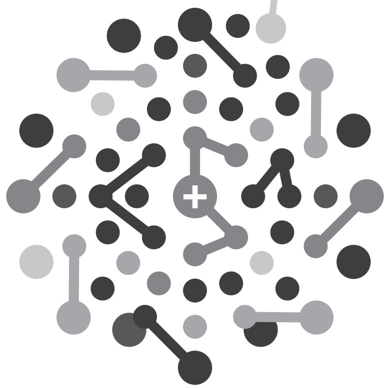
THE AGILE NETWORK



A Model to Foster Innovation, Implementation, and Diffusion in Healthcare Settings

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DEDICATION

This book and the remarkable results it describes are a result of funding from CMS and the TCPI. We are grateful for the opportunity to effect change on such a large scale and to share our discoveries with the world of healthcare delivery. The extraordinary results are a reflection of the dedicated clinicians, quality improvement advisors, and leadership within the Great Lakes Practice Transformation Network in Illinois, Michigan, Kentucky, and Indiana.

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CONTENTS

1

THE HEALTH SYSTEM BEFORE THE TRANSFORMING CLINICAL PRACTICE INITIATIVE (TCPI)

Tommy's Story

Today, the needs of those who receive healthcare surpass the capabilities of the system that provides care. To illustrate, let's consider Tommy's story. Tommy was born in the 1920s in rural Kentucky. He loved to play basketball and worked hard on his family's farm. He was among the first nine men in his rural area to volunteer to serve in the United States Army in World War II. He participated in the Normandy invasion at Omaha Beach as part of the wave of troops collectively known as D-Day Plus 2; he earned a Purple Heart for his service.

After majoring in agriculture in college, he returned to his community and became an insurance agent and bank executive while continuing to help out on his family's farm. He soon met a young bank teller who would become his wife, and they began their life together.

Tommy was a great husband and father, as well as a hard worker. Over time, his career interests expanded beyond insurance and banking. He came to own a bottling company and a furniture store. Eventually, he became a home builder. He was an active member of his church, serving as both treasurer and deacon. Tommy also participated in multiple community, civic, and veteran-related groups. His interests led him to become involved with several regional and statewide causes, including environmental conservation and helping to bring a veterans' nursing home to western Kentucky.

As Tommy aged, he became an avid reader of the *Wall Street Journal*. He enjoyed staying up to date on the latest business news and making regular trades on the stock market. Typical of his age group, he was fiscally conservative—some would say "tight"—and he leveraged his financial acumen by building and selling homes to fund college educations for his three daughters. All three women pursued successful careers as a doctor, an IT leader, and a healthcare executive.

Tommy was well liked and well respected in his community, and he enjoyed close relationships with his business partners, siblings, and extended family. Whether it was over a cup of coffee, while working on a project, attending a family event, or traveling for business or pleasure, he always enjoyed jovial conversations and social interactions with those around him.

Life continued this way for Tommy for several years. He watched his daughters marry and start families of their own. He and his wife remained in their loving rural Kentucky community surrounded by trusted friends. In his eighties, while aging healthfully and enjoying life, he decided to take advantage of a service offered by a local hospital. The hospital was sending healthcare professionals to his church to provide interested parishioners with ultrasounds designed to assess their risk of stroke. Despite being in good health, Tommy opted for a scan. A dear friend and former business partner of Tommy's had recently had a stroke; he'd witnessed firsthand its effects and was worried about what would happen to his own family if he were to suffer the same fate.

The results of the free screening offered in the mobile ultrasound unit in the church parking lot were clear and unambiguous: Tommy had significant blockage in his carotid arteries. Those who performed the screening informed him that he needed surgery right away to reduce his risk of stroke. This information came as a crushing blow to Tommy, but he understood the results of the test and believed fully in what he had been told: major arteries carrying blood to his brain were clogged, and they required urgent treatment to prevent an embolism capable of producing a severe stroke. Already primed by his friend's experiences, he was immediately convinced that surgery was the right and only option. And so, Tommy quickly scheduled a consultation with a surgeon in a neighboring community. The result of the consultation was to schedule the procedure: a carotid endarterectomy. Everything happened so quickly that at this point, Tommy had not yet shared any of this news with his daughters or their families.

