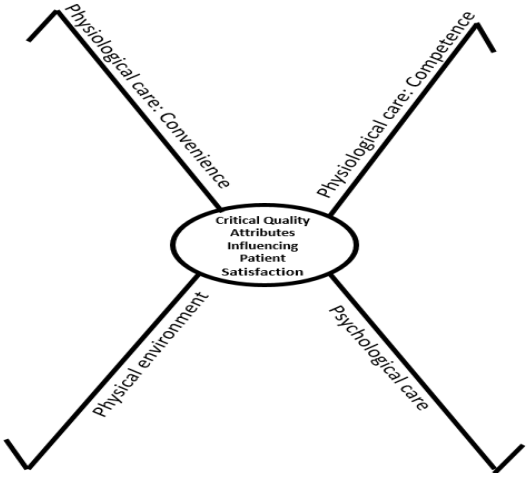

Figure 3.15. Spidergram: Key concepts of critical care attributes.

2. ***Draw lines from the central topic to represent related key concepts or ideas.*** In this example, the four topics include physiological care–competence, physiological care–convenience, physical environment, and psychological care.
3. ***Provide more specifics about each key concept.*** Break down each key concept into subconcepts. For example, physical environment includes condition of the equipment, experience in the waiting area, opinions about the food, and conditions of the hospital room (see Figure 3.16).

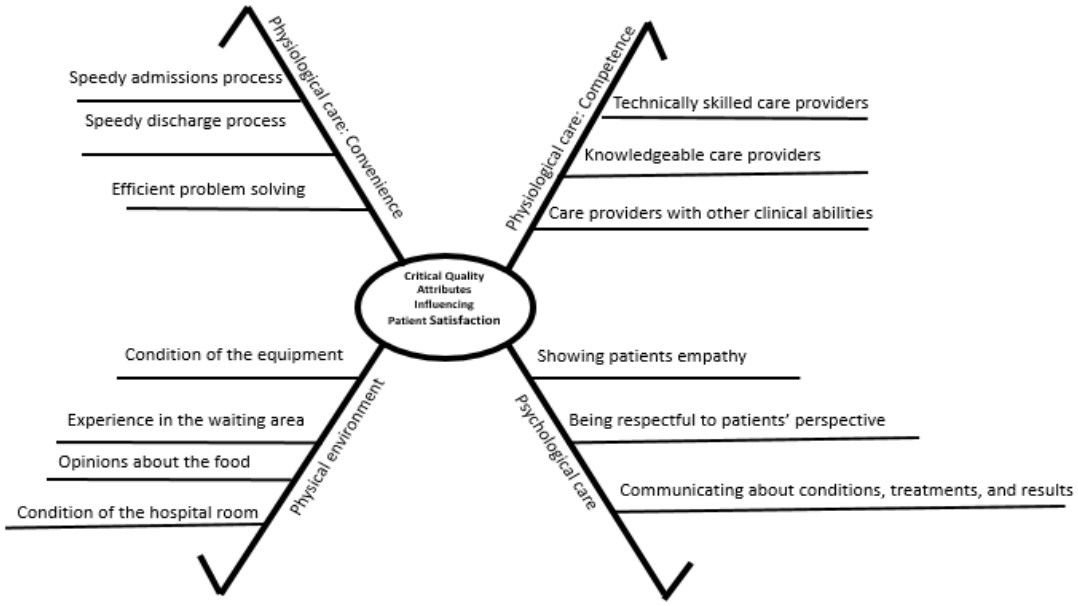

Figure 3.16. Spidergram: Critical care quality attributes influencing patient satisfaction.

4. ***Review the diagram to see if it is consistent and logical.*** Make changes to fine tune the diagram as needed.

Works Cited

Cunliff, E. (2018). Connecting systems thinking and action. *Systems Thinker.* Retrieved from https://thesystemsthinker.com/connecting-systems-thinking-and-action/

Liu, S. S, Kim, H. T., Chen, J., & An, L. (2010). Visualizing desirable patient healthcare experiences. *Health Marketing Quarterly*, *27*(1), 116-130.

Spider-Web Diagram

Description/purpose. A spider-web diagram allows you to "compare different dimensions of a construct visually and therefore provide a complete picture of the strengths and weaknesses of all the dimensions" (Liu, Kim, Chen, & An, 2010, p. 118). Various lines represent the dimensions or attributes of an issue, and numbers represent the level of importance of each attribute (see Figure 3.17).

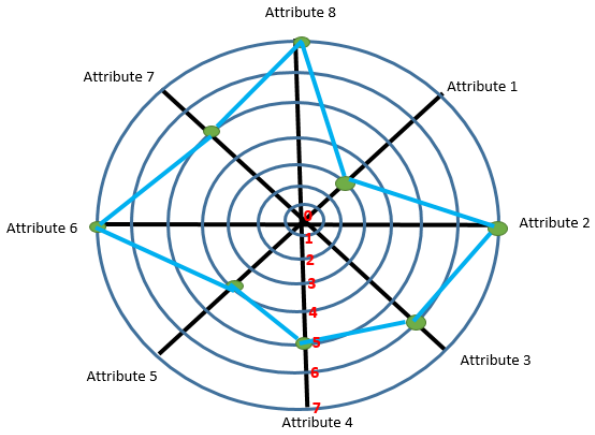

Figure 3.17. Spider-web diagram.

Suggested use. Use the spider-web diagram for decision making related to specific topics or areas of concern. A spider-web diagram can identify performance gaps for multiple dimensions concurrently and enable quick and easy analysis, evaluation, or measurement.

Step-by-step procedure

1. ***Draw the diagram and label the attributes***. Start by determining how many attributes you will be analyzing and drawing a circle with lines originating from the center to represent each one. Using Liu et al.'s (2010) study regarding critical quality attributes, we can create a spider-web diagram to evaluate each attribute (see Figure 3.18).

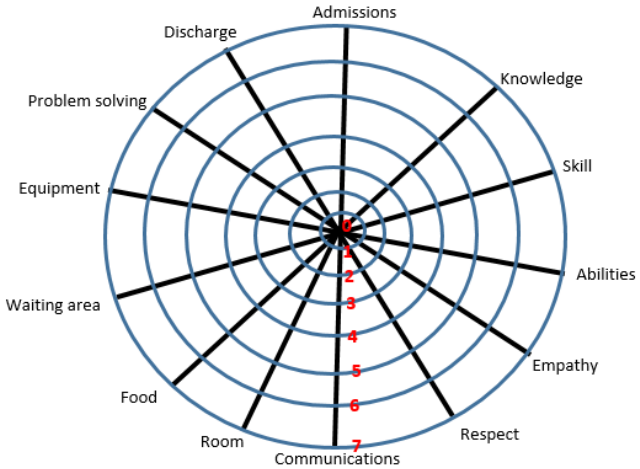

Figure 3.18. Spider-web diagram: Quality care attributes influencing patient satisfaction.

2. ***Use dots to depict evaluation level.*** For each attribute, evaluate the relative strength or weakness and assign a number on a scale (i.e., 1 = weak; 7 = strong). An evaluation of the patient's critical care attributes are represented by dots on the chart, which indicates the level of satisfaction on a scale (see Figure 3.19).

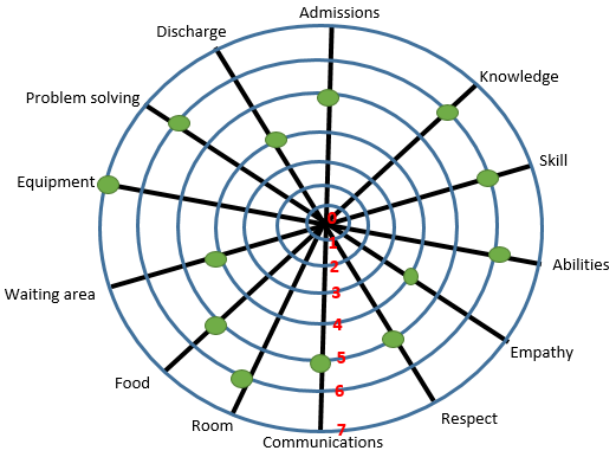

Figure 3.19. Spider-web diagram: Evaluation of patient's critical care attributes.

3. ***Draw lines to connect the dots to complete the spider-web diagram.*** Drawing lines between the dots provides a clear picture of strengths as well as areas for improvement. In this example, problem solving, knowledge, skills, abilities, room, and equipment receive high ratings; admissions, respect, communications, and food receive an average rating; discharge, empathy, and waiting area need improvement (see Figure 3.20).

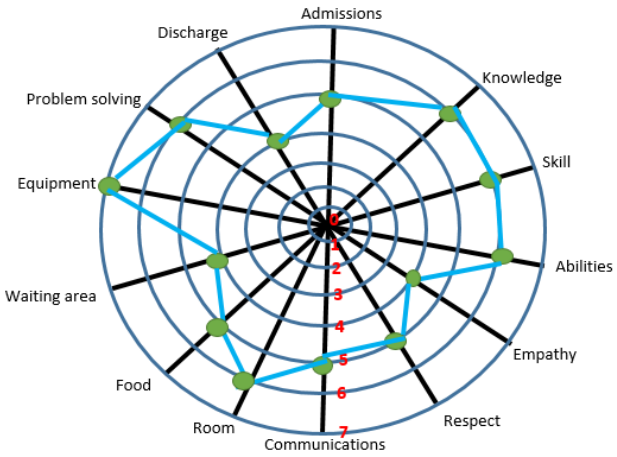

Figure 3.20. Spider-web diagram: Connecting the dots.

4. ***Review the diagram for consistency.*** Take a moment to review the diagram for consistency to make sure it is in line with actual experience. Adjust as necessary.

Work Cited

Liu, S. S., Kim, H. T., Chen, J., & An, L. (2010). Visualizing desirable patient healthcare experiences. *Health Marketing Quarterly, 27*(1), 116-130.

Chapter 4:
Tools to Analyze and Understand the System

In practice, frameworks describe and organize information. For example, the International Classification of Functioning, Disability and Health (ICF) model organizes multidimensional concepts related to an individual's body functions and structures, activities, participation, and restrictions as well as the environmental factors that affect an individual's experiences (World Health Organization, n.d.). The following tools—causal loop diagram, connection circle, stakeholder analysis, iceberg model, perspective taking, and left-hand column—focus on developing an understanding of various relationships among and between concepts, people, or variables within a system.

Causal Loop Diagram

Description/purpose. A causal loop diagram captures the cause-and-effect relationship between variables, identifies the links between variables, and recognizes processes that enhance change or promote stability. According to Lannon (2012),

> A causal loop diagram consists of four basic elements: the variables, the links between them, the signs on the links (which show how the variables are interconnected), and the sign of the loop (which shows what type of behavior the system will produce). By representing a problem or issue from a causal perspective, you can become more aware of the structural forces that produce puzzling behavior. (para. 2)

Causal loop diagrams help to explain the root cause of problems, drivers and outcome variables, feedback within the system, and leverage points for intervention. They allow decision makers to explore potential outcomes from interventions and model the potential impact of those interventions.

Suggested use. A causal loop diagram can be used to understand the drivers in a healthcare system that impact resources, utilization of services, and patient care (see Figure 4.1).

Figure 4.1. Causal loop diagram. (Adapted from Aronson and Angelakis)

Step-by-step procedure

1. ***Identify the variables and explore the linkages between variables.*** The first step in creating a causal loop diagram is to identify the essential variables (which may vary over time). To determine the "outcome variables" and the "driver variables," reflect on the items in Table 4.1.

Table 4.1
Causal Loop Diagram Components

Reflection questions	Examples
What is the problem/issue?	Underutilization of prenatal/postnatal care
What are the system's boundaries?	Healthcare facilities (doctor's office, hospitals, clinics)
At which level will the intervention take place?	Patient level, organizational level
What are the variables?	Resource adequacy, mother's frustration, mother's use of services, safe deliveries/postnatal care, trust in healthcare services
What are the drivers and outcomes? (use arrows)	Inadequate resources decrease mother's patience, adequate resources drive safe deliveries and postnatal care

Source: Columbia University Mailman School of Public Health, 2015.

2. ***Identify the polarity of relationships.*** Determine the direction of the relationships between the variables (i.e., how variables affect one another). Some variables move in the same direction: for example, as safe deliveries and postnatal care increase, trust in healthcare services increases. These variables are positive and are labeled with a "+." Variables that move in opposite directions (i.e., as mother attends more pre/postnatal care and hospital deliveries, resource adequacy decreases) are labeled with a "-" (see Figure 4.2). Table 4.2 depicts the relationship between the drivers and outcomes for this example.
   - Pick a starting point in the diagram.
   - For each pair of variables, determine what would happen to variable B if variable A changed.
   - Label changes in the same direction (+) and changes in the opposite direction (-).

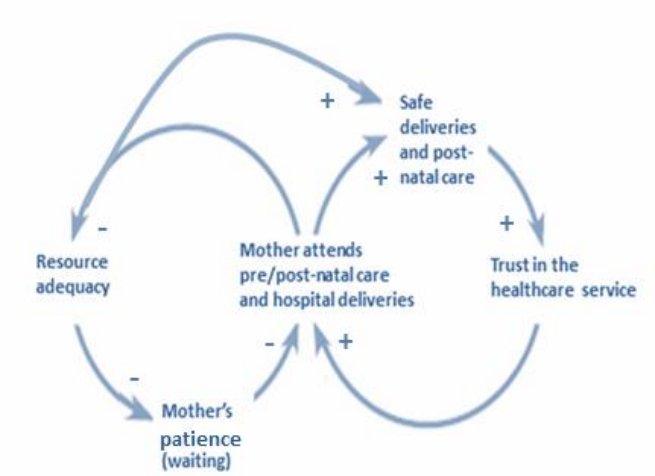

Figure 4.2. Causal loop diagram: Polarity of relationships. Adapted from Aronson and Angelakis (n.d.).

Table 4.2
Relationship Between Drivers and Outcomes

Driver	Outcome
Resource adequacy	Mother's patience, safe deliveries and postnatal care
Mother's patience	Mother's attendance (pre- and postnatal)
Mother's attendance	Resource adequacy, safe deliveries and postnatal care
Safe deliveries and postnatal care	Trust in the healthcare service
Trust in the healthcare service	Mother's attendance pre-/postnatal care and hospital deliveries

3. ***Identify feedback loops.*** Feedback loops include both reinforcing and balancing loops. Reinforcing loops increase the impact of change because action produces change that is compounded by more change. A growth or positive change is considered a virtuous cycle. In the example above, the loop on the right is a positive reinforcing loop. As the mother attends pre-/postnatal care and hospital deliveries, there are safe deliveries, which result in trust of healthcare services, which results in more mothers attending pre-/postnatal care. A decline or negative change is considered a vicious cycle. In the example above, the loop on the left is a negative reinforcing loop. As the mother attends pre-/postnatal care and hospital deliveries, the amount of available resources decreases, which decreases the mother's patience, which leads to a decrease in attendance in pre-/postnatal care and hospital deliveries. Balancing loops reduce the impact of change because actions produce change in one direction that counters change in the other direction. In other words, resisting forces seek to limit growth, maintain stability, and achieve equilibrium.
    - Confirm that the links are labeled correctly.
    - To determine whether a loop is reinforcing or balancing, count the number of negative signs in the loop.
    - An even number of negative signs indicates a reinforcing loop, while an odd number of negative signs indicates a balancing loop.
4. ***Identify leverage points.*** Leverage points are areas where interventions can result in changes in the system. Small interventions can result in small changes in the system. They address symptoms of the problem that are immediately evident. For example, an introduction of helpful resources for the mother to use while she waits for services increases patience, which may increase the mother's attendance in pre-/postnatal care. Changes in the system may address the root cause of the problem. For example, if the root cause is the lack of adequate resources, increasing resources would also have a positive impact on the mother's patience.

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Connection Circle

Description/purpose. A connection circle is a thinking tool that allows you to brainstorm concepts (nouns or phrases) and relationships within a dynamic system. The purpose of a connection circle is to identify the pattern of the problem as well as the causal loop that drives the pattern. It is used to understand how concepts influence and change each other. It helps you to understand complexity by providing a way to organize concepts visually and increases awareness of underlying causes of changes (Quaden, Ticotsky, & Lyneis, 2009).

Suggested use. Use a connection circle to organize thoughts, find cause-and-effect relationships, trace feedback loops to explain the root cause of problems, and clarify thinking about root causes of complex issues (Quaden et al., 2009).

Step-by-step procedure

1. ***Identify a complex situation, which changes over time.*** Choose a complex issue that increases or decreases over time. For example, we could examine the 2018 flu outbreak (Bever, 2018; Sun, 2018).
2. ***Determine the main issue or problem***. Distinguish the main problem from other details. For example, the two articles describe the main issue as widespread flu activity, which predominantly affected the elderly, small children, and chronically ill individuals.
3. ***Collaborate***. Work with team members (if possible) to improve your thought process. Individuals can read and reflect on the articles independently and then discuss them openly in a group.
4. ***Brainstorm in a group or with a peer***. In a group or with peers, use the connection circle template (see Figure 4.3) to list two to three concepts. (Images adapted from Quaden et al., 2009.)

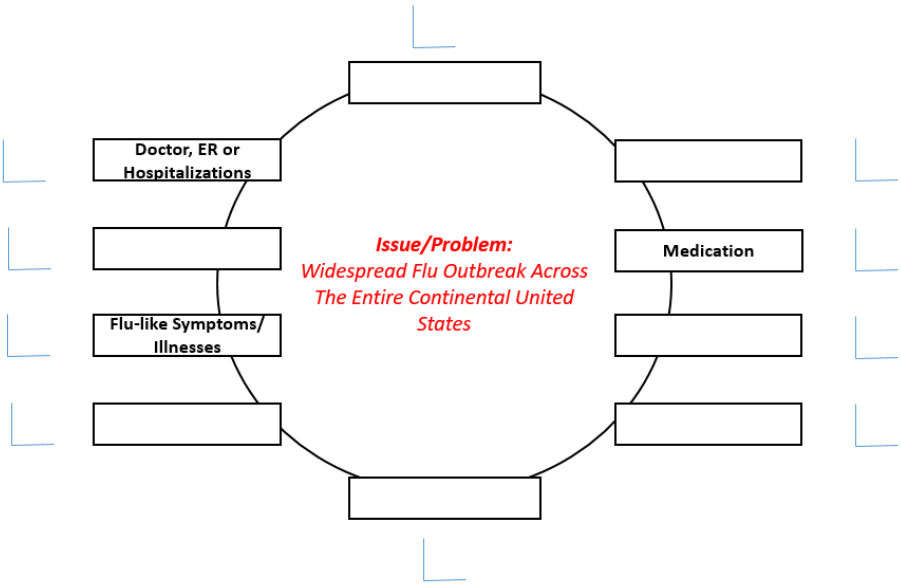

Figure 4.3. Connection circles.

5. ***Add concepts to the connection circle.*** Continue adding concepts to the connection circle as you discuss them with your team members. Follow the connection circle rules (Quaden et al., 2009) below:

- *Identify the problem:* What is changing? How is it changing?
- *Write concepts on the connection circle template.* Solicit information from the team to identify 5 to 10 concepts. Make sure they contribute to the problem, they are represented as common or proper nouns (people, places, or things), and they increase or decrease. Using the two articles (Bever, 2018; Sun, 2018), a potential connection is depicted in Figure 4.4.

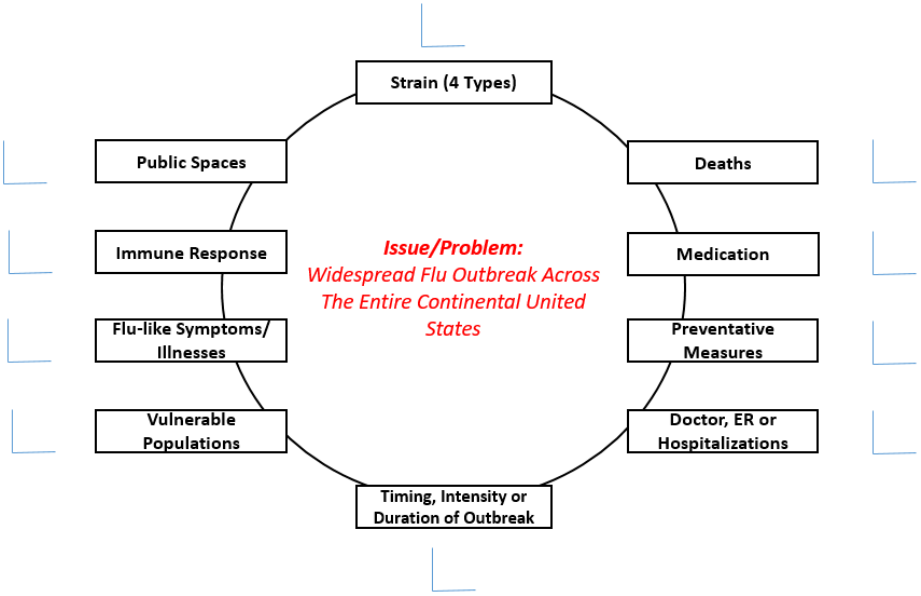

Figure 4.4. Connection circles: Flu season 2018.

- *Fill in the behavior over time with graphs that surround the circle.* Record the change over time for each concept (see Figure 4.5). These graphs provide information to assist in making connection between concepts. For example, during the flu season, the timing, intensity, and duration of the breakout will peak and decline. The same is true for flu-like symptoms and visits to the doctor, emergency department, or hospital. Sick people will stay home from work and school, so activity in public spaces might decline. The immune response might increase as the body tries to fight off the virus.

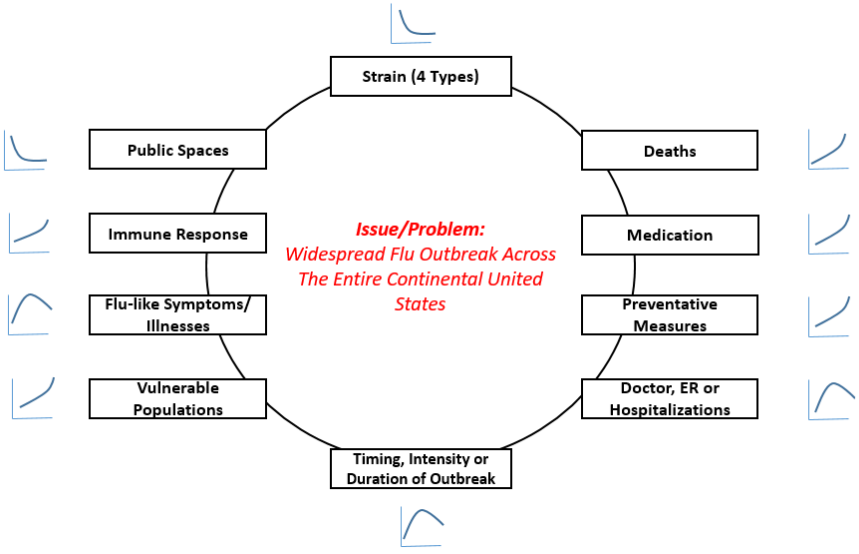

Figure 4.5. Connection circle and behavior over time graphs.

6. ***Identify concepts that have a direct effect (increase or decrease) on other concepts and draw arrows to connect related concepts***. Connect the concepts in the connection circle. Note that some concepts may have multiple connections while others have no connections. State how and why the two concepts are connected. Highlight each closed loop in a different color (See example of connections in Figure 4.6.) Describe the causal connections between the concepts by answering the following questions: *Does a change in one concept cause a change in another? Which direction does each concept change (increase or decrease)?*

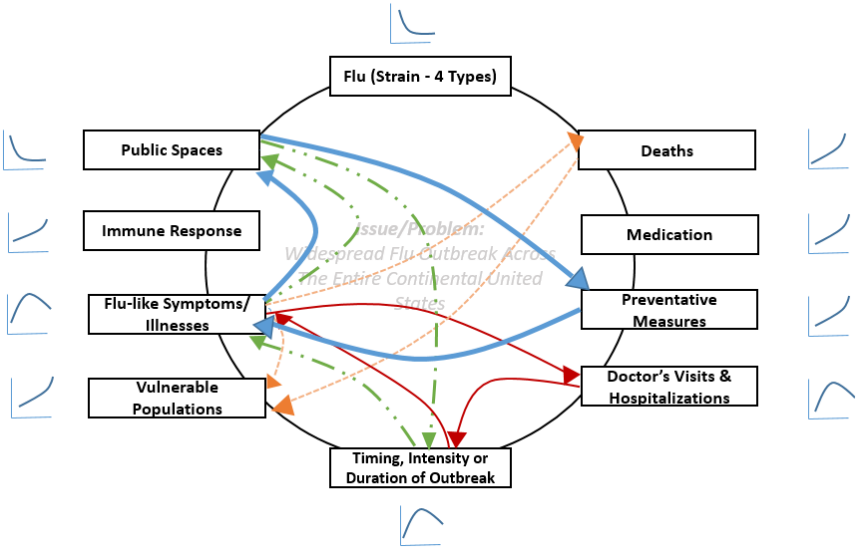

Figure 4.6. Connection circle: Identifying closed loops.

7. ***Identify feedback loops and explain how they work.*** Look for closed pathways or feedback loops, also called causal loops. These loops explain what causes the problem. There are different types of feedback loops (i.e., reinforcing loops and self-balancing loops).
   - *Reinforcing loops:* An increase in one concept causes an increase in another concept, and the loop begins again. The two types of reinforcing loops are *vicious cycles* (where a chain of events reinforce themselves through feedback loops with detrimental results) and *virtuous cycles* (where a chain of events reinforce themselves through feedback loops with favorable results). An example of a feedback loop is displayed in Figure 4.7.

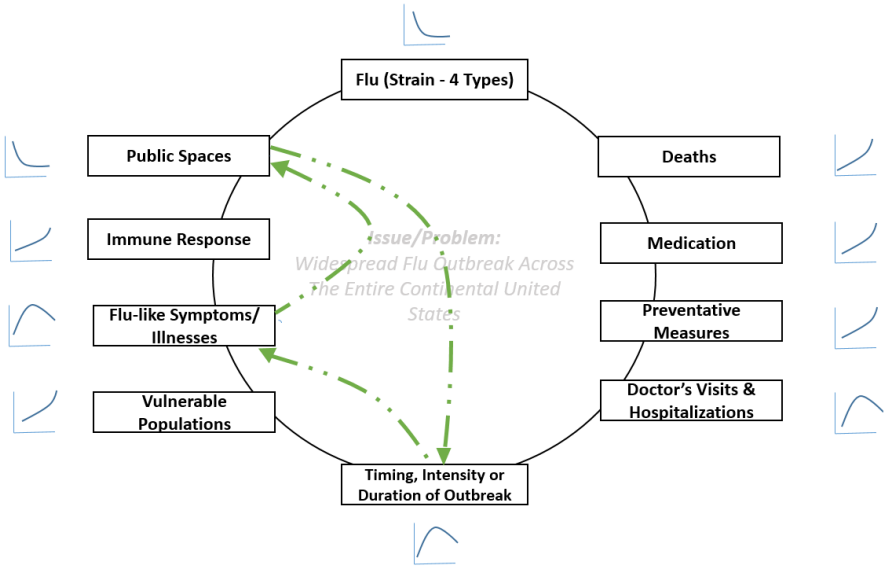

Figure 4.7. Connection circle: Feedback loop.

The feedback loop could be either a vicious or a virtuous cycle. For example, if ill persons go to school or work (or other public spaces), they increase the number of infected people in public spaces and increase the intensity or duration of the outbreak (i.e., a vicious cycle). If ill persons stay away from work or school (or other public spaces), this decreases the number of infected people in public spaces and decreases the intensity or duration of the outbreak (i.e., a virtuous cycle).

- *Self-balancing loops*: An increase in one element loops around and causes a decrease in that element. The balance goes back and forth each time the loop goes around. For example, in Figure 4.8, as preventive measures increase, flu-like symptoms and illnesses decrease and more people go to school or work (and other public places) and stop taking preventive measures. Once people stop taking preventive measures, the flu-like symptoms and illnesses could increase, which would lead to more people staying home and taking more preventive measures.

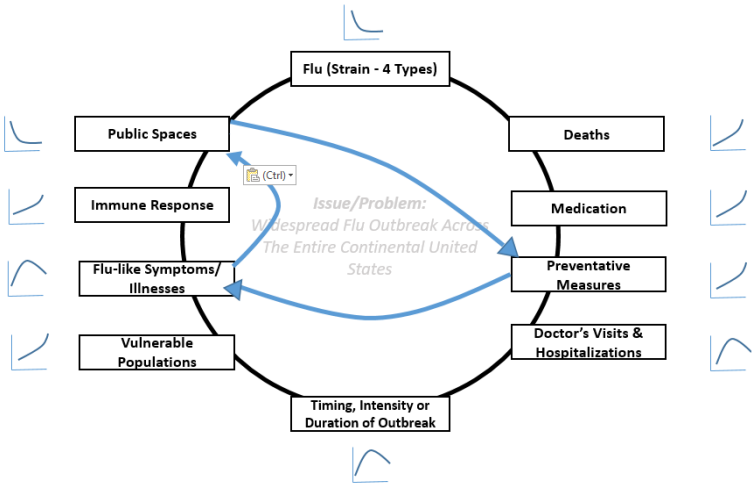

Figure 4.8. Connection circle: Self-balancing loop.

- *Intersecting loops*: Loops can share common concepts that appear in more than one feedback loop. Changes can be interdependent and simultaneous. For example, in Figure 4.9, flu-like symptoms appear in both feedback loops.

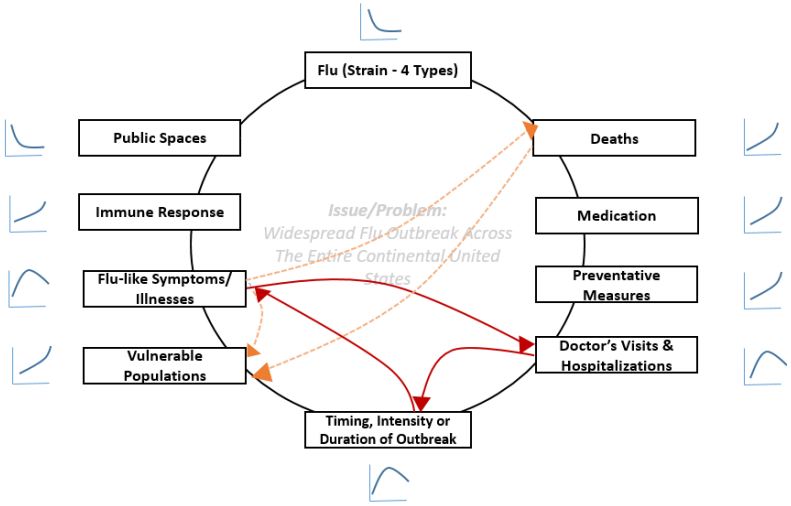

Figure 4.9. Connection circle: Intersecting loops.

In this case, flu-like symptoms/illnesses are the common concepts that appear in more than one feedback loop. You can depict this concept in two side-by-side connection circles (see Figure 4.10) as well.

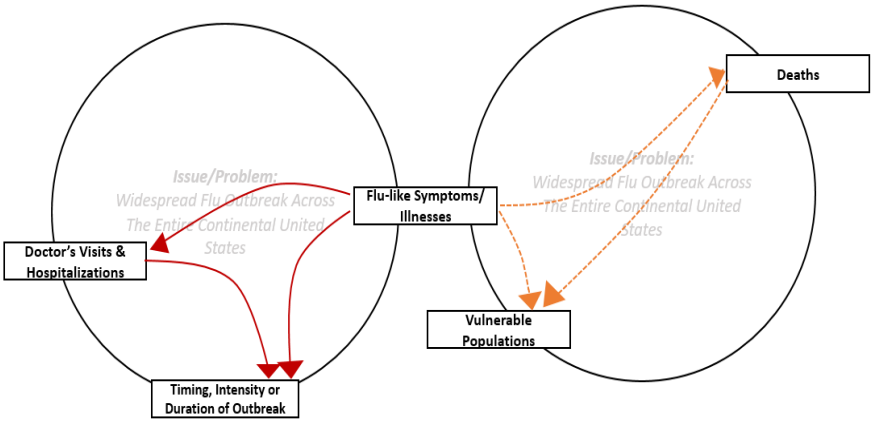

Figure 4.10. Connection circle: Concepts that appear in more than one feedback loop.

8. ***Draw each closed loop separately and explain how each works.*** To get a clear understanding about what is going on in the complex system, separate out the loops in the connection circle by drawing them independently. This will enable you to determine how each type of loop impacts the system.
9. ***Reflect on/discuss what you have learned by answering the following questions (Molloy, 2005):***
    - Which concepts have the most connection arrows going in both directions? Why? [These are leverage points, key elements, or drivers of the main issue.]
    - Why would a concept have no arrows pointing to it? [The element is not being changed by other elements.]
    - Why would a concept have no arrows coming from it? [The element doesn't influence any other element.]
    - Why would a concept have no connections at all? [It is not critical or relevant to the situation or issue.]
    - Why would the arrows lead back to the starting point? [This is a feedback loop.]
    - Why would a concept appear in more than one feedback loop? [This is a complex situation.]
    - How has your thinking changed from the way that you originally viewed the problem?

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Stakeholder Analysis

Description/purpose. A stakeholder analysis is a process used to identify relevant parties such as persons, groups, neighborhoods, organizations, or institutions (Mitchell, Agle, & Wood, 1997) that have an interest, concern, or ownership in a project plan, program, policy, or proposed action (Schmeer, n.d.; Makan et al., 2015). The stakeholder analysis identifies, categorizes, and analyzes individuals or groups who have a 'stake' in the outcome of the action or objective (Makan et al., 2015) or whose support is required to ensure successful accomplishment of the goal or survival of a project/program (Elias, Cavana, & Jackson, 2016). The analysis also provides information about potential barriers and actions required to gain buy-in and participation of key individuals or groups.

Suggested use. A stakeholder analysis could be used for problem structuring or scenario planning and modeling (Elias et al., 2016). It is helpful in "health policy and systems research to improve the understanding of policy stakeholders and increase the likelihood of knowledge translation into policy and practice" (Makan et al., 2015, p. 1). It is also useful for project management and may be beneficial in managing conflicts.

Step-by-step procedure. Elias et al. (2016) detailed a systematic stakeholder analysis as follows:

1. ***Develop a stakeholder map.*** A stakeholder analysis begins by developing a map of each person with significant roles in the project. Figure 4.11 depicts a stakeholder map of an improvement project for a mental healthcare program, which might include practitioners, persons affected by mental health illness, community and social organizations, media, donors, and policy makers (Makan et al., 2015).

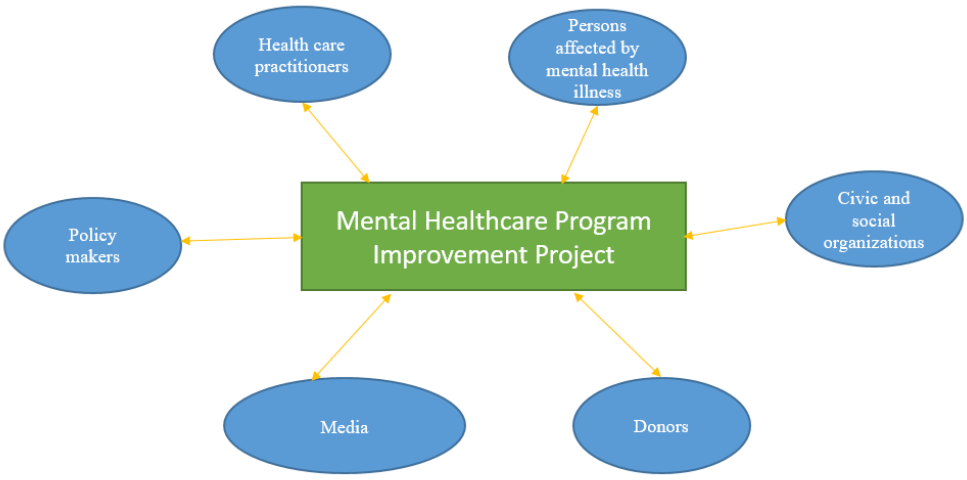

Figure 4.11. Stakeholder map: Mental healthcare program improvement project. Adapted from Elias et al. (2016).

2. ***Prepare a stakeholder chart to conduct a logical analysis of the stakeholders.*** Gather information and create a chart that provides details about the key stakeholders. Table 4.3 depicts the stakeholder chart for the program improvement project.

Table 4.3
Stakeholders Chart

Stakeholder	Description	Stakeholder	Description
Healthcare practitioners	• Mental health specialists • General primary healthcare workers (doctors, nurses, community health workers)	Persons affected by mental health illness	• Persons with psychosocial disabilities • Families • Caregivers • Service user groups
Policy makers	• World Health Organization • Ministries of health, social development, economic development • Correctional services, police services, peace and reconciliation • Health and government committees (health and related sectors)	Civic and social organizations	• Nongovernmental organizations • Community-based organizations • Faith-based organizations
Media	• International, regional, national, state, and local media	Donors	• Department for International Development regional or country offices • Other funding agencies

3. ***Identify the stakeholder's stakes.*** Determine what is important to the stakeholders based upon existing knowledge, in-depth interviews, and/or focus groups. Table 4.4 identifies the major stakes of the six identified program improvement project stakeholders.

Table 4.4
Stakeholders' Stakes

Stakeholder	Stakes
Healthcare practitioners	Providing care, education, and reducing mental health stigma
Persons affected with mental health illnesses	Interest, availability, access, awareness, and activism
Policy makers	Implementing policy and legislation
Civic and social organizations	Raising awareness through antistigma campaigns, influencing communities, engaging in activism, and providing support and advocacy
Media	Raising awareness, creating sensitivity around the issue, influencing the policy and implementation agenda
Donors	Funding

4. ***Prepare a rational-level analysis.*** Complete a two-dimensional power versus stake grid. Table 4.5 provides an example of a grid of power (i.e., decision-making, economic, political, and advocacy) vs. stake (influencer, care provider, and care receiver) for scaling up mental health services.

Table 4.5
Power vs. Stake Grid

		Power			
Group	Stake	*Decision making*	*Economic*	*Political*	*Advocacy*
Influencer (Media, donor, policy makers)	High	Ministries of Health	DFID and other funding agencies, Ministries of Health	WHO, Ministries of Health	
	Medium high			Government committees	International, regional, national, state, and local media
	Medium			Government services	
	Low medium				
Care provider (Healthcare practitioners, civic and social organizations)	High	MH specialists	MH specialists Doctors/nurses		
	Medium high	Doctors/ nurses			
	Medium	Community health workers			MH specialists
	Low medium				
Care receiver (Persons with MH illness, families, user groups)	High		Families/ persons with MH illness		Service user groups
	Medium high	Families		Families	
	Medium	Caregivers		Service user groups	
	Low medium	Persons with MH illness			

Note. DFID indicates Department for International Development; MH, mental health; WHO, World Health Organization. Source: Elias et al. (2016).

5. ***Conduct a process-level stakeholder analysis***. Analyze the implicit and explicit relationships between the project manager and the stakeholders. It is also important to determine if the processes align with the stakeholder's map (Elias et al., 2016).
6. ***Conduct a transactional-level stakeholder analysis***. Analyze the transactions or negotiations that take place between you and the stakeholders. According to Elias et al. (2016), success is dependent on an understanding of the stakeholder's legitimate power and the implementation of the appropriate processes to ensure that all stakeholder issues and concerns are uncovered and addressed. For example, stakeholders may have conflicting interests, which need to be resolved to avoid project delays.

7. ***Determine the stakeholder management capability of the project.*** The stakeholder's management capability is an understanding of the key stakeholders, the processes used to handle the stakeholders, and the transactions required to achieve the project's purpose (Elias et al., 2016). Elias and colleagues (2016) stated:

> Stakeholder management capability of a . . . project can be defined as its understanding or conceptual map of its stakeholders, the processes for dealing with these stakeholders and the transactions which it uses to carry out the achievement of project purpose with its stakeholders (Freeman, 1984). (p. 307)

For example, for project managers, the process for dealing with the stakeholders may be high; however, the transaction between the project manager and the stakeholders may not be effective (see Table 4.6).