What Tommy did not know at the time was that the latest clinical guidelines did not recommend surgery for someone in his situation, because he exhibited no signs or other risk factors for stroke. Further testing and medications would have been prudent next steps. They would have provided a prognosis as good, if not better, than the riskier surgical option. His daughters were uncertain about the surgical option and begged Tommy to consult with another physician in a larger, urban hospital near where they lived. He declined. They also suggested that if he was certain of the surgery, perhaps he should consider other surgeons. After all, one of his daughters was an anesthesiologist who could handpick a surgeon she knew personally. She could also be present in the operating room during the surgery. Furthermore, one of his sons-in-law was a physician at a large teaching hospital. His expertise was in brain health. Their pleas were to no avail.

Even though Tommy was well informed, affluent, and had significant family support and knowledge about the situation, the health system was ill equipped to provide him with the guidance and assistance he needed to select the best possible option for his specific situation.

Tommy's admittance to the hospital for the surgery was a source of significant anxiety for his friends and family. They knew the risks involved in surgery. Tommy was in his eighties, and they worried about what could happen to him should he undergo this two-part procedure. Regrettably, their fears were realized. After the first surgery on his carotid arteries, Tommy developed delirium. This went undiagnosed and complicated both his recovery and his ongoing brain health.

Despite this outcome, the second surgery on the other carotid artery was scheduled. He was prescribed blood-thinning medication. It was unknown whether he was able to take his blood thinners as prescribed given his compromised cognitive state, but within weeks of the first procedure, he developed a gastrointestinal bleed and had to be readmitted to the hospital from which he had been discharged a few weeks earlier. Nevertheless, the second surgery proceeded as planned, and just as with the first procedure, he once more suffered delirium during recovery.

During this time, his son-in-law had been conducting research funded by the National Institutes of Health (NIH) to develop interventions to prevent and manage delirium and to understand the relationship between delirium episodes and the future risk of developing Alzheimer's disease. His research has since revealed delirium as a potential risk factor for Alzheimer's, increasing the odds of developing the disease by two- to five-fold within approximately five years.

This physician-scientist son-in-law and Tommy's daughters and family were concerned about Tommy's cognition but had been unable to change his decision and behavior. In retrospect, it was clear that there were several reasons for this.

- First, they were not the right messenger: in Tommy's mind, the mobile ultrasound in the church parking lot represented an authority whose opinion garnered significant weight.
- Second, Tommy's loved ones tried persuading him through discussion and verbal reasoning, which are often much less effective than the choice architectures that exist in the individual's physical and social environment.

In Tommy's case, he was primed to fear the unexpected nature of strokes and their devastating effects because he'd witnessed the personal experience of his friend. The cognitive recency and availability of this experience likely influenced his perception of his own stroke likelihood, and the results of the free ultrasound confirmed his concerns. These explanations are born out of numerous findings in the fields of behavioral economics and social networks. Unfortunately, at the time, they were not known or understood by Tommy's loved ones.

After physically recovering from both surgeries, Tommy remained in his rural community with his friends. Life proceeded as before . . . or so his family thought. Within a year or two, Tommy's family received a strange phone call from Tommy's local post office. Evidently, Tommy had repeatedly sent money to an account in the Bahamas. Needless to say, his family was alarmed and asked him about it, but he denied anything nefarious was occurring. His family further worried about his cognitive function, but his primary care doctor had not diagnosed any impairment, so there was not much they could do.

Tommy also refused any formal cognitive testing, despite knowing the signs of cognitive impairment; his wife had been diagnosed with dementia. Lacking alternative courses of action, his son-in-law, the expert on brain health, observed him in a casual setting and quickly identified indications of Alzheimer's disease.