Table 4.6
Stakeholder Management Capability

		Understands Correct Stakeholder Map	
Process	**High**		X
	Low		
		High	**Low**
		Transaction	

Source: Elias et al. (2016, p. 308).

8. ***Analyze the dynamics of stakeholders.*** To analyze the stakeholders' dynamics, focus on the attitudes of the stakeholders towards the project and the perception (which may change over time) of the stakeholder's importance to the accomplishment of the project. Figure 4.12 shows a Venn diagram of the stakeholder's typology.

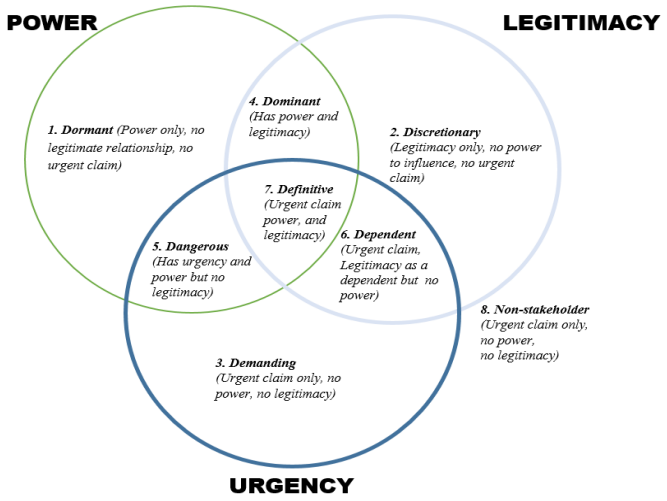

Figure 4.12. Stakeholder's typology. Source: Elias et al. (2016, p. 304) and Mitchell, Agle, & Wood (1997).

An examination of the stakeholder's dynamics strengthens the overall project analysis. The stakeholder's typology (Mitchell et al., 1997) facilitates the understanding of stakeholders' dynamics. Table 4.7 presents the stakeholder's typology (Elias et al., 2016).

Table 4.7
Stakeholder's Typology

Group	Power	Stakeholder
Dormant	Power only	Ministries of health, DFID, other funding agencies, WHO, government committees and services, media
Discretionary	Legitimacy only	Caregivers, doctors/nurses, community health workers
Demanding	Urgency only	NA
Dominant	Power and legitimacy	MH specialists
Dangerous	Power and urgency	NA
Dependent	Legitimacy and urgency	Persons with MH illnesses, family
Definitive	Power, legitimacy, and urgency	Service user groups
Nonstakeholder	No power, legitimacy, or urgency	NA

Note. DFID indicates Department for International Development; MH, mental health; WHO, World Health Organization.

9. ***Complete the stakeholder analysis matrix***. Summarize key information for the stakeholders in the project. Table 4.8 presents a template for the matrix.

Table 4.8
Stakeholder's Matrix

Stakeholder	Contact info.	Impact	Influence	Stake	Contribution	Blocks	Strategies for engagement
Policy makers							
Civic and social organizations							
Media							
Donors							
Healthcare practitioners							
Persons affected with MH illnesses							

Source: Tools4dev (n.d.).

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Iceberg Model

Description/purpose. The iceberg model is a tool for understanding global issues within a system. Analogous to an iceberg in the ocean, only 10% of the structure is visible. The submerged 90% generates the perceived issues and determines the visible outcomes. The iceberg model enables us to use different lenses to view the system and expand our perspective to include various patterns, structures, or events that may cause a critical event to occur. The iceberg model has four levels: *events*, which are observable variables; *patterns of behavior*, which describe trends; *system structure*, which describes interrelationships between the parts of the system; and *mental models*, which include beliefs, values, and assumptions that shape an individual's perceptions (Complexity Labs, n.d., Goodman, 1997; REOS, 2010) (Figure 4.13).

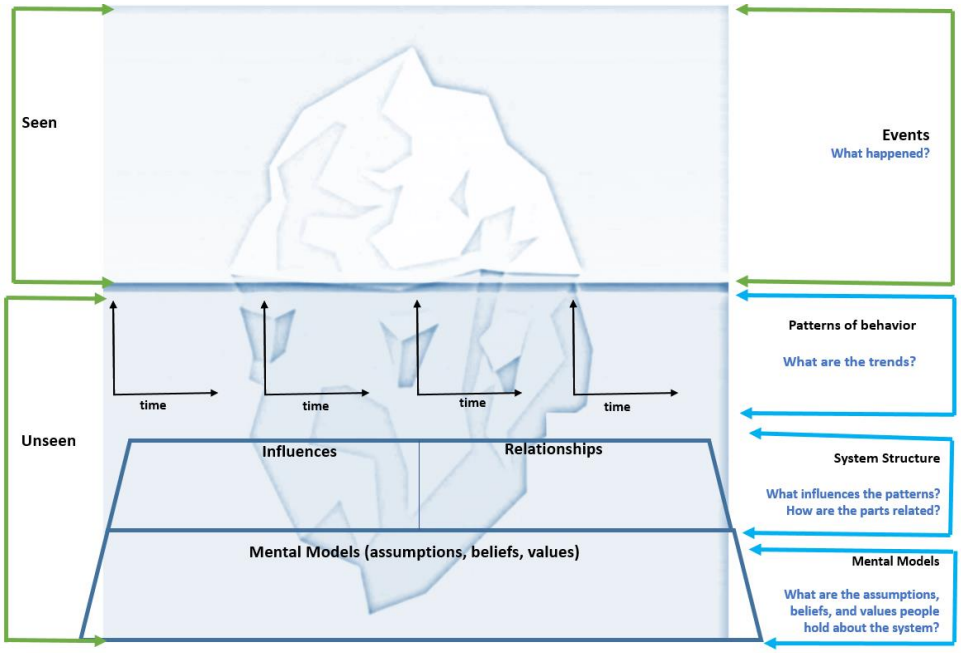

Figure 4.13. The components of the iceberg model. Image source: Freepik.com, https://nl.freepik.com/vrije-vector/ijsberg_1075784.htm

Suggested use. An individual or group can use the iceberg model to expand their perception of a critical event by viewing it within the context of the entire system. An analysis of the iceberg model is helpful in identifying and changing mental models and behavior.

Step-by-step procedure

1. ***Identify the event.*** First, identify the event by asking: *What happened?* For example, consider a runner's knee injury. The runner recently injured his knee training for a marathon. An iceberg model could explore his experience with the injury (the event).
2. ***Explore the patterns of behavior.*** Ask: *What are the trends?* After the initial injury, the patterns of behavior may include:
   - Using ice to stop the pain but continue running
   - Using over-the-counter medication to block the pain but continue running
   - Seeing a doctor, who prescribes physical therapy but continue running

- Experiencing more severe/chronic knee pain (due to lack of rest)
- Requiring surgery, which prevents him from running the marathon

3. ***Explore the system structures.*** System structures include influences and relationships. Ask: *What influences the patterns?* He is a member of a running club that is training for an upcoming marathon. *What are the relationships between the parts?* Taking a break from running to give the knee a chance to heal will prevent him from qualifying for the marathon.
4. ***Determine which mental models shape the person's perception***. Identify mental models by asking: *What are the assumptions, beliefs, and values that the person holds?* The person *assumes* that it is not a major issue and that the knee pain will resolve on its own and/or that more activity will strengthen the knee. He *believes* that the injury is no big deal; believes that winners never quit; believes in the adage "no pain, no gain." He *values* being competitive and being a part of a club as well as being active, energetic, and vibrant. Additionally, he does not want to appear weak.
5. ***Identify leverage points in the system.*** Look for places in the system where you can make a small change that will produce large results (Complexity Labs, n.d.). Determine what you will do to make shifts or changes at each level (see Figure 4.14). How will you react to the event? How can you anticipate the trends? What design changes need to be made to manage the influences and relationships in the structure of the system? What steps can you take to transform your mental models? For example, the runner could rest his knee when it is first injured. He could choose not to train for this marathon but stay engaged with the running group as a motivator/cheerleader. This would give him time to heal and to get ready for the next marathon. He would change his mental model from individual winner to team supporter.

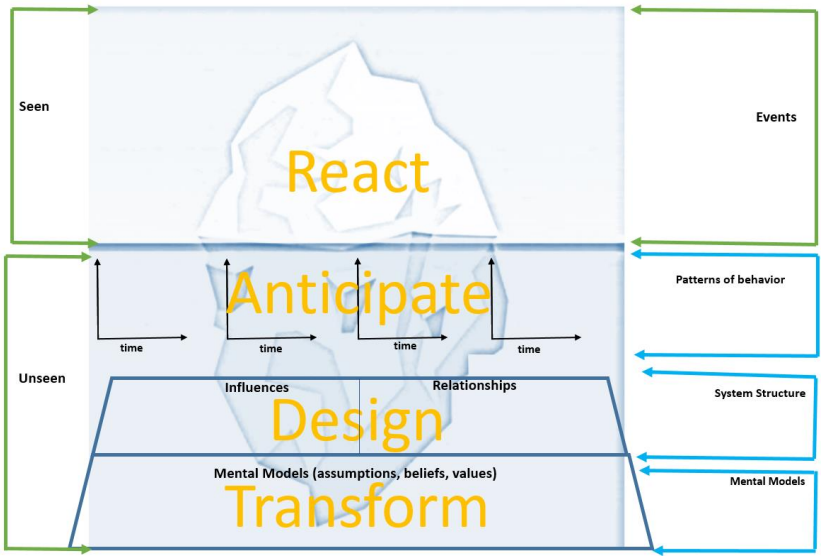

Figure 4.14. Mapping leverage points. Adapted from Waters Foundation (2008) and Northwest Earth Institute. (n.d.).

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Perspective Taking/Multiple Perspectives

Description/purpose. According to Edson (2008), viewing a problem from various stakeholder perspectives is a basic tool of a systems thinker. Developing *multiple perspectives* can be a simple process of gathering information from key stakeholders via interviews, focus groups, and surveys. When access to the stakeholder is not possible, a systems thinker can derive multiple perspectives from imagining the stakeholders' concerns, issues, and needs. In addition to detailing the perspectives of the key stakeholders, a systems thinker may detail concerns, issues, and needs based on the context or professions of the key stakeholders (i.e., medicine, nursing, physical therapy, or physician assistants). This allows the systems thinker to gain a fresh and holistic perspective of the problem or situation.

Suggested use. In the parable of the blind men and the elephant, each man sees different aspects of the elephant (i.e., a snake, fan, rope, or tree) depending on his position. His perceptions are therefore limited based on the exposure he has to a part of the elephant (see Figure 4.15). Identifying multiple perspectives can be particularly useful in managing a patient's care. Healthcare professionals each have a particular perspective, which enables them to see different aspects of the patient's care. However, they may be oblivious to others' perspectives. Like the blind men in the fable, they only see a part of the system.

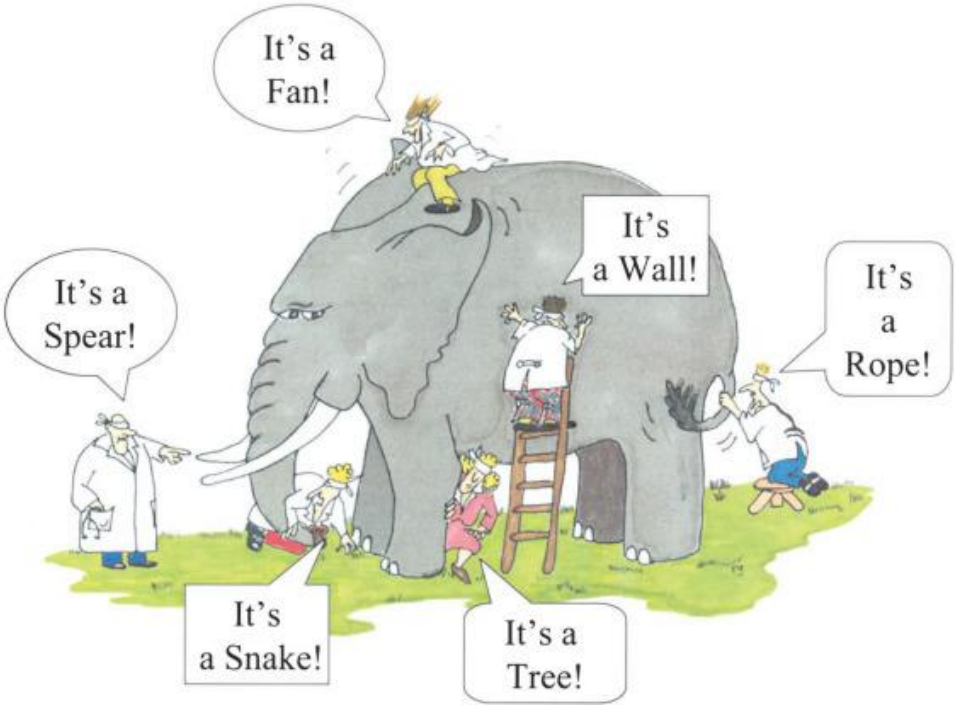

Figure 4.15. Different perspectives based on position. Reprinted from Kidney International, Volume 62/Issue 5, Himmelfarb, Stenvinkel, Ikizler, and Hakim, The elephant in uremia: Oxidant stress as a unifying concept of cardiovascular disease in uremia, pages 1524-1538, Copyright 2002, with permission from Elsevier. https://www.sciencedirect.com/journal/kidney-international

Step-by-step procedure

1. ***Prioritize open communications.*** Seek ways for team members to communicate with each other, share information, and incorporate various lenses into healthcare delivery. This starts

with creating "an environment that supports perspective sharing and effective communications among team members" (Frimpong, Myers, Sutcliffe, & Lu-Myers, 2017, para. 11). This prioritization may require a culture shift as well as efforts by the care team and leadership.

2. ***Identify the care team's various lenses***. Create an environment where opinions and concerns can be voiced rather than having a siloed, hierarchical, or blaming culture (Frimpong et al., 2017). In the patient care example, identify the care team that will support the patient and determine the various perspectives of each person. For example, different professions (i.e., physicians, nurses, social worker, and physical therapists) can have vastly different perspectives.
3. ***Collaborate to provide the best solution.*** Encourage teamwork to deliver the best outcomes. The doctors may determine that the patient is clinically ready for discharge. However, the nurse may notice that the patient has mobility challenges unrelated to the original medical condition. The nurse brings in the social worker who determines that the patient will not be able to navigate his current home environment in his weakened physical state. The social worker brings in the physical therapist who assesses the patient's mobility and strength. The physical therapist recommends that the patient move to a temporary rehabilitation facility. The social worker and the rehabilitation facility work together to transfer the patient.
4. ***Team debrief.*** Conduct a team debrief to understand the limits of each perspective. To avoid adopting a myopic view, individuals on the care team can come together to discuss various patients' cases. This will give them an opportunity to appreciate their limited perspectives and to find ways to embrace other care team members' lenses—especially in complex situations. To practice shifting perspectives, team members can adopt different lenses in hypothetical situations.
5. ***Improve individual decision-making skills***. When individuals make the decision, they need to be able to adopt different lenses to ensure that they are able to see the issue or the situation from multiple perspectives. To accomplish this, ask the question: *How would my colleague (i.e., physician, nurse, social worker, or physical therapist) view this issue?* Observing others, shadowing team members, and rotating through different specialties (Frimpong et al., 2017) provide additional opportunities to shift perspectives and improve decision-making skills.

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Frimpong, J. A., Myers, C. G., Sutcliffe, K. M., & Lu-Myers, Y. (2017). When health care providers look at problems from multiple perspectives, patients benefit. *Harvard Business Review.* Retrieved from https://hbr.org/2017/06/when-health-care-providers-look-at-problems-from-multiple-perspectives-patients-benefit

Left-Hand Column

Description/purpose. The left-hand column is a tool for analyzing difficult conversations. It allows you to identify tacit assumptions that may impede your goal and negatively influence your actions (Figure 4.16).

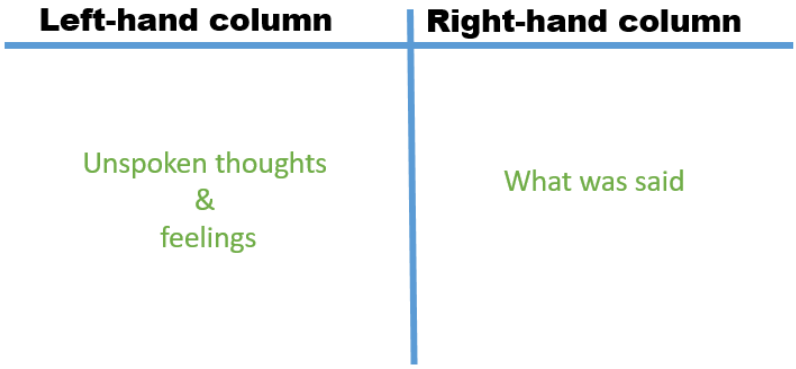

Figure 4.16. Left-hand column template.

Suggested use. This tool can be used to identify unspoken assumptions that hinder communication between two parties. For example, a complaint from a registered nurse (see Figure 4.17) could be the basis of conducting a left-hand column exercise to tackle challenges with interpersonal relationships.

Nurses Rant Discussions Board
(adapted from actual posts on allnurses.com)

I work on the hospital floor that's a nightmare. Why? The certified nurse assistants (CNAs) on the day shift have extremely bad attitudes and always seem to be frowning. The ones on the night shift are always sneaking off to take a nap or a smoke. The registered nurses (RNs) and the licensed practical nurses (LPNs) have to be downright rude to the CNAs just to get them to do any work. Even though they think this is abusive, it's the only way to get any work done around here. Even though I try to be nice to the CNAs, they are so disrespectful to me. I have to ask them repeatedly to do their jobs and even then, they reluctantly do what I ask. I think the overall disrespectful environment comes from the top. The charge nurse prides herself in being tough but her approach is not working. Instead of promoting harmony and good work ethics, she sows chaos. As a result, so many of us are burned out. I find it difficult to do my job, deal with a difficulty supervisor, do the CNAs job, and deal with the CNAs bad attitudes. Many of the CNAs are lazy and have terrible work ethics. Even though I don't like bothering people, I feel like I'm nagging them all the time. I don't want to babysit lazy CNAs. I have my own responsibilities but sometimes it's easier to just do it and get it over with. The way that I look at it is that it's easier to do it than keep asking them over and over, wait for it to get done, and then finally end up doing it anyway. In the end, I just feel resentful. I think the CNAs are taking advantage because they know I'll end up doing it any way. The problem is that doing their job takes time away from me being effective on my job. I feel so powerless. Why are some people like this?

Figure 4.17. Discussion board: Registered nurse complaint. Adapted from http://allnurses.com/nursing-issues-patient/rn-how-do-237196-page2.html.

Step-by-step procedure

1. ***Choose a problem where you have experienced interpersonal difficulties.*** Identify a problem that you have interacting with others such as lack of agreement, unequal power dynamics, unfair treatment, discounted or ignored point of view, resistance to suggested changes, or overlooked critical issues.
2. ***Complete the right-hand column with what was said.*** Consider a conversation between the RN and the CNA. See Table 4.9 for a sample.

Table 4.9
Left-Hand Column: Conversation Between RN and CNA

Registered nurse's unspoken thoughts and feelings	What was said
	RN: I have asked you repeatedly to help Ms. Gray to the bathroom; she is a one-assist. **CNA:** She will have to wait because I have to give Ms. Jones a bath. **RN:** I cannot help Ms. Gray because Mr. Roberts is calling out for his pain medicine and that is top priority. **CNA:** Well, Ms. Gray will just have to wait (walking away).

3. ***Complete the left-hand column with what the speaker was thinking but did not say.*** Table 4.10 provides an example.

Table 4.10
Left-Hand Column: Conversation Between RN and CNA with Unspoken Thoughts and Feelings

Registered nurse's unspoken thoughts and feelings	What was said
She knows that giving a patient a bath is not a priority.	**RN:** I have asked you repeatedly to help Ms. Gray to the bathroom; she is a one-assist. **CNA:** She will have to wait because I have to give Ms. Jones a bath.
She know it is time for med pass.	**RN:** I cannot help Ms. Gray because Mr. Roberts is calling out for his pain medicine and that is top priority.
I guess I'll have to do it myself and be late again	**CNA:** Well, Ms. Gray will just have to wait (walking away).