Because his family loved him dearly, they wanted to relocate Tommy to live closer to them so they could help coordinate and manage his care and everyday life. In fact, his son-in-law had developed, evaluated, and implemented an evidence-based collaborative care model for Alzheimer's disease at Indiana University. The model had been proven to improve the behavioral and psychological symptoms related to Alzheimer's and to reduce the burden and stress for informal caregivers, such as Tommy's wife and daughters. This evidence-based collaborative care model could also reduce unnecessary hospitalizations and emergency department visits and keep patients in their own homes longer, lessening their reliance on institutional facilities.

Yet these data were not nearly enough to convince Tommy to move away from his rural community and enroll in a collaborative care program.

Here, again, one sees the role played by concepts of behavioral economics such as framing: scientific data did not provide Tommy a trusted and relevant story; or, said another way, his son-in-law framed the message using language Tommy found hard to understand or believe.

Additionally, the care model at Indiana University was not scalable and thus was unavailable in the most important place for Tommy: his own rural hometown. Even had his son-in-law converted the evidence-based data into an engaging story told by someone Tommy trusted, Tommy would have faced the hard decision of leaving his community. To receive better care, he would have had to leave a place where he had purpose, autonomy, and mastery, and leave his church, his farm, his house, and his friends.

With Tommy's continued money transfers to the Bahamas, his daughters worried their parents' spending was out of control. Tommy had previously set up a trust to protect his life's earnings, but now he was refusing to fund that trust. Devastated and worried about their parents' future, the daughters felt they had no choice but to seek power of attorney through a court order. They needed to bring some stability to their parents' economic situation. Their goal was to protect their parents' assets, but some community members who didn't recognize any cognitive impairment in Tommy or his wife suspected that his daughters were seeking power of attorney for their own benefit.

The day of the court hearing to determine power of attorney, during questioning by the judge, Tommy's wife received a phone call and began speaking with the person on the other end of the line. The judge ordered her to hand over her phone. On the other end of the line were scammers, telling Tommy and his wife that they were going to receive a new car and that it would be delivered that day. When the judge suggested that they instead bring the car to the courthouse, the scammers hung up, and the judge was convinced that Tommy's daughters had been right about the situation. Within minutes of hanging up the phone, the judge ruled in the daughters' favor and put them in charge of the trust and of their parents' assets.

Unfortunately, not long after, Tommy's wife fell and suffered a fractured wrist, which needed surgery to treat. This time, the daughters were able to positively influence one of their parents' care: they convinced their mother to have her surgery at the facility where one daughter was a practicing anesthesiologist. The family used their mother's postsurgical rehabilitation needs as an opportunity to move their parents into an assisted living facility near where the oldest daughter lived.

Tommy and his wife lived the rest of their lives in that facility. Tommy died peacefully in 2016, surrounded by his kids, grandkids, and other loved ones while listening to his beloved bluegrass music.

This story is emblematic of Healthcare 1.0, where the quality of care and the penetration of evidence-based innovations vary across the country's many healthcare delivery systems. Poor or outdated practices may disseminate and persist despite better, newer findings and updated clinical guidelines. Misleading advertisements, inappropriate procedures, and medical errors are common because providers and health systems have little incentive to act proactively, apply evidence, or treat the entire patient. Patients and families are not empowered to choose or direct their care and have limited access to care, information, and clinical care team members. The system relies too much on individuals to go out of their way to take deliberate, disciplined, and sometimes heroic actions to attain their best care.

Tommy possessed knowledge, financial means, and family support. Yet he was still subject to inappropriate medical advice, inappropriate treatment, and neglect of the social and cognitive aspects of his health. As predicted by his son-in-law's research, Tommy developed Alzheimer's disease within two years of his first episode of postoperative delirium. It is ironic and sad that a physician neuroscientist focusing on preventing and managing delirium to protect brain health for millions of people could not translate and implement his research findings to protect his own family.

For Dr. Boustani, this is not a random story: Tommy was his father-in-law. Dr. Boustani was the son-in-law who identified Tommy's first indications of Alzheimer's disease. It was his wife and her sisters who desperately fought for their father to receive appropriate care. They could not assuage his fears about a stroke and had to watch him pursue a less-than-optimal course of treatment that ultimately contributed to his cognitive decline. Even with the combined knowledge of Tommy's family, they could not convince him that he had received inaccurate information and needed to consider other options. To this day, Dr. Boustani identifies this situation as the one that affects him more than any other he has encountered during his years as a physician and researcher.

Multiple providers failed to recognize either Tommy's delirium or subsequent Alzheimer's disease, which, if identified, could have been treated and potentially improved his quality of life, keeping him in his community much longer.

We believe there is a better way to provide care. As an industry, we can provide higher-quality, more affordable care that produces better outcomes and patient experiences not only in urban and suburban areas but also in rural America. This story has fueled our commitment to implementation science as the most valuable tool to transform healthcare.

How much of what happened to Tommy was a product of how Healthcare 1.0 functions versus how much would have occurred anyway? It may be difficult to assign an exact percentage, but certainly more personalized care that was evidence-based and addressed Tommy's emotional and psychological needs as well as his physical needs may have prevented many of the adverse events he experienced. As we will see in the coming pages, it is possible to create a more comprehensive care system that incorporates compassion and trust while delivering the most effective care possible. But to accomplish such a goal, it is necessary to step back and reevaluate how the need for care has changed.

The Need to Transform Clinical Practice in Healthcare

Many years ago, the healthcare needs of most people were very different from what they are today. When individuals required care from a physician, it was usually for an acute event or condition and required specific and targeted activities to treat and "cure" the individual. Further, the scope of available treatments was modest by comparison: hip replacements were not an option, organ transplant did not exist, clogged arteries could not be easily decalcified. Lower life expectancy meant fewer people developed or lived with chronic diseases. In that context, paying physicians for the specific set of tasks performed to treat an acute condition was sensible and functional.

In the past, it was a legitimate strategy to order a myriad of tests, most of which would turn out to be unnecessary, to quickly assess all the potential causes of a patient's symptoms. It used to make sense that patients should be referred to numerous specialists, to explore all possible explanations for a condition. The individual physicians could then maximize their efforts to provide all the care they could under their purview. Doing so was perfectly reasonable in a system reimbursing professionals on a per-activity basis: each provider did all they could and was paid accordingly. There were no financial incentives for providers to collaborate or coordinate care over multiple settings and time periods. Each encounter was treated individually, and once the encounter ended, so did the direct contact with the provider.

As an example, when patients were discharged from a hospital, it was frequently the last interaction they had with those who had delivered their care unless they required a return visit. These patients were on their own to discover ancillary services and community resources, find answers to questions, schedule follow-up appointments with primary or specialty care professionals, and manage medications. If these responsibilities proved too much to handle, it was considered a failure on the part of the patient, rather than a harm imposed by the healthcare delivery system.

Things have changed, and as a result some of the continued practices of the past appear glaringly outdated. The evolution of healthcare over the last fifty years, including new technologies and treatments, has occurred in parallel with changes in the length and quality of life. These changes have ushered in a greater need for managing multiple chronic conditions, multidisciplinary-based treatment, holistic and preventive care, and long-term medical and social services. As care needs have become exponentially complexer, it has become harder for any one provider to understand and address the full breadth of the patient's biopsychosocial needs. Other changes have come from changes in reimbursement policies brought about by skyrocketing costs.

However, despite this new landscape, care persists as before. It often remains restricted to a sequence of isolated episodes, with care provided without coordination or collaboration between disciplines. Tests and treatments, despite being costlier and more numerous than ever before, continue to be ordered indiscriminately. Patients remain responsible for selecting, securing, and arranging payment for their own care. Consequently, many visit emergency departments and hospitals for minor ailments, while others cannot secure the home-based services they need and must either rely on friends and family or seek assisted living or long-term care too early.

In these last five decades, the persistence of residual practices, such as the fee-for-service system, has become a noticeable and costly deficiency for regulators, consumers, and others. But change is difficult, and there was reluctance to reengineer the system through sweeping changes to how medicine is practiced and how hospitals and physicians are paid.