4. ***Reflect on the two columns and answer the following questions*** (Senge, 1994, pp. 248-249). For example, the RN in the above scenario might respond as follows.
   - What has really led me to think and feel this way? *It makes no sense to argue and create conflict with one CNA. Conflicting with one CNA will make it difficult to work with all of them. In addition, the supervisors do not do anything.*
   - What was your intention? What were you trying to accomplish? *The intent was to provide quality care to both patients and to pass meds on time.*
   - Did you achieve the results you intended? *Yes, there a 15-minute window to give the pain medication. The patient had to go to the bathroom urgently. The patient was escorted to the bathroom and the CNA was advised to retrieve her while I went to give the meds. However, the CNA will be annoyed. RNs put patient care first. There ends up being animosity or conflict between the RN and CNA because the RN is ultimately responsible for getting the work done.*
   - How might your comments have contributed to the difficulties? *My first comment was accusatory. My second comment may have indicated that my job is more important.*

- Why didn't you say what was in your left-hand column? *To avoid wasting time and causing a conflict or further damaging the relationship.*
- What assumptions are you making about the other person or people? *I am assuming that the CNA has the time to assist the patient but is just resistant.*.
- What were the costs of operating this way? What were the payoffs? *Poor interrelationships, burnout, mistakes, or blow-up (when conflicts are not managed).*
- What prevented you from acting differently? *As the leader of the team, I have the ultimate responsibility for patient care. Therefore, meeting patients' needs takes priority over sorting out interpersonal issues with the CNAs.*
- How can I use my left-column as a resource to improve our communications? *Seeing where there are perceptions and mental models that limit effective communication can enable me to temper my tone and find a collaborative working arrangement. Maybe I can help the CNA figure out how to prioritize her patient care responsibilities.*

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Chapter 5:
Tools to Measure Performance

A challenge in medical education is measuring clinical performance versus organizational performance. People, educational, clinical, and research metrics yield snapshot results or answer yes or no questions rather than assess dynamic changes. The systems thinking tools that follow—the behavior over time graphs and the archetypes of drifting goals, fixes that fail, and limits to success—evaluate changes over time.

Behavior Over Time Graph

Description/purpose. A behavior over time graph is a basic tool that focuses on trends or patterns over time rather than as standalone events. This tool can foster robust conversations about the reason for change as well as the process of change. A behavior over time graph is a simple line graph of trends and pattern changes related to a variable (Y) over a specified time (X). When compared to a static graph (which focuses on a point in time), a behavior over time graph may depict a drastically different narrative (Waters Foundation, 2008).

Expanding or narrowing the boundaries may change the frame of the problem as well as the conceived solution. Drawing a behavior over time graph allows you to think dynamically about an issue or problem rather than focusing on a snapshot of a situation. The graph presents trends and patterns for variables with specific beginning and ending points.

Suggested use. Use a behavior over time graph as the foundation for understanding individual interpretations and perspectives. Use the graphs to focus on specified periods, identify broader systems-based issues (rather than taking a snapshot of 1 year), and investigate interdependence or causality between variables. For example, a behavior over time graph can be used to evaluate emergency room referrals to primary care (A) and specialty care (B). While the snapshot shows more referrals to primary care than specialty care, the behavior over time graph shows a decline in referrals to primary care and an increase in referrals to specialty care (see Figure 5.1).

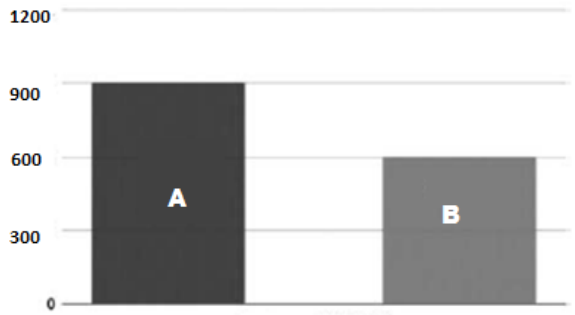
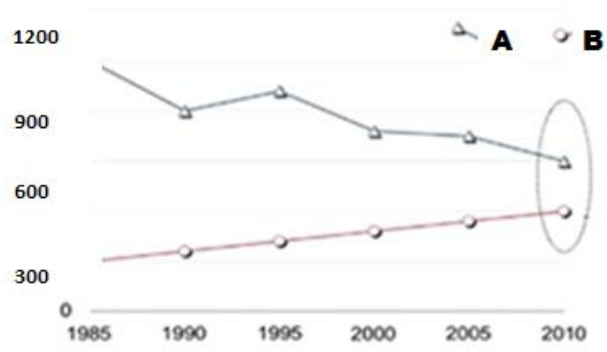
Static graph	Behavior over time graph
	

Figure 5.1. Emergency room referrals: Comparison of a static graph and behavior over time graph. Reprinted from Minyard, Ferencik, Phillips, and Soderquist (2014, p. 119), which has a Creative Commons Attribution 3.0 Unported License (http://creativecommons.org/licenses/by/3.0/).

Step-by-step procedure

1. ***Draw a simple chart and label the X axis with the beginning and end points of interest.*** Pay careful attention to the time scale (i.e., intervals between endpoints).
2. ***Clearly identify the Y axis with concrete labels with a defined scale.*** The scale should be numeric (e.g., 0-100) or descriptive (low, medium, high).
3. ***Plot the variables.*** To aid in comparative analysis of interdependent variables or causal relationships between variables, consider the benefit of plotting more than one variable on a graph.
4. ***Label the diagram.*** Carefully differentiate between the lines on the chart by labeling them and providing a key that explains the labels.

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Archetypes

The Fifth Discipline (Senge, 1990) describes several systems thinking archetypes (i.e., storylines of a system) that are recurring patterns of behaviors and provide insight on universal behaviors within various system scenarios. These archetypes help explain system dynamics by presenting behaviors and flows in more concrete ways. In this section, we highlight three of these archetypes: drifting goals, fixes that fail, and limits to success.

Drifting Goals (Goals and Gaps)

Description/purpose. Drifting goals describe a situation where "a gap between the goal and current reality can be resolved by taking corrective action or lowering the goal. The critical difference is that lowering the goal immediately closes the gap, whereas corrective action usually takes time" (Kim, 1992, p. 6). Typically, short-term solutions to the problem result in the deterioration or erosion of the long-term goal (Kim, n.d.).

A causal loop diagram (see Figure 5.2) depicts a gap between the current state and the desired state. To resolve the gap, you take corrective action to move toward the desired state. However, a delay exists between the action and the effect within the system. Concurrently, there is external pressure to lower the goal to make it easier to obtain. While lowering the goal may close the gap, it also causes the goal to drift, resulting in lower standards. Drifting goals lead to goal erosion.

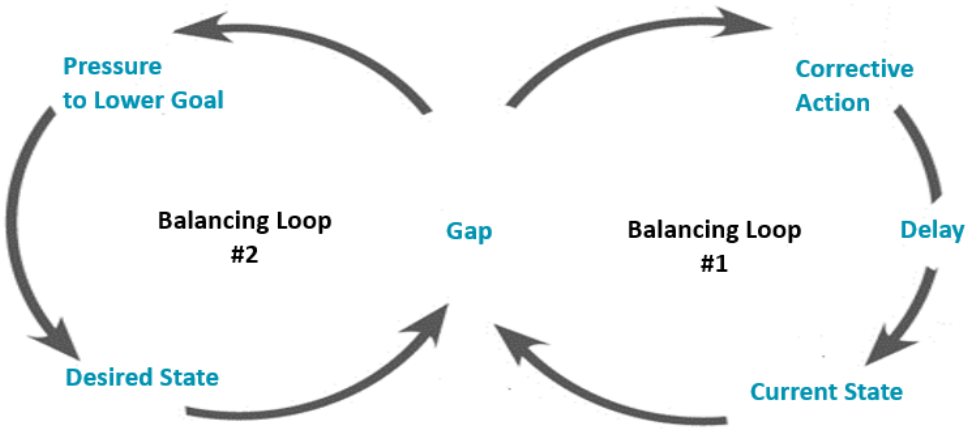

Figure 5.2. Drifting goals archetype (Kim, 1992).

Suggested use. The drifting goal archetype may apply in a situation where goals are not being met consistently. For example, it could be used to identify issues when nurses or certified nursing assistants (CNAs) are unable to meet patient care standards due to understaffing.

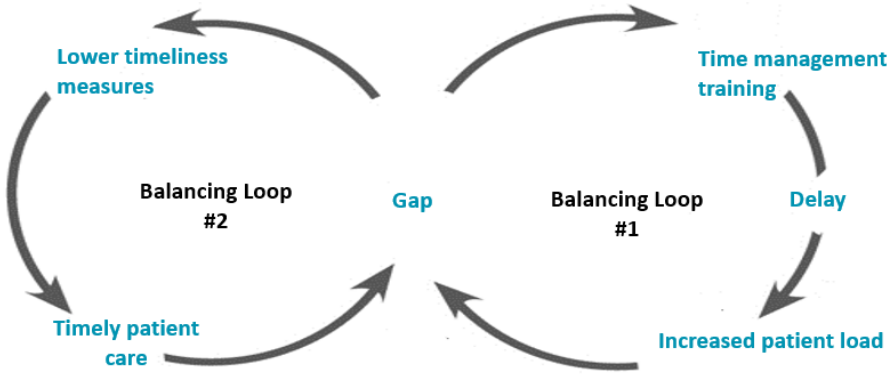

Figure 5.3. Drifting goals archetype: Timeliness metric (Kim, 1992).

Step-by-step procedure

1. ***Identify the goal.*** Articulate the goal that you are attempting to achieve. In the patient care example, the goal is timely patient care (see Figure 5.3).
2. ***Determine the gap.*** Identify where you are missing the mark. In this case, the goal is not being met because the CNA has additional patients, leading to increased wait times for each patient.
3. ***Take corrective action.*** Determine what action will help to close the gap. For example, the administrator may choose to train CNAs in the hope of increasing efficiency.
4. ***Acknowledge delayed results.*** Determine where there are delays in the system. It will take time for the CNAs to receive training and begin to implement the appropriate strategies. Also, training takes time away from their patient care duties. During this time, there is a change in the current state.
5. ***Lower timeliness measures.*** Rather than taking corrective action (Step 3), the administrator may acknowledge an issue with staffing and choose to lower the metrics associated with timeliness of care and service temporarily.
6. ***Determine outcomes.*** Review the causal loop to determine how the corrective action *or* the pressure to lower the goal has affected the system and whether the changes (i.e., training and/or changing metrics) has impacted the goal.

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Fixes That Fail

Description/purpose. Fixes that fail describe a situation where "a problem or symptom cries out for resolution. A quickly implemented solution alleviates the symptom, but the unintended consequences of the 'fix' exacerbate the problem. Over time, the problem symptom returns to its previous level or becomes worse" (Kim, 1990, para. 3). The issue with this archetype is that regardless of the solution/quick fix for the symptom, there will be some delay before consequences are apparent. It is possible that the solution or quick fix actually makes the situation worse or causes unintended consequences (see Figure 5.4). This is especially the case if you apply the wrong solution that masks symptoms while exacerbating the problem (Kim, 1992a, 1992b).

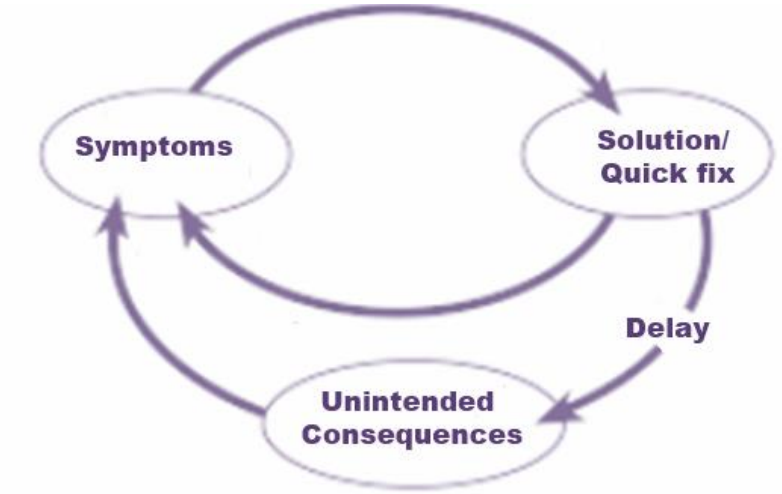

Figure 5.4. Fixes that fail archetype. Source: Kim (1992a).

Continually being in a problem-solving mode does not make room for you to reflect on the impact of your actions. A focus on the symptom (rather than the problem) encourages quick fixes rather than long-term solutions. Fixing a symptom to a problem is generally a short-term solution that results in a return of the original or a far worse symptom. To overcome the fixes that fail cycle, acknowledge that the quick fix is temporary while diligently uncovering hidden issues to solve the actual problem.

Suggested use. The fixes that fail archetype can be used to identify where quick fixes are causing unintended consequences and hampering real solutions. An example of a fixes that fail archetype is evident in healthcare utilization review (see Figure 5.5).

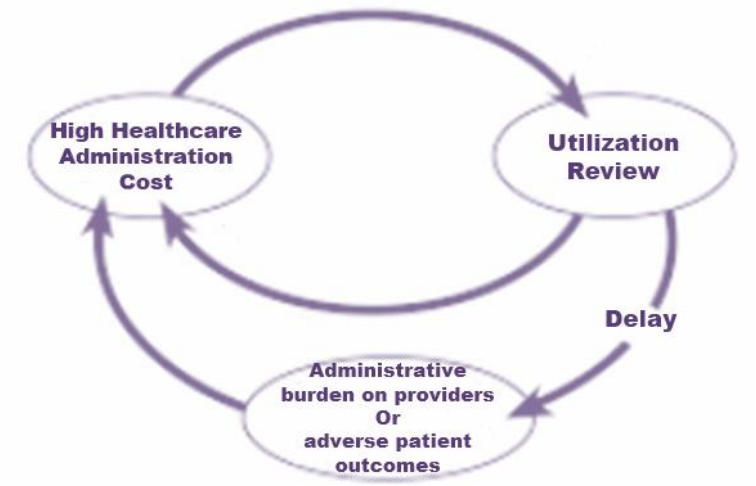

Figure 5.5. Fixes that fail: Healthcare utilization review (Kim, 1992a).

Due to the increasing cost of healthcare, insurance companies are requiring utilization reviews, a process for scrutinizing and rationing medical treatments. In a utilization review, the insurance company determines if the prescribed treatment is "medically necessary" and authorizes or denies such treatment. During this process, the doctor has the responsibility to gain permission, justify the treatment plan, and continue treatment while the case is under review. Sometimes, the process requires that the doctor spend a significant amount of time justifying his or her recommendation. If the insurance company denies the request for treatment, this may have a negative impact on the patient's health (ScribeAmerica, 2014; Wickizer, Wheeler, & Feldstein, 1989).

To avoid falling into the fixes that fail trap, consider finding solutions to the underlying problem while implementing the quick fix. In other words, the third-party payers/insurance companies could spend more time determining where the cost challenges arise in the system and come up with ways to mitigate them.

Step-by-step procedure

1. ***Identify the symptom of the problem.*** Start by identifying the obvious areas of concern (i.e., the squeaky wheel). In this case, the symptom is the high cost of administering healthcare. Note, in this step you are actually focused on identifying the symptom, not the actual problem or underlying issues.
2. ***Determine the fix to the symptom.*** Next determine how the symptom can be resolved while acknowledging that quick fixes could aggravate the situation. For example, to control the rising cost of healthcare, third-party payers insist on conducting utilization reviews. Rather than control the cost, they attempt to control who has access to medical treatments.
3. ***Analyze the situation to identify the problem and root cause of the problem.*** Rather than continuing to address symptoms, do a root cause analysis to determine why the cost of healthcare has skyrocketed. This can take place in conjunction with the quick fix (i.e., utilization review) with the understanding that the quick fix is a stopgap until the discovery of a viable solution.
4. ***Consider potential delays in the system***. Brainstorm or list areas in the system that could slow down the fix. In this example, the additional justification for treatment causes delays in the system.
5. ***Identify unintended consequences of the fix.*** Look for additional symptoms that crop up as a result of delayed resolution to the actual problem. In this example, unintended consequences

include less service to other patients as the physician handles increased administrative responsibilities and appeals denial of service decisions. Second, the patient's health may deteriorate as he or she waits for a decision from the insurance company. Ultimately, the insurance company, rather than the physician, decides the level of patient care.

6. ***Determine how unintended consequences affect the system.*** The administrative burden caused by utilization reviews makes the system inefficient and raises costs to the system. In addition, a patient's deteriorating health escalates healthcare costs, particularly if the patient's condition deteriorates and more expensive treatments are required.

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Limits to Success (Barriers and Facilitators)

Description/purpose. Limits to success (also known as limits to growth) describes a situation where the more effort is exerted, the more success is achieved (A); however, performance eventually plateaus, halts, or reverses. To improve performance, the natural inclination is to redouble past efforts that led to success. However, this renewed effort is less successful. In fact, the more effort that is exerted, the more the system resists. This occurs because a limit has been reached that prevents further success (see Figure 5.6). Rather than exerting more effort, success lies in discovering and eradicating limiting factors or constraints (B) (Kim, 2012, 1992, 1990)

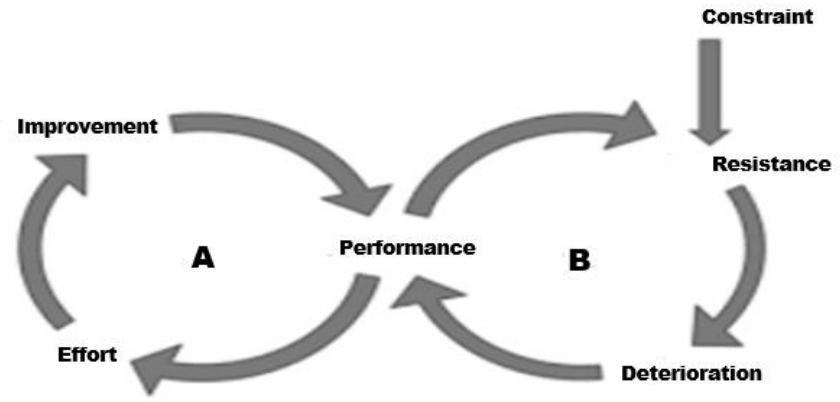

Figure 5.6. Limits to success archetype. Reprinted with slight adaptations from Scotland (2011; licensed under a Creative Commons Attribution-ShareAlike 4.0 International License).

Suggested use. A weight loss attempt is an example of a limit to success archetype (see Figure 5.7). Typically, dedication to a diet plan yields rapid initial results. Unfortunately, weight loss begins to slow down, halts, or reverses. Kim (2012) outlined a process that uses the limits to success archetype as a planning tool to counter deteriorating performance.

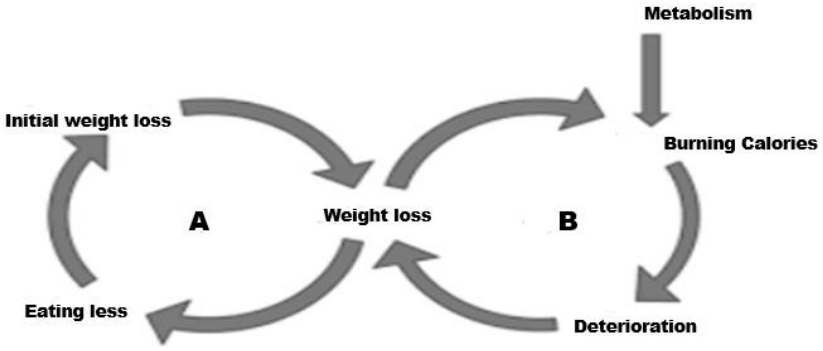

Figure 5.7. Limits to success archetype: Weight loss.