Nevertheless, several steps have been taken to use advanced technology, social networks, alternative payment strategies, and transparency to empower patients and families to demand evidence-based, person-centered, highly reliable healthcare services that offer great experiences at a lower cost. This is, in essence, the move from Healthcare 1.0 into Healthcare 2.0.

The Establishment of the Transforming Clinical Practice Initiative

The Centers for Medicare & Medicaid Services (known as CMS) launched several large-scale efforts to promote better care, smarter spending, and better health, including the establishment of the Transforming Clinical Practice Initiative in 2015.[1] This initiative was designed to support more than 140,000 clinicians over a four-year period. Its aim was to improve health outcomes; reduce unnecessary hospitalizations, testing, and procedures; and develop strategies to show the value of transforming healthcare practice. The overall objective was to transform the current healthcare reimbursement system from one based on service volume to one based on the value of care provided.[2] Delivery system reform incentivizes healthcare delivery organizations to lead a cultural shift toward lower-cost, higher-value healthcare.[3,4]

In 2019, the payment adjustments to providers through the Medicare Access and CHIP Reauthorization Act of 2015 took effect. Under this act, healthcare payment became based, in part, on quality. The Merit-Based Incentive Payment System (MIPS) and an alternative payment model developed by the Centers for Medicare & Medicaid Services incorporated quality and risk into reimbursement. Any provider who provided billable services to a Medicare beneficiary and was eligible for the Quality Payment Program in 2017 was enrolled in either the Merit-Based Incentive Payment System or the Alternative Payment Model track. These new models were designed to improve healthcare by encouraging health systems to invest in those initiatives that would enhance efficiency and improve health outcomes—specifically telemedicine, care coordination, mental health services, group visits, and community engagement.[5]

The federal government notes that the Transforming Clinical Practice Initiative "aligns with the criteria for innovative models set forth in the Affordable Care Act" and lists the following goals:[6]

- *Promoting broad payment and practice reform in primary care and specialty care*
- *Promoting care coordination between providers of services and suppliers*
- *Establishing community-based health teams to support chronic care management*
- *Promoting improved quality and reduced cost by developing a collaborative of institutions that support practice transformation*

The Transforming Clinical Practice Initiative defines five phases of transformation, listed in table 1, believed necessary for practices and care delivery systems to thrive as value-based businesses.

Table 1. The five phases of transformation according to the Transforming Clinical Practice Initiative

Phase 1	Setting Aims and Developing Basic Capabilities
Phase 2	Reporting and Using Data to Generate Improvements
Phase 3	Achieving Aims of Lower Costs, Better Care, and Better Health
Phase 4	Getting to Benchmark Status
Phase 5	Demonstrated Capability to Generate the Triple Aim (Better Health, Better Experience, Lower Cost)

To carry out and effectively progress through the five phases, practices must adjust how they manage and coordinate population-level health with individual-level care. They need to actively move toward an accountable health community by developing functional teams within their system and within broader, community-based organizations. Such a transformation requires healthcare administration leadership that embraces and encourages collaboration, innovation, and continuous learning. The new healthcare system must have the financial and intellectual capital for not only providing care but connecting, engaging, and coaching providers, patients, and their families through the entire patient and family health journey.

The Great Lakes Practice Transformation Network was one of the organizations formed with federal funding to deliver the Transforming Clinical Practice Initiative model to practices. What follows in this book is a description of how the Great Lakes Practice Transformation Network was developed, how it formed, the concepts and frameworks upon which it is based, and the results it achieved.

2

THE ORIGINS OF THE GREAT LAKES PRACTICE TRANSFORMATION NETWORK

The story of the Great Lakes Practice Transformation Network has its origins in 2011. At that time, in addition to practicing medicine as a geriatrician, Dr. Boustani was a successful clinical investigator in the field of brain health, participating in activities like developing care models for delirium, Alzheimer's disease, and other related dementing illnesses. He became an associate professor of medicine at the Indiana University School of Medicine after mastering the methods of designing research studies with internal and external validity, executing these studies by securing external and internal resources to enroll safely the right subjects and collect high-quality data from them, and analyzing the data to differentiate a real signal from the noise that emanates from random variation.