Step-by-step procedure

1. ***Identify initial success.*** Review the system for successful performance. For example, dieters begin to lose weight rapidly by taking in less calories. They may lose the first 10 pounds quickly by controlling portion size. Since eating less leads to weight loss, they continue eating less and experience even more weight loss.
2. ***Determine limits to success.*** Notice where previous action does not yield the same results. Over time, the same dieting behavior has diminishing returns. As the body adjusts to the lower caloric intake, it begins to burn fewer calories. Eventually metabolism slows and weight loss stalls or reverses so the body stops burning food as quickly as it did in the beginning.
3. ***Overcome the resistance.*** Identify areas where resistance can be eliminated. To continue burning calories and losing weight, dieters can add exercise to the weight loss plan to increase metabolism. However, exercising is not enough because it will not address the underlying problem of stored fat. Even increasing the intensity of the exercise is futile because it only gives a temporary boost to metabolism. Since it also increases appetite, it may cause weight gain.
4. ***Apply leverage.*** Look for ways to use leverage to maximize results. The best way to address the constraint is to combine steady, prolonged exercise (leverage) with portion control. Long brisk walks will permanently increase the body's metabolic rates.

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Chapter 6:
Tools to Identify and Test Changes

In clinical settings, quality metrics are widely used for improvement in product quality, site operations quality, and site systems performance. The tools that follow—six thinking hats and collaborative problem solving—focus on thinking and problem-solving skills that help to identify and test changes in the system as well as provide solutions to systemic problems.

Six Thinking Hats

Description/purpose. The six thinking hats technique explores different perspectives regarding complex situations or problems. According to DeBono (1999), the tool encourages a shift from habitual thinking styles to one of six alternate styles of thinking. To foster better problem solving, the tool takes into account different perspectives by switching between different imaginary hats. The technique encourages risk-free conversations, highlights multiple perspectives, allows individuals to switch gears, fosters creative thinking, improves communications, enhances decision-making, and focuses thoughts. It allows for objective, intuitive, negative, positive, creative, and reflective styles of thinking, which provide an opportunity for robust decision-making. It allows people to examine a situation or problem from various perspectives and embrace thinking styles that may conflict with their own.

Separating thinking into six distinct categories enables individuals to redirect thoughts, conversations, and meetings. Each of the six thinking hats represents a different style of thinking (see Table 6.1).

Suggested use. Use the tool to think about the potential reaction of a patient and family to an unwelcomed diagnosis of cancer or as an exercise for students to figure out how to deliver bad news about a patient's condition. Note that plans, practices, and processes developed with this technique are typically more rigorous and resilient.

Table 6.1
Six Thinking Hats Summary

Hat	Characteristic	Thinking is...	Wear the hat by...	Focus on...
Blue 	Reflectivity	Focused on being cognizant about what thinking is necessary to navigate towards a viable solution	Thinking about thinking	Thinking (meta)
Green 	Creativity	Based on developing innovative solutions to problems	Looking for alternative solutions without restricting possibilities	Options
White 	Objectivity	Based on available information in the form of facts and figures	Taking an objective view of the available information	Data
Red 	Intuition	Based on emotions, doubts, intuition, and judgment	Relying on gut reaction to the situation	Feelings
Black 	Negativity	Focused on cynicism, devil's advocacy, and pitfalls	Pointing out all the flaws in a suggested course of action	Risks
Yellow 	Positivity	Focused on optimism, positive outcomes, and benefits	Highlighting the inherent worth and benefit of a decision	Value

Sources: United Nations (n.d.), DeBono Group (n.d.).

Step-by-step procedure

1. ***Choose a problem to frame the discussion (i.e., giving an unwelcomed diagnosis).*** Determine which problem or issue you will use for the exercise.
2. ***Form a group of six participants.*** Divide large groups into subgroups of six.
3. ***Have each person choose one of six hats:***
   - ***Blue*** hat conducts the conversation, ensures that all perspectives are represented and the conversation moves forward
   - ***Green*** hat is responsible for coming up with creative solutions and out-of-the box thinking (even irrational ideas) while avoiding mundane or obvious solutions
   - ***White*** hat is responsible for looking at the situation objectively and avoiding emotions while focusing on the facts
   - ***Red*** hat uses intuition, gut reactions, and initial impressions and shares thoughts without being overly analytical
   - ***Black*** hat finds reasons why suggestions will not work and has a pessimistic outlook concerning all suggestions/solutions
   - ***Yellow*** hat has an optimistic outlook and only focuses on the positive aspects of ideas
4. ***Share perspectives in the order determined by the blue hat (15 minutes).*** The blue hat takes on the facilitator's role and leads the group through the process of sharing their perspectives based on the color hat they are wearing.

- The blue hat leads the discussion by assigning speaking order and time limits.
- Each person takes turns providing a solution or perspective on the problem based on the color of their hat (approximately 2 minutes each).
- Each person listens attentively to the other perspectives.

5. ***Debrief with the team members.*** Discuss and document potential solutions based on perspectives that were voiced. Also, discuss the value of having different perspectives.

Note: To conduct this technique as an individual exercise, each person can shift perspectives and reflect on the situation based on each of the colored hats. Rather than debrief, the individual can reflect (i.e., complete step 5 in a reflection journal, if desired).

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Collaborative Problem Solving

Description/purpose. Collaborative problem solving addresses complex dynamic issues. The pace of change is constantly increasing and problems are getting more and more complex. Complexity requires a systems thinking approach. To ensure systemic improvements, it is necessary to have all members of the team involved in solving numerous concurrent complex problems. The synergy—wherein the whole is greater than the sum of its parts—that comes from collaborating is essential. The inclusion of the right skills, tools, processes, practices, mindsets, and conditions fosters collaborative problem solving. If these components are not in place, the team may devolve into groupthink, which causes many more problems (and mistakes) than it solves (Alexander Hancock Associates, 2017).

Collaborative problem solving has several benefits:

- A holistic approach to problem solving that is based on root cause analysis rather than fixing symptoms of the problem
- Stakeholder buy-in and involvement in the solution and implementation
- Creative, lasting solutions to complex problems
- Involved and engaged team members

Collaborative problem solving includes a combination of skills, including problem solving, communications, critical thinking, and collaboration (Act, Inc., 2018; Nelson, 2005). In addition, it may draw on business skills such as "statistical and decision analysis, managerial accounting, organizational behavior, operations management, administrative strategy and policy, and marketing (Texas A&M University–Corpus Christi, 2017).

Lowry (2018) detailed a nine-stage process for conducting collaborative problem solving (see Figure 6.1) which is based on an urgent/important issue, influential convener, adequate time/resources, stakeholders' participation, group charter, skilled process leader, a carefully

crafted process, consultation of stakeholders and technical experts, technical analysis, group decision-making, and output (plan, recommendations, policy) documents.

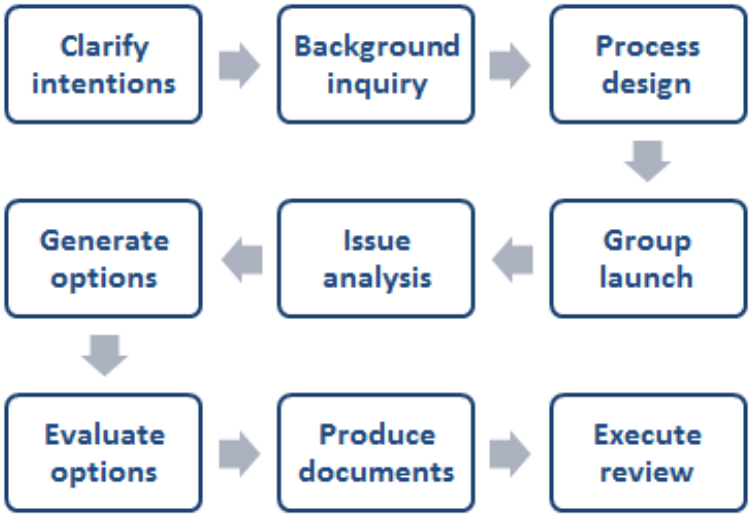

Figure 6.1. A nine-step collaborative problem-solving process (Lowry, 2018).

Suggested use. Use the nine-step collaborative problem solving process to handle complex dynamic issues such as the inequitable distribution of food to low-income and minority communities, which leads to food deserts in the United States (Blackwell, 2016) (see Figure 6.2).

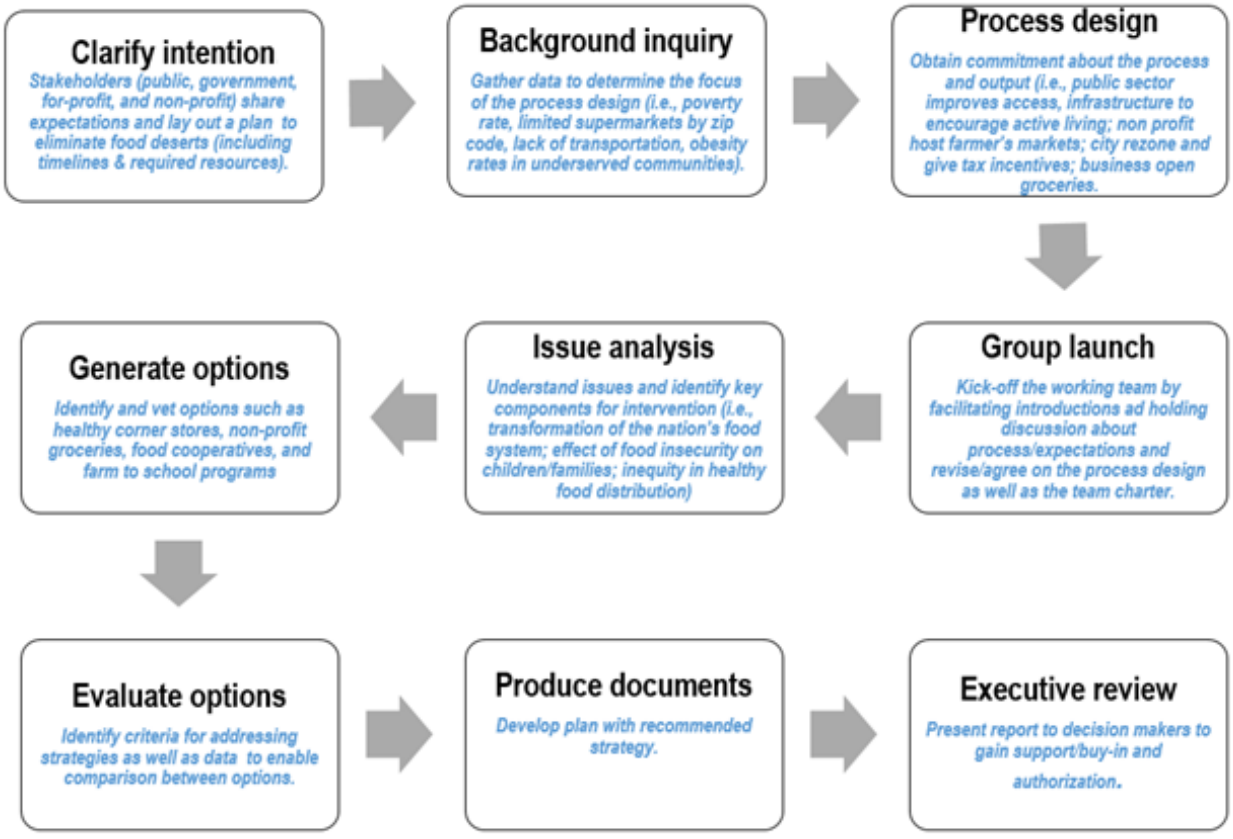

Figure 6.2. Collaborative problem solving process: Addressing food deserts. (Lowry, 2018).

Step-by-step procedure

1. ***Clarify intentions***. Discuss expectations and create an initial process map (i.e., detail the purpose, timeframe, and allotted resources). For example, stakeholders from the public, government, for-profit businesses, and nonprofit businesses share expectations and lay out a plan to eliminate food insecurity in the underserved community with timelines and required resources (The Intersector Project, 2016).
2. ***Background inquiry***. Gather data to make a determination about the issues that will be the primary focus of the collaborative process design. In the food desert scenario, data collection identifies the number of residents who live in low-income communities without access to a supermarket; the number of children who live in those communities; the percentage of zip codes that do not have access to nutritious foods; and the obesity rate for residents in the underserved communities (Dallas News, 2016).
3. ***Process design***. Obtain initial commitment from stakeholders regarding the process design, logic, and expected results for each phase (The Intersector Project, 2016). For example:
    - *Public sector:* Provides bikes, improves neighborhood streets, and promotes healthy eating and active living in the city
    - *Nonprofit sector:* Hosts farmer's markets in conjunction with Parks and Recreation
    - *Government sector (city):* Encourages grocery stores to open in underserved areas by adjusting zoning regulations and giving tax incentives
    - *Business sector:* Commits to opening and operating more grocery stores in underserved neighborhoods
4. ***Group launch***. Gather key stakeholders to develop a team charter and finalize the process plan, to include concerns of the entire group. For example, a kick-off would include introductions, discussions (i.e., process, expectations, and goals) designed to build confidence and foster trust, revision of the draft process design (including phases), and revision of and agreement on a team charter (Lowry, 2018).
5. ***Issue analysis***. Perform due diligence to understand the issues and identify the components that are most suitable for an intervention. For example, Blackwell (2016) highlighted the following issues:
    - "The nation's food system radically transformed from one sustained by family farms to an industrialized system dependent on toxic agricultural practices, farm consolidation, food processing operations, and distribution warehouses. Such a system often further elongates the distance between food sources and consumers" (para. 2).
    - "The effects of food-insecurity on children and families spill into everyday lives. . . . Residents who live in food deserts . . . are more likely to be people of color [and] . . . also tend to have lower levels of education, earn lower incomes, and are more likely to be unemployed" (para. 4).
    - There is an inequitable distribution of healthy food across socioeconomic and racial lines.
6. ***Generate options***. Identify and vet options for addressing the problem. For example, to address food insecurity in disadvantaged communities, the following best-practice programs (Blackwell, 2016) could be analyzed:
    - *Healthy corner stores initiative:* Transform corner stores, which are prevalent in underserved communities, into healthy food distribution centers by incentivizing with credits or subsidizing the cost of refrigerators, training staff on fresh produce handling practices, and increasing shelf space.
    - *Nonprofit grocery stores:* Create mission-driven groceries within underserved communities to provide healthy low-cost food options.

- *Food cooperatives:* Establish retail food businesses where members decide on food production and distribution; ensure lower prices and benefits to members; and make buying decisions based on values and preferences rather than manufacturer demands.
- *Farm to school programs:* Provide fresh healthy locally produced food by incorporating food procurement into the school curricula (i.e., purchasing, promoting, and serving local foods; participating in school gardens and other nutritional and healthy activities).

7. ***Evaluate options***. Evaluate the various options and related strategies to determine the best fit with the group's objectives and criteria. For example, the team would identify the criteria for assessing the strategies, identify the data to be applied to the criteria, and compare the options to determine the most feasible solution.
8. ***Produce documents***. Develop a plan with recommendations, detailing the group's proposed strategy, rationale, and the process used to develop it.
9. ***Executive review***. Create a written/oral report for executives/decision makers to gain buy-in and authorization to proceed to next steps.

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Chapter 7:
Tools for Simulation, Games, and Modeling

The goal of simulation in a healthcare setting is to imitate care delivery or clinical contact between healthcare providers and actual patients. This could include using anatomic models, dynamic computer-based models, or virtual reality surgical simulation. Activities could also include individual or group role-playing scenarios as well as specific task training. The tools in the following section—simulation, games, and modeling—provide additional resources for understanding systems.

Simulation

Description/purpose. Simulation is a flexible, multifaceted, multipurpose, and complex instrument that can introduce changes in practices and procedures, enhance teamwork and communication, uncover the root cause of problems, correct and prevent medical errors, and facilitate individual and team competency assessments (Gallo & Smith, 2014). Simulation is an interprofessional activity that fosters teamwork and critical skill acquisition as well as provides a platform for assessing team-based competencies. Simulation has the following characteristics:

- Educates trainees; provides advanced learning and assessment; focuses on patient safety.
- Uses models or manikins (adult, pediatric, neonatal); videos and audiovisual systems; high-fidelity computer-based devices (including those that incorporate tactile feedback, voice, and symptoms); and standardized patients (human actors).
- Focuses on deliberate practice and extensive debriefing.
- "Improves performance in clinical contexts, facilitating the acquisition and application of cognitive, behavioral, psychomotor, and interprofessional skills" (Friedman, Doefler, & Tamuz, 2014, p. 45).

DeVoe and Kerner (2014) created a mnemonic device known as DEBRIEF, which is associated with after-action reviews (see Figure 7.1).

Suggested use. Simulation scenarios develop healthcare practitioners' critical thinking and decision-making skills. Friedman, Doefler, and Tamuz (2014) detailed a postoperative hip infection case as follows:

> The nurse participant, informed only that the patient is a 47-year-old woman recovering from hip surgery, enters the hospital room to discover the patient complaining of pain at the surgical site. Examining the site, the nurse finds it is inflamed, warm to the touch and purulent. The patient's pulse is elevated and her respirations are 22 breaths per minute. (p. 50)

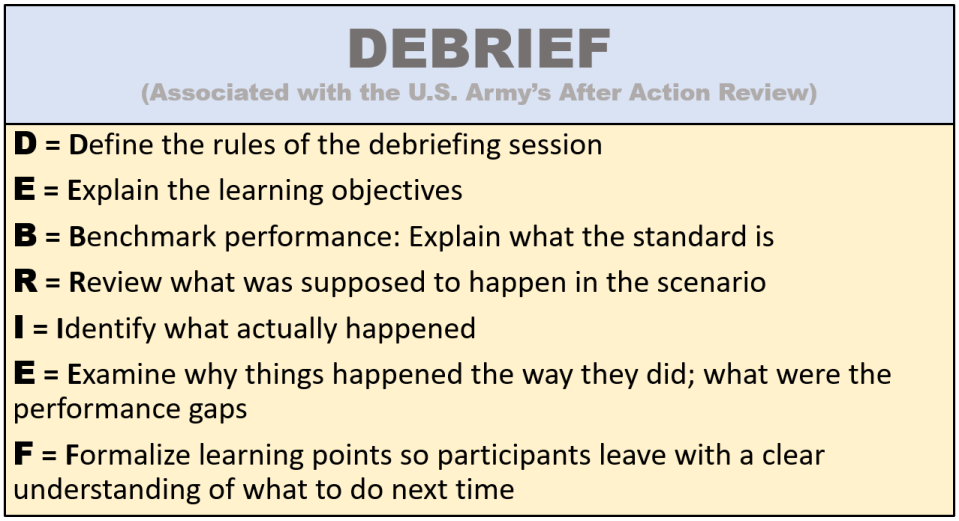

Figure 7.1. DEBRIEF process (DeVoe & Kerner, 2014; Sawyer & Deering, 2013).

Step-by-step procedure. The case details the following steps performed in the determination of sepsis:

1. ***Recognize the issue or problem.*** The participant should recognize the symptoms of sepsis.
2. ***Communicate with team members.*** Contact the attending physician or nurse practitioner to provide a succinct description of the situation (patient description, assessment, symptoms), make the necessary requests for tests to confirm sepsis, and recommend medications to reduce temperature and infection.
3. ***Collaborate to resolve the issue.*** Work with interprofessional team (i.e., nurse practitioner, physician's assistant, or physician) as a team to stabilize the patient.
4. ***Debrief with the team.*** To reinforce learning, strengthen skills, and confirm successful performance, conduct an extensive debriefing at the conclusion of the simulation. The debriefing may include "underlying scientific knowledge base, issues of medication, teamwork, and all recommendations" (Friedman et al., 2014, p. 50).

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Games

Description/purpose. According to Sweeney and Meadows (2010), games can be used to promote systems thinking such as having a big-picture perspective, shifting perspective, seeing interdependent variables, understanding the impact of mental models, focusing on long-term rather than short-term issues, seeing complex cause-and-effect relationships, looking for emerging unintended consequences, and visualizing systems in maps and models of causal relationships. While some people might discount the effectiveness of using fun or entertaining games, they can be effective for problem solving and training.

Suggested use. Games offer the opportunity for individuals to interact with each other within complex systems; learn and make mistakes without consequences; expose team problem-solving practices; highlight habits, paradigms, and perspectives; duplicate structure and behaviors; test theories in a safe environment; and encourage interaction between individuals with varied learning styles. Carefully selected and well-timed games can facilitate the learning process by creating a safe place for trial and error, the practice of acquired knowledge, skills, and abilities, and the understanding of key concepts.

According to Sweeney and Meadows (2010), it is important to consider how games support the concepts, fit the learning intervention appropriately, reinforce past concepts or insights, and accommodate various learning styles. Additionally, it is essential to create an environment that is conducive to engagement and learning by deciding on the seating arrangement (i.e., half/full circle) up front; optimizing the group size (i.e., between 8 and 12); creating diverse groups (i.e., backgrounds, gender, perspectives); and being clear about expectations (i.e., dress code, group composition, videotaping).

How you position the game will greatly affect the participants' perception of it. This includes the way goals, guidelines, and success criteria are communicated. You may choose to link the game to specific challenges within the organization or position it more generically. The three types of frames to position a game are *isomorphic*, which replicates characteristics that are present within the organization; *universal*, which uses everyday situations or events; and *fantastical*, which uses imaginary or extraordinary circumstances (Sweeney & Meadows, 2010).

Debriefing is a key component of the process. It allows the participants to reflect on their experience. Sweeney and Meadows (2010) outlined a four-step debriefing process as follows.

Step-by-step procedure

1. ***Tell the story.*** After the game, record the answers that participants provide to the following questions: *What happened here? What did you see? What did you feel? What did you experience?* The responses form the basis for creating "causal loop" diagrams (see step 3).
2. ***Graph the variables.*** Ask the participants to discuss the way selected variables perform over time. This can be visually represented in a behavior over time graph (see Figure 7.2), which explains the group's experience with a dynamic system.

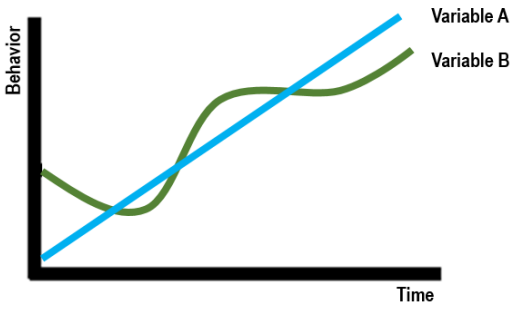

Figure 7.2. Behavior over time graph.

3. ***Make the system visible by drawing a causal loop diagram.*** Causal loop diagrams make connections between the cause and effect of particular variables. They help to identify structures that cause, reinforce, or balance particular behaviors. Figure 7.3 depicts a causal loop diagram with reinforcing and balancing loops based on variables A and B.

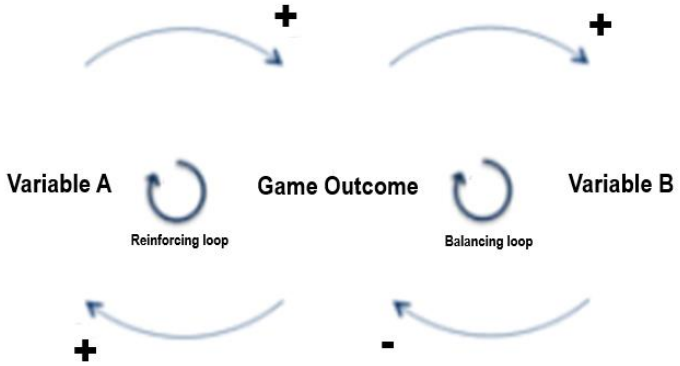

Figure 7.3. Causal loop diagram.

4. ***Identify the lesson.*** Finally, prompt for lessons and insights that the participants gained from playing the game. Determine what needs to be changed to improve results and what activities would provide the most leverage.

In the *Systems Thinking Playbook,* Sweeney and Meadows (2010) highlighted several games that incorporate systems thinking concepts. Table 7.1 highlights several examples. After each exercise, a facilitator debriefs the group to discuss the experiences and outcomes as well as the systems thinking concepts demonstrated.

Game Examples:
The Beer Game: http://www.beergame.org/
Friday Night at the ER: https://fridaynightattheer.com/ Young (2018)
The Systems Thinking Playbook for Climate Change: http://www.laos-proceed.com/la/images/literature/giz_playbook-cc_2011.pdf

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Table 7.1
Selected Systems Thinking Exercises

Systems thinking concept	Game/description	Concept(s)	Purpose
Changing the rules	*Wrapped Juggle:* Toss an object around the circle in a sequence so that everyone touches it only once. Then introduce two additional objects that must follow the same sequence.	• Limits to success archetype • Mental model • Assumption-making process	To work with systems archetypes; explore the automatic process of making assumptions; experience the power of collective mental models; examine creative process of creating alternate solutions; map group processes; surface team problem-solving assumptions
Reinforcing or balancing processes	*Group Juggle:* Participants throw a ball in a sequence to a designated catcher. As more and more balls are added, the sequence remains the same. Other items and distractions are introduced to increase chaos.	• Group problem solving • Teamwork • Communication and trust • Strategy	To improve interpersonal relationships and increase engagement and teambuilding
Changing information flows	*Community Maze:* In silence, group members independently navigate a path on a grid without skipping squares. Mistakes, which cost money, are deducted from budget. No visual trails are permitted but gesturing is allowed.	• Mental models • Challenge tacit/ implicit beliefs • Debunk teamwork myths	To explore the discipline of team learning; understand the cost of missed "win-win" opportunities and the benefit of collaborative competition; discover interdependencies in complex systems; work with barriers to team learning
Shifting paradigm/ perspective	*Thumb Wrestling:* Pairs grasp hands to thumb wrestle with the goal of pinning the other person's thumb the most times in a minute.	• Competition and collaboration	To uncover mental model; raise awareness about barriers and enablers; see interdependencies/unintended consequences; explore/ expose implicit assumptions
Improving team communications	*Squaring the Circle:* 8 to 30 blindfolded participants are tasked to create a square with a lengthy piece of rope and vote on when they think the task is completed. Once it is complete, individuals remove the blindfold and view the shape of the rope.	• Adapting to new environments • Collective problem solving • Self-organizing systems • Visioning and visualization	To explore group and social learning; introduce the concept of self-organizing; create a shared vision; develop group problem-solving skills
Changing the length of delays	*Balancing Tube:* Participants attempt to balance a tube on one hand near the tips of their fingers on three separate occasions (when focusing slightly above where the tube meets their fingers; the top of the tube; the ceiling). Note: it will be difficult to do when the focus is too close or too far away.	• Increase awareness of time horizons • Shifting time perspectives	To focus on appropriate time horizons within dynamic systems; choose time horizons that are compatible with dynamic systems

Source: Sweeney & Meadows (2010).

Modeling

According to Fortmann-Roe and Bellinger (2013), every model has some combination of three common structures: independent growth, goal seeking, and exponential growth.

1. ***Independent growth models***: In an independent growth model, linear flow results in linear accumulation as long as there is no feedback (see Figure 7.4).

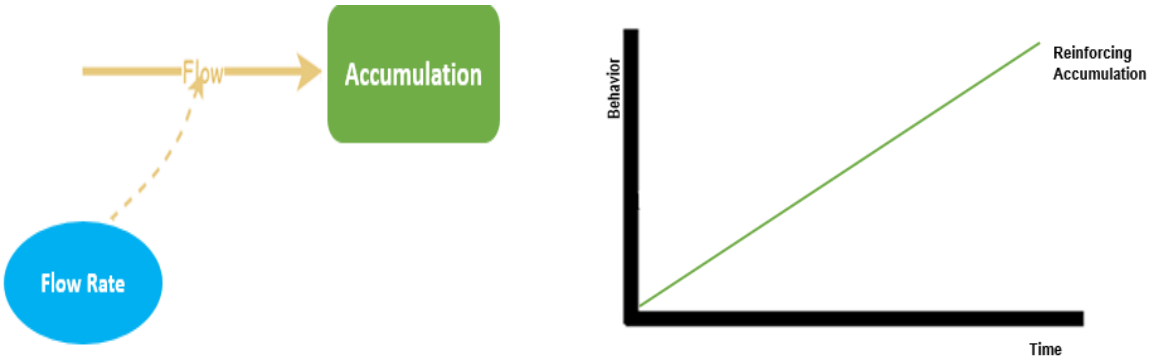

Figure 7.4. Independent growth model (Fortmann-Roe & Bellinger, 2013).

2. ***Goal-seeking models***: In a goal-seeking model, there is a balance between the current and desired state (see Figure 7.5).

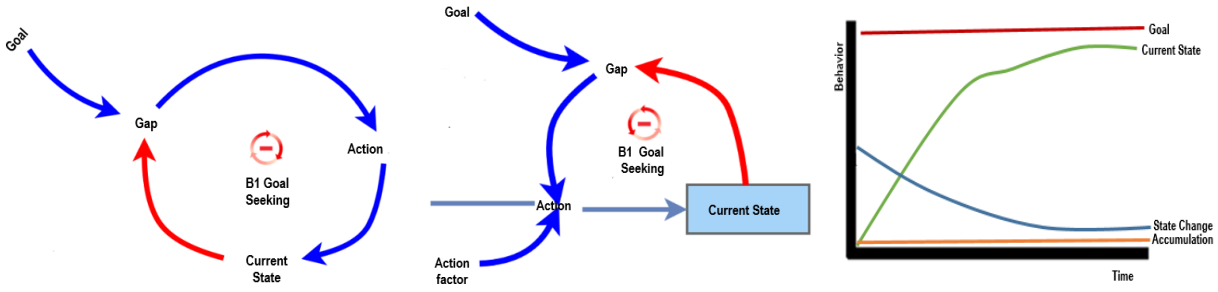

Figure 7.5. Goal seeking/balancing model (Fortmann-Roe & Bellinger, 2013).

According to Bellinger (2014), goal-seeking structures occur in situations where action is taken to move toward a desired state. The gap is the difference between the goal and the current state. Action, which moves the current state toward the goal, reduces the gap. As the gap closes, the current state moves towards the goal. The gap will be zero when the current state is equal to the goal.

3. ***Exponential growth models***: Reinforcing feedback produces exponential growth (see Figure 7.6).

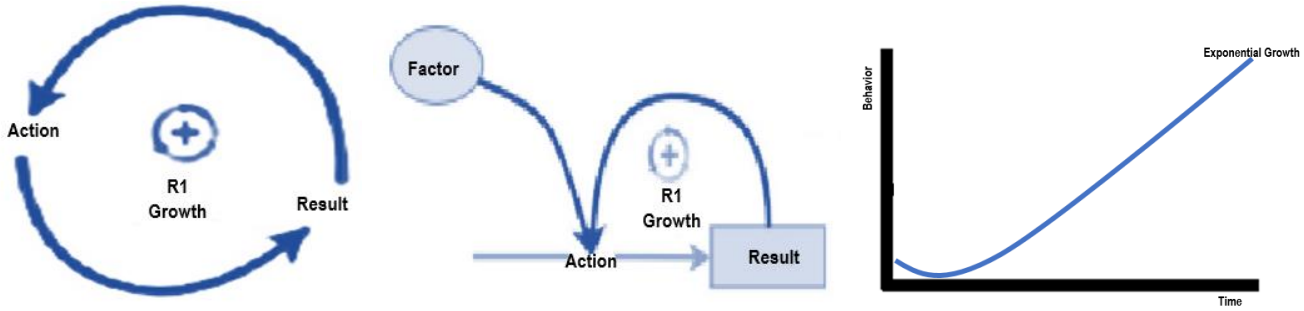

Figure 7.6. Exponential growth/reinforcing model (Fortmann-Roe & Bellinger, 2013).

In addition to these common structures, models typically consist of *rich pictures, causal loop diagrams,* and/or *stock and flow models*. The model that you choose depends on what you are attempting to understand, your audience, and your intended use.

- ***Rich picture models*** use pictures to depict relationships between components. You can use variables, links, text, and pictures to create a rich picture model. Figure 7.7 shows the relationship between patients who arrive at the emergency room with various conditions (i.e., urgent, less urgent, and nonurgent) and the responsibility of the triage nurse to determine which ones will be admitted and in which order.

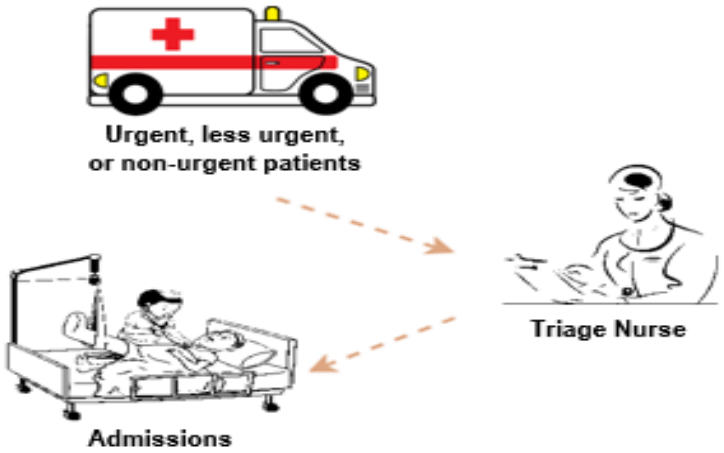

Figure 7.7. Rich picture model

- ***Causal loop diagrams*** use arrows/links to depict how one variable influences another in either a positive (+) or negative (-) direction. Figure 7.8 shows that births increase the population and deaths lower it. By looking at the loops separately, we can identify reinforcing and balancing loops.
    - *Reinforcing loop:* The more births there are, the more the population increases. The more people there are, the more births there will be.
    - *Balancing loop:* As the population increases, the more deaths there will be, which decreases the population.

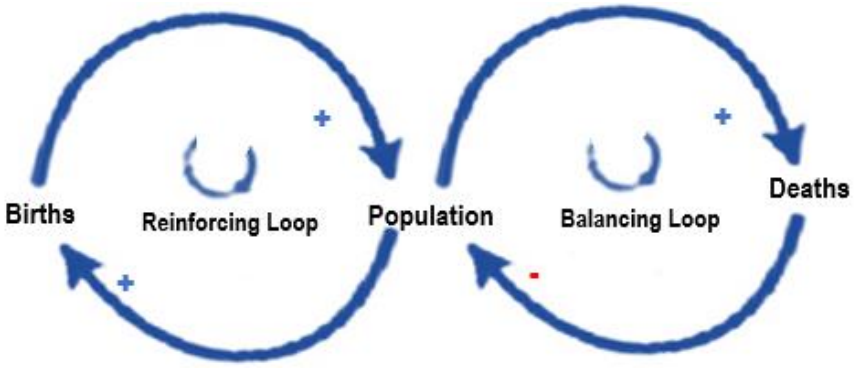

Figure 7.8. Causal loop diagram: Population impact (Fortmann-Roe & Bellinger, 2013).

- ***Stock and flow models*** focus on measurements over time. A stock is the quantity of an element, and the flow is how much the element flows over time out of the stock. The link indicates the value between elements. Figure 7.9 indicates that both birth and death rates affect the population (stock). The births represent the inflow to the population and the deaths represent the outflows from the population.

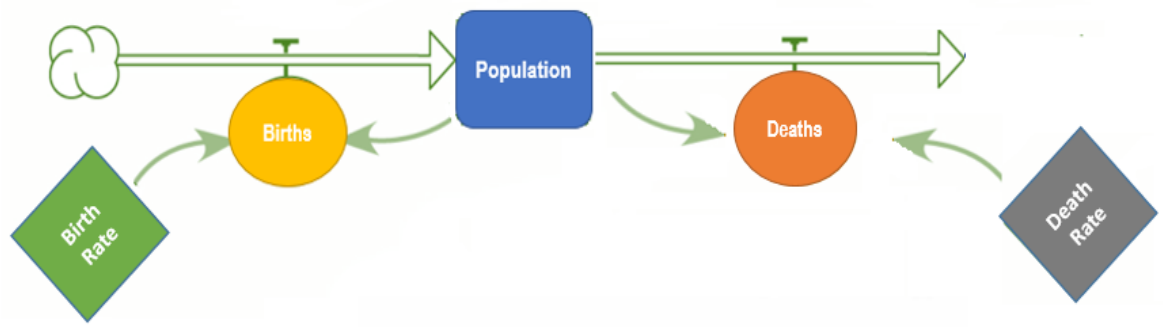

Figure 7.9. Stock and flow model: Population impact (Fortmann-Roe & Bellinger, 2013).

Suggested use: Fortmann-Roe and Bellinger (2013) posited that the primary reason to construct a model is to gain understanding or learn about a particular situation. Models can be used to make predictions (forecast outcomes based on variables that influence the outcome); make inferences (does variable x affect variable y); and provide a narrative (persuade by telling a story).

Combining structures (i.e., independent growth, goal seeking, reinforcing) and basic models (rich picture, causal loop diagrams, and stock and flow model) enables you to construct various models. By constantly asking questions such as "*and?*" you can advance your understanding of the world around you (Fortmann-Roe & Bellinger, 2013). Keep asking questions about how the various components of the model influence each other. When you have exhausted your questions, ask someone else to review the model. They will likely come up with questions that you did not consider. This iterative process concludes when you are certain that you have identified all the relevant influences.

To begin constructing a model, start with an aspect of a real event or the world that you would like to learn more about. The model can depict something that you would like to fix, change, or create. Your perception of the event allows you to form conclusions that lead to abstract versions

of those events. The abstract versions form the basis of representative models, which serve as depictions of your understanding. As you study the interactions in the model, you form conclusions and adjust behaviors, which contrast with the actual events. Clear up confusion by modeling the essence of interactions within a system.

Step-by-step procedure

1. ***Define the purpose of the model***. The purpose of the model may evolve over time. Clearly articulate the intention of the model as well as the model's boundaries (i.e., included/ excluded elements).
2. ***Determine the timeframes and time steps for the model.*** The timeframe of the model can be depicted in days, months, years, or other temporal values. In addition, determine the time step values for transitions within the timeframe.
3. ***Keep record of your decisions***. As you build the model, make notes that you can refer to later or share with others who are using or evaluating the model.
4. ***Determine the subcomponents of the model.*** Make decisions about the types of structures and basic models that will be included in your model. For example, are there stocks and flows, delays, causal loops, balancing loops, reinforcing loops?
5. ***Confirm inclusion of all influences.*** Ask the appropriate questions (i.e., "*and?*") to ensure that you have taken into account all the relevant influences.
6. ***Identify and label the elements accurately.*** As you complete the model with labels, consider the following:
    - Identify delays because they can impact the way the model behaves.
    - Identify stocks and flows in the model. Stocks accumulate and flows change the stock over time. If time stops, stocks have remaining quantities, while flows have no value. Stocks are persons, places, or things without modifiers indicating direction.
    - Order the story by labeling the sequence of the causal loops.
    - Clearly define goals of balancing loops.
    - Clearly state limits on stocks, variables, or flows.
7. ***Ask questions***. Keep questioning the model components. Encourage others to ask questions about your model.
8. ***Evaluate the model for consistency with reality***. Use the gap analysis as a learning opportunity.

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Chapter 8:
Assessing Systems Thinking

Assessing an individual's systems thinking ability is very challenging; there is no validated measurement tool. Effective assessment requires agreement on what systems thinking is and how it can be measured (Sweeney & Sterman, 2000). This is further complicated by the different approaches or schools of systems thinking, which focus alternatively on cognitive processes, applying analytical tools, and/or computational modeling (Burnell, 2016).

Assessing system thinking related to a specific assignment. At the instructional level, assessment should always be tied to learning objectives (Diamond, 2008). Publicly available syllabi for courses titled "Systems Thinking" can be found at schools or departments of business and management, public health, public affairs, computer science, and systems science. The concepts covered in these syllabi vary widely, including systems theory, selected analytical tools and software applications, computational modeling, and legislative policy development. Assessment methods used in these courses include quizzes and exams, individual and group projects, policy designs, and term papers. Assignment instructions focus on applying specific tools (i.e., drawing a concept map) or the steps in developing a simulation or policy, as opposed to assessing a student's actual thinking process.

Similar assessment methods can be found in the health professions, where systems thinking is not explicitly taught but is associated with activities such as quality improvement, interprofessional education, and error mitigation and advocacy (Plack & Driscoll, 2017). We have found that assessment of systems thinking in coursework is often described as highly subjective via projects, exams, case studies, presentations and reflection papers, and, in the clinical setting, is largely observational via preceptor evaluation forms.

Literature on assessing system thinking in the health professions is also sparse (Moore, Dolansky, Palmieri, Singh, & Alemi, 2010; Moore, Dolansky, Singh, Palmieri, & Alemi, 2011). Studies are focused on initiatives to meet requirements for competency in systems-based practice (Accreditation Council on Graduate Medical Education, 2017) and concern highly specific initiatives related to drug costs, teamwork, specific care processes like handoffs and discharge planning, use of community resources, and error alleviation (Chen, O'Sullivan, Pfenning, Leone, & Kessler, 2012; David & Reich, 2005; Delphin & Davidson, 2008; Soto, Cormican, Gallagher, & Seidman, 2010). Assessment measures in these studies include tests of knowledge retention, self-assessed comfort or completion of required process steps, or perceived organizational process improvements. None assessed the thinking process. Authors have voiced concerns about both the lack of appropriate evaluation tools and, where used, issues of interrater reliability.

Downing and Yudkowsky (2009) described four major types of assessments typically used in medicine and the health professions education and provided a few examples of each:

1. Written exams: Multiple choice questions, fill in the blanks, true or false, extended matching, and essays
2. Performance exams: Objective structured clinical examinations, oral exams, simulations, and standardized patients
3. Clinical observational methods: 360 evaluations, checklists, and rating forms used by faculty and others to assess performance in the clinical setting
4. Other or miscellaneous: Oral exams, case assessments, and portfolios

There are pros and cons to each type of assessment, and all have limitations and challenges. The best assessment strategy is to use a combination of assessment methods (Downing & Yudkowsky, 2009). Relying on a single method such as written exams or performance exams will not fully enable you to assess an individual's knowledge, skills, and abilities. In addition, using blueprints for written exams and rubrics for performance and observations may enhance the reliability of your assessment.

To start, though, as noted earlier, assessment must always be linked to outcomes or learning objectives. Also noted previously, to develop a "habit of mind," concepts must be introduced early and reiterated and assessed often. In previous chapters, we identified sample topics and learning objectives that build upon one another to develop individuals who possess the 12 habits of mind of a systems thinker identified in chapter 1. These same habits also require higher-order thinking, as noted by Bloom's taxonomy.

Table 8.1 shows the link between different levels of Bloom's taxonomy and potential strategies for assessment. Remember, you must first identify the specific learning objectives you are trying to assess before determining what type of assessment you will use. As noted, no one assessment will be able to gauge a learner's knowledge, skills, and attitudes related to systems thinking; multiple strategies will need to be developed across the curriculum. Table 8.1 provides some examples of assessments you might use at each level of the taxonomy and at different levels of healthcare delivery (patient, family and community, healthcare team, organization, and society).

Table 8.1
Assessment Across the Four Levels of the Healthcare Delivery System

Bloom's taxonomy	Sample objectives across the four levels of healthcare delivery	Sample assessment strategies (Downing & Yudkowsky, 2009)
Knowledge and comprehension	1. Identify body structures and functions (patient, family, community) 2. Recognize the potential impact of family and community perspectives, assumptions, and biases on patient care (patient, family, community) 3. Describe the contextual factors impacting a patient's current function (patient, family, community) 4. Discuss individual and team behaviors that may positively and negatively impact patient care (healthcare team) 5. Describe the roles and functions of various healthcare team members (healthcare team) 6. Describe the information flow across units of a healthcare system (organization) 7. Recognize interconnections among the sociocultural, political, economic, legal, and regulatory factors influencing healthcare delivery (environment/society)	1. Written exam: Multiple choice 2. Written assignment: Create a concept map that diagrams potential family and community perspectives on a plan of care for a patient 3. Written assignment: Complete an International Classification of Functioning model on a given patient 4. Written assignment: Write a reflective paper identifying factors impacting team performance 5. Written exam: Multiple choice 6. Written assignment: Given a case study, draw a flow chart that illustrates the flow of information in a given organization 7. Written assignment: Given a case study, diagram the linkages of factors influencing healthcare delivery
Application and analysis	1. Diagram interdependencies across body systems (patient, family, community) 2. Distinguish among errors, near misses, and sentinel events (healthcare team) 3. Apply feedback to optimize communication and collaboration (healthcare team) 4. Analyze organizational dysfunction from multiple perspectives (organization) 5. Compare strengths and weaknesses of different service-delivery models on healthcare delivery (environment/society) 6. Compare the potential mental models underlying healthcare policy decisions (environment/society)	1. Written exam: Diagrams including causal loops 2. Written exam: Multiple choice 3. Simulation: Apply feedback received on previous performance to current simulation 4. Written exam: Draw a fishbone diagram that represents potential causes of dysfunction in an organization 5. Simulation: Participate in a pro/con debate of different delivery models 6. Written assignment: Write a reflective paper on potential stakeholder assumptions that may influence the outcomes of a given solution
Creating and evaluating	1. Create a plan of care to address identified body system issues (patient, family, community) 2. Hypothesize primary causes of adverse events based on a root cause analysis (patient, family, community) 3. Propose systematic methods to enhance coordination of care (healthcare team) 4. Appraise trends in organizational usage/activities that will optimize systemic efficiencies, minimize costs, and	1. Observational assessment: Given a clinical case, articulate a discharge plan to the family that considers the patient's and family's health beliefs and potential barriers to access to follow-up care 2. Written assignment: After creating a fishbone diagram, hypothesize the primary cause for an adverse event 3. Performance tests: After completing a quality improvement project,

Bloom's taxonomy	Sample objectives across the four levels of healthcare delivery	Sample assessment strategies (Downing & Yudkowsky, 2009)
	provide high-quality healthcare (organization) 5. Propose changes in laws, regulations, standards, and guidelines to address the Triple Aim and the health and wellness needs of society (environment/society) 6. Develop a policy proposal based on an evaluation of current evidence (environment/society)	propose solution to enhance care coordination 4. Written test: Synthesize data from a behavior over time graph on unit performance and make recommendations for change; diagram downstream consequences of potential changes 5. Portfolios: Compile clinical case examples to support your recommendations for changes in the law 6. Written assignment: Given a challenge in healthcare, develop a policy proposal based on current evidence

Assessing the overall ability of system thinking. As noted earlier, there is as of yet no validated tool for measuring an individual's system thinking ability. The general literature on assessing systems thinking is very sparse and focuses on perceived or preferred competencies as opposed to actual applications or results. Limited research has linked some cognitive intelligence competencies (system logic, interactivity, process orientation) to some social intelligence competencies (influence and change management) and to organizational performance (Skarzauskiene, 2010). These competencies may be used in many activities, including in systems thinking. Other work has indicated that individual orientations that many consider related to systems thinking (logic, causality, subjectivity, data, structures, self-reflection) can be assessed through the use of storytelling, interviews, and responses to scenarios (Burnell, 2016). Studies using these methods test theoretical understanding of the orientations, not the actual application of the tools or processes used to apply them. A different approach to assessing systems thinking uses scales to measure an individual's preferences between pairs of characteristics required to govern complex systems: complexity-simplicity, integration-autonomy, interconnectivity-isolation, embracement-resistance to requirements, emergence-stability, holism-reductionism, flexibility-rigidity (Jaradat, 2015). The author reported that the value of each characteristic depends on the problem to be addressed—the level of complexity—rather than there being an overall winning combination.

What appears to be missing in these efforts is assessment of the actual behavior of individuals—what they do when they are applying systems thinking. Such behavior specifics are the basis of human resource competency models used to assess overall performance (Mansfield, 1996). We suggest using the 12 "habits of mind" of a systems thinker, as discussed in chapter 1, as a measurement tool to assess an individual's ability (Table 8.2). This type of global assessment will give you a sense of where along the continuum the learner is in developing the habits of mind of a systems thinker.

Table 8.2
Assessment Based on the 12 Habits of Mind of a Systems Thinker

Using the scale on the right, how often does the individual exhibit these behaviors?	Never	Rarely	Some-times	Very often	Always
1. Strives to understand the big picture					
2. Discerns how elements within the system change over time to generate interdependencies, patterns, and trends					
3. Considers how individual and collective mental models affect views of the current reality and possible futures					
4. Identifies complex cause-and-effect relationships, including the role of feedback, time delays, and the circular nature of interactions					
5. Identifies connections both within and between systems					
6.Recognizes how a system's structure influences its behavior					
7. Alters perspectives to increase understanding					
8. Pinpoints and tests underlying assumptions					
9. Applies understanding of the system's structure to surface possible leverage points for change					
10. Thinks through short-term, long-term, and unintended consequences of actions					
11. Resists the urge to come to a quick conclusion without thinking things through					
12. Monitors results and changes actions as required					

Summary. While many agree that systems thinking is essential to high-quality healthcare and achievement of the Triple Aim, literature offers few strategies for assessing systems thinking in our learners. In this chapter we offered suggestions for assessing learners at the assignment or course level as well as at the more global level of the "12 habits of mind" of a systems thinker. As with any good curriculum, assessments must be linked to specific objectives, both as the course/ assignment level as well as the broader outcome level. Systems thinking is a process that requires knowledge, skills, and attitudes, which need to be developed over time. As such, multiple longitudinal assessment strategies are needed to capture learning and development over time. No single strategy will fit all curricula; rather, assessments must be uniquely designed to meet the needs and identify outcomes of each individual curriculum. Linking assessments to identified curricular objectives at each level of the healthcare system and along Bloom's taxonomy from the knowledge and comprehension level to the analysis, synthesis, and evaluation levels provides a solid framework from which to design your assessment strategies.

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Chapter 9:
Putting It All Together: Case Scenarios

Our goal in this last chapter is to help you apply all of the concepts and theories previously described in this monograph; without application, concepts can seem rather abstract, theoretical, and not very practical. Through applying what you have learned, you can make the link from theory to practice.

We use the taxonomies, reflective questions, and systems thinking tools to address a variety of common challenges that present themselves across the different levels of the healthcare delivery system. We provide case scenarios as well as some sample questions and tools you might use to define and describe the system; analyze and better understand the drivers, restraining forces, and stakeholder perspectives; develop a plan for change; and monitor the success of your plan. The questions and tools we provide are in no way exhaustive; rather, they are meant as exemplars. Each complex problem you encounter in healthcare will have its own unique context, which will drive the types of questions you pose and the tools you select to help you resolve your challenge.

We also attempted to provide you with typical scenarios you might encounter across the healthcare landscape. While we label each with the component of the system where the major focus of analysis occurs, it is important to remember that complex problems often have drivers at all levels of the system—from the patient to the team to the organization and even society—and resultant solutions will often have consequences that reach far beyond a single level of the healthcare delivery system. Hopefully the different levels will be evident in some of the questions posed and tools selected in each case scenario.

As discussed in a previous chapter, it is important to start with learning objectives in designing any assignment or activity. Below are the learning objectives for the case scenarios that follow.

Upon completion of the cases, learners should be able to:

1. Pose a depth and breadth of questions based on the cognitive and reflective frameworks to fully analyze a given situation/scenario.
2. Assess a given situation/scenario using the appropriate systems thinking tools.
3. Select systems thinking tools for ongoing monitoring of the proposed change to the situation/scenario.
4. Appreciate the value of using a systems thinking approach in analyzing case scenarios.

Case 1. Focus on the Individual: Mr. Smith's Discharge

Mr. Smith is an 86-year-old patient at your rehabilitation facility. Until recently he had been in decent health, living by himself with the assistance of a son who lives nearby. He spent his days alone in his house, reading the newspaper and drinking coffee. In the last few months, he had fallen three times but in each case his son was nearby to assist him. His son noted that his father was somewhat forgetful, and he no longer allowed his father to pay the bills. (Mr. Smith previously made a large mistake in the checkbook and bounced some checks.) A trip to his primary care physician to renew medications for high blood pressure revealed an emergent heart problem that required surgery. The surgery went well, and Mr. Smith was transferred to a rehabilitation facility to regain strength and functioning.

Mr. Smith has been at your rehabilitation facility for 2 months, during which time his condition has deteriorated. He can no longer walk with a walker and uses a wheelchair to navigate the hallways. He has gained some of his strength back, but the gains have been slow. He sits alone in his room and does not interact with other residents. He is nonadherent with bathing and other self-care. He sleeps throughout the day. He recently started refusing to eat. He has lost 20 pounds since arriving at the facility. Mr. Smith's stated goal is to "go home." His son works full time but tries to visit him every day, and Mr. Smith seems to enjoy these visits. His son recently spoke with the facility director and expressed concerns about his father coming home without assistance; the director referred him to social work to begin the process of finding an assisted living facility for Mr. Smith. His son believes that Mr. Smith has long-term care insurance but cannot find the paperwork; Mr. Smith cannot remember if he has it or not.

Exemplar Questions

At the knowledge level, questions are posed to understand the problem from multiple perspectives.

Patient, Family, Community

1. What personal, social, and environmental factors might be contributing to Mr. Smith's current decline?
2. What personal, social, and environmental factors may be impacting Mr. Smith's potential to achieve his goal of going home?
3. What family supports does Mr. Smith have that may improve his convalescence?
4. What potential barriers exist to his care at home?
5. What supports would Mr. Smith need to be able to achieve his goal of going home?
6. Where else might he look for additional supports in the community?
7. What community-based programs are available for Mr. Smith in his local community?
8. What are Mr. Smith's desires for his end-of-life care?

Care Team

1. What is each team member's role in Mr. Smith's care?
2. What factors should the team consider in making any decisions about Mr. Smith's current and future care?
3. What has the team considered in managing Mr. Smith's failure to engage with his own self-care?
4. What additional strategies could the staff use to enhance Mr. Smith's engagement in his self-care?

5. Besides physical therapy, occupational therapy, nursing, and social work, what additional referrals might be needed to evaluate and potentially assist in Mr. Smith's care (considering his current decline, lack of engagement, and loss of appetite)?
6. What process will the team use in making decisions about Mr. Smith's care?
7. What is the role of the team in communicating Mr. Smith's desires for end-of-life care?

Organization

1. What components and processes in place at the rehabilitation facility will influence care for postsurgical patients?
2. What is the process for making referrals to additional practitioners?
3. What processes are in place to evaluate the effectiveness of communication among various units in the organization in order to optimize patient care and function?
4. What are the national trends in rehabilitation for patients with diagnoses similar to Mr. Smith's?
5. What role does the organization play in individual cases of patient decline?

Environment/Society

1. What are the regulatory policies, such as the type of insurance he has, and how do they drive the care he receives?
2. What typical barriers do older adults face in obtaining the care they need?
3. How do barriers to care differ for individuals of differing socioeconomic demographics?
4. What supports are in place for the care of older adults—including local, state, and federal supports?
5. How do supports (local, state, federal) differ for aging adults of different socioeconomic means?

Analysis-level questions are posed to deconstruct the issues and identify barriers, supports, drivers, and constraints.

Patient, Family, Community

1. Why is Mr. Smith refusing to eat? Why is he refusing to bathe or engage in self-care?
2. What impact does his recent weight loss have on his ability to heal from surgery and regain strength?
3. What is the nature and severity of his 'forgetfulness'? How can the team be sure?
4. What assumptions might Mr. Smith be making about his recovery? What assumptions might his son be making? How might these assumptions be impacting Mr. Smith's level of engagement?

Care Team

1. Given Mr. Smith's current needs, which team members should take the lead in his care at this time?
2. What additional team members are needed to address Mr. Smith's issues?
3. What additional information will the team need in making decisions with Mr. Smith?
4. Which members of the team should be responsible for obtaining the additional information needed?
5. What aspects of Mr. Smith's care has the team been most/least effective in addressing?
6. What else could the team do to enhance Mr. Smith's care?

Organization

1. How do the organization's care teams differ in terms of efficacy and efficiency across the rehabilitation setting?
2. What is the cost benefit of keeping Mr. Smith in the rehab setting vs. sending him to a skilled nursing facility given his current level of decline?
3. How efficient is the flow of communication among various units in the organization?
4. How efficient is the process for making referrals to additional practitioners (i.e., time from referral to assessment)?
5. What percentage of postcardiac surgery patients in the facility experience decline? How does this compare to other rehabilitation facilities in the state and nation?
6. How do the trends in discharge to home vs. assisted living vs. nursing home in the facility compare to facilities statewide and nationwide?
7. How effective have the primary determinants of discharge across the rehabilitation unit been?

Environment/Society

1. What are the costs to society if Mr. Smith is allowed to go home unsupervised?
2. How do the costs to society compare for in-home care with nursing and rehabilitative supports vs. skilled nursing facility? (Consider personal, sociocultural, political, and economic costs.)
3. What are the end-of-life costs for individuals in hospice care at home vs. hospice care in a nursing home? (Consider personal, social, political, and economic costs.)
4. What are the pros and cons of providing hospice care at home vs. hospice care in a nursing home? (Consider personal, social, political, and economic costs.)
5. What changes might the team propose on a local, state, and federal level to minimize the barriers to care experienced by Mr. Smith?
6. What steps would the team take in advocating for change at the local, state, and federal levels?
7. What information would the team need to acquire to effectively advocate for the changes it is proposing?

At the evaluation level, questions are posed to assess aspects of the system and to determine if changes to the system are successful.

Patient, Family, Community

1. Given current personal, social, and economic constraints, what plan of care could be developed to allow Mr. Smith to go home safely?
2. Assuming no community-based programs exist, what alternatives to care are available for Mr. Smith?
3. What impact (e.g., personal, social, economic) would the plan of care the team designed have on Mr. Smith and his family?

Care Team

1. How did the team perform overall in providing Mr. Smith's care?
2. To what degree did the team appropriately address all of his healthcare needs? Without error? Efficiently? (i.e., What did they do well? What could they have done better?)
3. What changes could the team make to optimize efficiency and efficacy should they encounter a similar case in the future?
4. What metrics might be used to assess the efficacy of the care team?

Organization

1. Was the referral process between the facility and the assisted living facility efficient, effective, and timely for the family? For the staff?
2. What plan could be put in place to monitor rates of patient discharge to skilled nursing facilities vs. assisted living facilities vs. home? What metrics could be used to ensure appropriateness of discharge?
3. What process could be established to ensure patients receive optimal care before significant decline is noted? What metrics could be used in this process to monitor both care and decline?
4. How can the effectiveness of new policies and measures be evaluated? What standard does the organization want to achieve?

Environment/Society

1. What percentage of the national economy will be spent on assisted living facilities as the population ages?
2. What are the sociocultural, political, and economic ramifications of the changing demographics (i.e., increasing numbers of aging baby boomers) and family migration on the future care of the aging population?
3. What sociocultural, political, and economic impact would the proposed local, statewide, or federal policy changes have?

Exemplar Tools

Prior to discharging Mr. Smith, the team needs to understand Mr. Smith's and his family's capabilities and needs. A visualization tool such as a ***Concept Map*** could be used to categorize the capabilities and needs of Mr. Smith and his family and how they are inter-related. The map would help the team clarify relationships between what Mr. Smith wants and what support his family is able to provide in order to meet his goal of discharge to home.

After completing a concept map, use of a ***Force Field Analysis***, which delineates the driving and restraining forces to discharge, will enable the team to clearly see what forces are working against one another, which ones have the greatest potential impact, which ones can be managed, and which ones cannot. This will more easily allow the team to determine if any of the restraining forces are modifiable and whether the supports identified in the concept map are sufficient to overcome the potential barriers or restraining forces to enable discharge home. The result of this analysis would be a determination regarding feasibility of discharge to home.

A ***Spidergram*** could then be used to assist the team in organizing the processes, resources, and other support structures that must be in place for Mr. Smith's discharge to be successful. Drawing a spidergram with Mr. Smith at the center, what are the key areas in which he will need support, and how will these be managed? The team might consider his medical needs, social/emotional functioning, ability to complete activities of daily living independently, and financial status. Within each of these areas, the team could then identify key areas of need, such as supports needed to ensure that Mr. Smith's medical care continues after discharge, transportation to his rehabilitation appointments, and food and housecleaning help. The team might also consider opportunities for Mr. Smith to socialize once he returns home, the status of Mr. Smith's finances and insurance, and how these resources might be used to pay for his home-based care.

Six weeks after discharge, Mr. Smith returns for a follow-up evaluation. In order to analyze and evaluate the success of Mr. Smith's discharge plan, the team might use ***Perspective Taking***, a tool that allows the team to gather information from different stakeholders involved in Mr. Smith's care. The team decides to gather information regarding how Mr. Smith is doing from Mr. Smith himself, his family, the visiting nurse, the home health aide, the social worker, and the physicians and rehabilitation professionals that Mr. Smith has continued to see as an outpatient. Perspective taking allows the team to see Mr. Smith's discharge from different viewpoints, thereby allowing them to get a more holistic picture of how Mr. Smith is doing at home. Having these discussions increases the team's chances of identifying potential problems that might interfere with Mr. Smith's care or continued ability to remain at home.

Another way to evaluate the success of Mr. Smith's discharge plan would be to track behaviors over time. ***Behavior Over Time Graphs,*** often used at the organizational level, can easily be adapted to enable the team to track if Mr. Smith is meeting the goals stated in his discharge plan and to quickly see trend lines and changes in behavior. The team might graph at least one outcome in each area identified by the predischarge Spidergram (i.e., medical needs, social/emotional functioning, ability to complete activities of daily living independently, and financial status) to document success of the discharge plan. There are many possible examples here. To track his medical outcomes, the team could monitor Mr. Smith's blood pressure and weight gain. His social/emotional outcomes could be measured by tracking his level of engagement in the community over time and by tracking his self-reported quality of life. Independence could be tracked by charting the amount of supports needed over time and his frequency of falls.

Case 2. Focus on the Team: The Handoff

You are a member of a healthcare team that provides inpatient care on the internal medicine unit. You work the night shift and are typically responsible for handing off four to five patients to the day shift team when the shifts change at 6 am. After a particularly busy shift, your team members complete their handoffs and head home. When you come to work the next evening, you are told that there is an emergency team meeting in 10 minutes to discuss a problem from the previous night. It appears that a patient had a negative reaction to a drug administered by the day shift, subsequently became unresponsive, and almost died. He is stable now but may have incurred some hypoxia during the time he was unresponsive. Members of the day shift are angry because they feel they were not well informed about the patient's care prior to the handoff the previous morning. The night shift team does not want to be blamed for the deterioration of a patient who was stable during their shift.

Exemplar Questions

At the knowledge level, questions are posed to understand the problem from multiple perspectives.

Patient, Family, Community

1. What caused the negative reaction?
2. Was there anything in the chart that might have suggested this patient would have a negative reaction?

3. How did the negative reaction start? How did it evolve?
4. Who identified the negative reaction? When? How?

Care Team

1. What is the team's understanding of the process for handoffs?
2. What are the individual team members' roles in the handoff process?
3. What information was given to the day shift?
4. What information was not conveyed to the day shift that may have impacted the outcome?
5. Which night shift team members were involved in the handoff?
6. Has the team had other similar handoff errors?
7. What type of training is in place to optimize handoffs?
8. What does the literature say about best practices in handoffs?

Organization

1. What is the protocol for handoffs? Was it followed?
2. What policies are in place to ensure safety, efficiency, and communication during handoffs, and were these policies followed during this handoff?
3. What checks and balances are in place to prevent errors?
4. What training is involved for staff? Were all staff involved previously trained?
5. What metrics are currently used to document the accuracy and efficiency of handoffs?

Environment/Society

1. How frequently are handoffs in error at this hospital? How does this compare to the national average?
2. What are the national trends for handoff errors?
3. What are the most common handoff errors nationally?
4. What legal and regulatory policies are in place to reduce medical errors?

Analysis-level questions are posed to deconstruct the issues and identify barriers, supports, drivers, and constraints.

Patient, Family, Community

1. What are the short-term and long-term consequences of the negative drug reaction for this patient?
2. What patient-specific information was missed during the handoff?
3. Where along the process of this patient's care might this information have been missed?
4. What are some possible strategies we might put in place to prevent this in the future?

Care Team

1. What are some possible points in the process where this handoff might have broken down?
2. Which communication strategies may have contributed to this error?
3. What are some possible assumptions made by the day shift and night shift team members regarding this patient's care?
4. What checks and balances were not effective in this handoff?

Organization

1. What is the cost to the organization of handoff errors?

2. What organization-wide policies would be most effective in ensuring safety, efficiency, and communication during handoffs?
3. What organization-wide policies or processes might be considered to prevent future handoff errors?
4. What types of training might be considered to prevent future errors across the institution?

Environment/Society

1. What is the cost to society for medical errors such as this one?
2. Do these types of medical errors differentially affect patients from different demographics?
3. In what ways might healthcare professionals' mental models or assumptions of patients from different sociocultural backgrounds influence the frequency of medical errors?
4. What political, regulatory, and economic factors influence these types of medical errors?

At the evaluation level, questions are posed to assess aspects of the system and to determine if changes to the system are successful.

Patient, Family, Community

1. What questions need to be added to the intake forms to prevent this error in the future?
2. What process changes are needed to ensure all pertinent patient information is obtained from the patient, properly documented in the chart, and passed on from team to team?

Care Team

1. What can the teams learn from this handoff error?
2. Why was there a breakdown in the process? What was the root cause?
3. In what ways did the different team members' assumptions influence the care provided?
4. What changes to communication are needed to ensure best continuity of care?
5. What team processes should be instituted to reduce the likelihood of this type of error happening again?

Organization

1. Why didn't the policies and processes currently in place prevent this error?
2. What institution-wide policy and process changes are needed to reduce the frequency of this kind of error?
3. How many errors have these two teams had over the last year? What is the root cause of these errors?

Environment/Society

1. Given the issues in this particular case, as well as findings from the literature on the frequency and cost of medical errors to society, how might the team advocate for changes in laws and regulations to reduce medical errors?
2. What changes would the team advocate for? Why?

Exemplar Tools

A ***Fishbone Analysis*** could be used to identify and categorize issues about the handoff. Once the issues have been identified, a ***Causal Loop Analysis*** could be used to identify relationships among the issues and to identify possible solutions.

Once possible solutions have been identified, a ***Stakeholder Analysis*** can be used to analyze the impact of the proposed solutions on various groups. During these stakeholder discussions, the ***Left-Hand Column*** tool can be useful in trying to understand what the groups really thought about the solutions proposed. The left-hand column tool helps to uncover unspoken thoughts that stakeholders may have about the proposed solutions. This process aids understanding of what people are concerned about and are not verbalizing. If not addressed, these unspoken thoughts will prohibit complete buy-in of the solution.

Once a solution has been identified and agreed upon, the ***Drifting Goals and Gaps*** tool can be used to assess the changes made and see how successful they were. Monitoring progress with this tool would also allow the team to work quickly to close potential gaps between the expected goal and the current reality on the unit.

Case 3. Focus on the Organization: Developing a New Unit in a Comprehensive Health System

You are the manager of an outpatient facility at a large inner-city health system. The system serves a broad range of community members across racial, ethnic, age, and socioeconomic groups.

The hospital has a reputation as a comprehensive care center and is valued by the community. However, many of the units within the hospital function relatively independently, making it challenging for patients with complex chronic disease to get all of their needs met in one place at one time. Communication across units is also somewhat limited.

Your boss recently read an article in the newspaper about a man who had to stay in a hotel for a week just to be able to get appointments with all the necessary healthcare providers. Your boss found this deplorable and approached you about organizing a more integrated care unit that could be a "one-stop shop" for community members with complex chronic disease. She's asked you to develop a proposal for her review.

Exemplar Questions

At the knowledge level, questions are posed to understand the problem from multiple perspectives.

Patient, Family, Community

1. What community-based programs are already available in the community to both address and prevent chronic disease?
2. What are the most common chronic diseases in the local and extended community?
3. Given the complex impact on body, structure, and function, what are some of the more common needs for persons with chronic disease?
4. What personal, social, and environmental factors positively influence the care of chronic disease patients? What factors have a negative influence?
5. What do family members need to know about chronic disease to provide care at home?
6. What are the barriers to care experienced by persons with chronic disease?

Care Team

1. What professionals should be members of the integrated care team?
2. How should it be determined who is on the team?
3. What areas of professional expertise overlap across team members? How will the team manage these overlaps in order to work efficiently?
4. Who will be in charge of the team? Will there be one point of entry (e.g., MD) or multiple points of entry for patients to access their care?
5. What aspects of management will be the most challenging for the patient, family, team, and organization? How will team-based care reduce these challenges?
6. Are there other healthcare professionals whose expertise the team might need on a referral basis? If so, what is the process for making such referrals?

Organization

1. How does the creation of an integrated care center address the facility's mission and vision?
2. Where will the center be 'housed' within the facility?
3. What additional data or information at the organizational level is needed to make decisions regarding composition of this integrative unit?
4. What processes are in place to ensure effective communication within the team and between the team and families of persons with chronic disease?
5. How will the referral process work to ensure optimal integration and efficiency of care?
6. What are the benefits to the organization of developing a center?

Environment/Society

1. What types of care delivery models are the most common for chronic disease?
2. What regulatory policies might influence care?
3. What typical barriers do younger adults with chronic disease face in obtaining the care they need?
4. Why do barriers to care differ for individuals of differing socioeconomic demographics?
5. Given the issues in this particular case, how might the team advocate for changes in laws and regulations to reduce barriers to care?
6. What changes would the team advocate for? Why?

Analysis-level questions are posed to deconstruct the issues and identify barriers, supports, drivers, and constraints.

Patient, Family, Community

1. What strategies can be used to determine the needs of the patient, family, and community?
2. What functions might be most valued by family members?
3. What are ways to measure the impact of the disease on the patient? Family? Community?
4. What personal, social, and economic factors will influence the design of this integrative care center to meet the needs of persons with chronic disease? How might these factors differ across the lifespan of different chronic diseases?

Care Team

1. What strategies might the team use to maximize efficiency of care for each patient?
2. How will the team's work change across the lifespan of different chronic diseases?

3. How might the team's understanding of and thoughts about chronic disease influence the care they provide?
4. How might the team measure the impact of their care on patient outcomes?
5. What else could the team be doing to enhance chronic disease care?

Organization

1. How does management of chronic disease change over time, and how does this effect the facility's financial bottom line?
2. What strategies will be used to determine the cost-benefit of a center such as this?
3. Where are the current gaps in resources needed to develop and maintain the center?
4. What are the current organizational barriers to integrated care? How can they be addressed?
5. What are the strengths, weaknesses, opportunities, and threats in the current system?
6. How efficient and effective has the flow of communication been among various units in the organization?
7. What are the short-term and long-term costs to create, support, and maintain the unit?
8. What are the pros and cons of providing an integrative center in this community? (Consider personal, social, political, and economic costs.)

Environment/Society

1. What changes might the team propose on a local, state, and federal level to minimize the barriers to care experienced by persons with chronic disease?
2. What are society's values regarding persons with disabilities?
3. What steps would the team take in advocating for change at the local, state, and federal levels?
4. What information would be needed to effectively advocate for the proposed changes?

At the evaluation level, questions are posed to assess aspects of the system and to determine if changes to the system are successful.

Patient, Family, Community

1. How might chronic disease influence the patient's social roles?
2. What metrics will be used to determine the impact of the center on individual patients and families?

Care Team

1. What is the value of a team approach to the organization as a whole? What metrics could be used to measure the team's contributions?
2. After the team is established, how will the team's performance in enhancing the coordination of chronic disease care be documented? How could this be measured?
3. If errors occur, what will the team do to address them?
4. How could the team incorporate self-assessment activities as part of ongoing team evaluation?
5. How will the team know that their work is efficient and effective?

Organization

1. What are other possible methods for addressing the issues faced by chronic disease patients in the community?

2. What processes could be implemented to make chronic disease care more efficient, effective, and timely for the family? For the staff?
3. What plan could be put in place to monitor outcomes of chronic disease patients who received care from the integrative center vs. those who did not? What metrics could be used to monitor these outcomes?

Environment/Society

1. Given the prevalence of chronic disease and the significant negative impact it has on people's lives, what changes might the team suggest regarding policies, regulations, and guidelines on patient care?
2. What sociocultural, political, and economic impact would the proposed local, statewide, or federal policy changes have?

Exemplar Tools

Many systems thinking tools are available to aid in complex decision-making processes such as in the scenario above. The planning team might begin with ***Collaborative Problem Solving*** to establish the processes to be followed in the decision-making process. Collaborative problem solving should lead to agreement in the steps to take. In short, using this tool early on should lead to group buy-in about the process.

A ***Concept Map*** could then be used to identify what is needed by patients and to see relationships among what is needed. Concept maps are good for brainstorming and seeing how aspects of the new center might be related and organized. Visually identifying aspects of the center will likely get people excited about the possibilities.

Next, a ***Force Field Analysis*** could be used to identify the positives and negatives of creating a comprehensive center. Creating the center will likely lead to some downsides, at least for some parts of the hospital, as well as some upsides for others. Force field analysis allows these pros and cons to be compared to each other. If the pros outweigh the cons, the planning for the center moves forward; if the cons outweigh the pros, the process does not move forward.

If the force field analysis suggests that the process should continue, a ***Tree Diagram*** would be useful to help the planning team decide what is needed and what is feasible to do in the center. Tree diagrams allow for exploration of all the possibilities, as well as allow the planning team to visualize the best solutions regarding how the center should be organized.

As the center becomes a reality, it will be necessary to monitor its success. A ***Spidergram*** could be used to identify and organize the parameters to measure to monitor the success of the center. The planning team could consider aspects of the center that are important to them (e.g., volume level, financial results, types of training needed by center staff), as well as aspects that are important to patients (e.g., empathy of staff, ease of access). These aspects of the center should be measured in management reports and appear on patient satisfaction surveys to track success.

Over time, a ***Spider-Web Diagram*** would be useful in monitoring the progress of the center. Overlaying results from the management reports and patient satisfaction surveys onto this type of diagram yields a "web" that visually informs the team how successful the center has been to date—and in what areas.

Case 4. Focus on the Community and Society: The Opioid Crisis

Opioid overdoses and deaths in your community are occurring at levels greater than the national average. You have been appointed by the mayor to a citywide task force to address the opioid crisis. You were chosen as a person representing the healthcare field. Others on the task force include an emergency medical technician, a police officer, a representative from the county health department, a city council member, a social worker, two community members, and two people whose families have been affected by the opioid crisis. The task force's charge is to create a coordinated set of recommendations to reduce opioid abuse and overdose in the community. An additional charge is to develop prevention strategies for use in the future.

Exemplar Questions

At the knowledge level, questions are posed to understand the problem from multiple perspectives.

1. How is the city currently responding to the opioid crisis?
2. What economic, political, and sociocultural factors influence opioid use and the city's possible response to it?
3. What citywide policies are currently in place to guide the city's response to opioid abuse and addiction?
4. What are the drivers of opioid addiction in this community?
5. How widespread is the problem in the community?
6. What are the costs to the city of the opioid crisis?
7. What environmental factors contribute to opioid abuse and addiction?
8. What are the biggest barriers to prevention?
9. Who else needs to be part of this conversation?

Analysis-level questions are posed to deconstruct the issues and identify barriers, supports, drivers, and constraints.

1. Which stakeholders are missing from this conversation, and what is the task force missing by not including them?
2. Where in the community will intervention have the highest impact? Where would resources be best spent?
3. What service delivery model is the most efficient?
4. Which actions or procedures can the task force suggest that would have the most immediate effect on the opioid crisis? Which actions would have the greatest long-term effect?
5. After identifying both drivers and barriers, how will the task force prioritize its approach to addressing the problem?
6. Why have current city policies been ineffective in addressing the crisis?

At the evaluation level, questions are posed to assess aspects of the system and to determine if changes to the system are successful.

1. What metrics should be used to evaluate the success of the task force's recommendations?
2. How might the recommendations influence city policies?

3. How might the recommendations be influenced by economic, social, and political realities at the citywide level?
4. Given the issues in this particular case, how might task force members advocate for changes in laws and regulations related to the opioid crisis?
5. What changes would members advocate for? Why?

Exemplar Tools

The task force could use a ***Fishbone Analysis Diagram*** to understand and describe the root causes of the opioid crisis. This tool could also be used to categorize the structures and functions of citywide resources (EMS, police, social work, etc.) that are currently in place to deal with the crisis and to note areas of potential overlap or areas of critical need. Categorizing in this way allows the task force to see how different parts of the system are contributing to the overall effect, which in this case is the city's current response to the opioid crisis. Once categorized, the "5 Whys" can be used to identify the root causes and prioritize key issues.

To understand the problem more deeply, and to get at assumptions that may influence decision-making, the task force could use the ***Iceberg Model***. This model allows the team to go beneath the 'surface' events described in the fishbone diagram to explore assumptions, beliefs, and values that might influence how the city deals with the crisis. The iceberg model also addresses patterns of behaviors and how these assumptions and behaviors interrelate. For example, are assumptions being made about opioid users, such as that all users are poor? Are there trends in behaviors, such as repeated visits to the emergency room after overdose, because users cannot get care elsewhere? This model also allows the task force to describe how providing assistance to opioid users relates to the city's stated values for its residents.

Once the task force has identified and analyzed the problem, it is ready to brainstorm solutions. The task force could use the ***Six Thinking Hats*** technique, which allows the team to think about proposed solutions from different perspectives. These perspectives include creativity, objectivity, intuition, negativity, positivity, and reflectivity. Discussing potential solutions from different perspectives often leads to better and longer-lasting solutions. How might the responses of the person with the white hat (objectivity) differ from those of the person with the green hat (creativity)?

Once the task force has developed a set of recommendations to address the opioid crisis, how could it use the process of ***Collaborative Problem Solving*** to ensure that it has covered all of the important aspects of the mayor's charge? Collaborative problem solving involves clarifying expectations, gathering data, getting buy-in from stakeholder groups, engaging in group discussions, identifying possible barriers to implementation, generating possible options and evaluating them, producing a report, and presenting it to the mayor. What might the task force do to complete each of these steps?

It's been 6 months since the task force presented its recommendations to the mayor. Some of the goals have been successfully implemented whereas others have not. The task force reconvenes to identify gaps between the desired goals and the current state of affairs. How might the task force use the ***Drifting Goals*** tool to assess progress and identify what needs to be done differently? They would need to decide if some sort of action might fix the problem, or they might decide to rewrite the goal to make it more obtainable. Both of these possibilities come with costs and

issues. How might the group address the gap between desired and current goals? How will these decisions influence what the group tells the mayor about the task force's progress?

Summary

By providing you with some typical case scenarios learners may encounter at each level of healthcare delivery, our goal was to help you apply information from the previous chapters to real-world case scenarios. In deconstructing each case scenario from a systems perspective, we offered some sample questions at each level of Bloom's taxonomy and embedded reflective questions from both Schön's (1983) and Mezirow's (1991) frameworks. We also provided examples of tools learners might select in analyzing each case scenario from a systems perspective. Again, there is no one right answer or one right tool to be used in analyzing a case scenario. Learners may select different questions and different tools in their analysis; the key is to encourage a comprehensive systems-thinking approach to solving complex problems. Just like medicine, systems thinking is both a science and an art.

Whether you are in the classroom or in the clinic, assignments and activities designed to develop systems thinkers and systems-based practitioners should be goal oriented, relevant, and authentic, replicating real-world situations. Becoming a systems thinker takes knowledge and skills, which takes time and practice. Encouraging learners to use a variety of tools and to ask questions at all levels of Bloom's taxonomy as well as reflective questions exploring the content, processes, and assumptions involved in all scenarios will prepare them to take a more comprehensive, well-informed systems approach to their problem identification, data collection, data synthesis, and, finally, decision-making.

Use of paper cases can be an effective teaching and assessment strategy; however, stopping with paper cases does not go far enough in determining whether learners across the continuum from preclinical learners to practitioners have developed the knowledge, skills, and attitudes of a systems thinker. As noted in earlier chapters, systems thinking must become a "habit of mind," and using the "12 habits of mind" of a systems thinker (Waters Foundation, 2010) longitudinally will enable you to capture learning and development over time.

The more practice learners gain in deconstructing case scenarios and real-world scenarios from a systems perspective, the more effective they will become in thinking on their feet (e.g., reflect-in-action), regularly reviewing their performance (e.g., reflect-on-action), anticipating outcomes, and developing plans for improving future performance (e.g., reflect-for-action)—which will ultimately result in more fully informed systems-based decision-making.

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