Even though he was able to consistently publish in peer-reviewed journals and secure federal and private funding to support his research activities, the translational cycle was one of "research to bookshelf." That is, even though Dr. Boustani was discovering important components to improving brain health and publishing the results of his studies, his research findings were not being used as widely or effectively as they could have been. Instead, they sat on the bookshelf in the form of published papers, conference proceedings, and written reports.

This cycle was not enough for Dr. Boustani to convey his desired impact on public health and transform brain health and brain care for millions of individuals. He did not measure his success by the number of grants he was awarded or the number of papers he published. Success for Dr. Boustani meant enhancing the life and health of everyone. Designing healthcare solutions to be scalable and sustainable became his scientific challenge and problem. He knew there was an opportunity to have a significant and lasting impact.

Consider this: in 2007, his research team at Indiana University Center for Aging Research found that exposure to certain prescribed or over-the-counter medications with anticholinergic properties may increase the likelihood of developing Alzheimer's disease and other related dementias. Right now, one in four to one in five older Americans are exposed to such inappropriate medications with adverse cognitive health. Such a high exposure rate has not changed for the past two decades!

Within six years of his arrival at Indiana University School of Medicine, the research team at the Center for Aging Research had successfully developed, evaluated, and implemented an evidence-based collaborative care model for patients and families living with Alzheimer's and other related dementias. The Indiana University team was able to translate their scientific findings from the peer-reviewed articles they published in the *Journal of the American Medical Association* in May 2006 into a clinical program that was open for serving the public in January 2008. They did this in less than twenty-four months.

The evidence-based clinical care program was named the Healthy Aging Brain Center, and it was located at Eskenazi Health, which is an urban- and county-supported integrated healthcare delivery system serving the privileged and underprivileged residents of Marion County in Indianapolis. Eskenazi Health includes an urban hospital, federally qualified health centers, and community mental health centers. The Healthy Aging Brain Center was born out of a need to improve care for patients and family caregivers living with Alzheimer's disease and related dementias. These families experienced fragmented care because of the way the healthcare system was set up: patients were treated during their time in front of a physician, but once they went home, they and their family caregivers were left to navigate their medical, psychological, and social needs with little to no additional support or help.

In May and October of 2006, the results of two pivotal randomized clinical trials were published in the *Journal of the American Medical Association* and the *Annals of Internal Medicine*.[7,8] These two major studies published in prestigious peer-reviewed medical journals demonstrated the effectiveness of the innovative collaborative care models as a new brain care delivery design that improved patient outcomes and reduced the burden on informal, unpaid caregivers. The collaborative care model addressed all aspects of care. They utilized and embedded trained care coordinators in the intersection of primary care, memory care, and community resources to deliver evidence-based care protocols and coach the informal caregivers on problem-solving strategies to manage the cognitive, functional, and psychological disability related to Alzheimer's and other related dementia.

Furthermore, the collaborative care models provided the informal caregivers with self-management tools and community resources to reduce their caregiving-related stress and burden. One of these two clinical trials was designed and executed by the research team at Indiana University. The collaborative care models stressed the role of personalized brain care, periodic assessments and adjustments to brain care plans, and coaching and supporting family and unpaid caregivers. Together with care coordination and navigation within the primary care practices and the community organizations, a properly aligned, collaborative care model was shown to provide the care needed and to avoid costly adverse events and inappropriate hospitalizations.

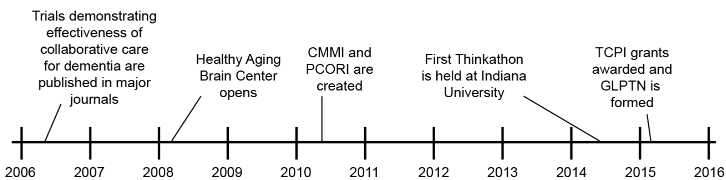


Figure 1. Time line of the GLPTN development

The Healthy Aging Brain Center opened in 2008, and by the fall of 2015, it had become so successful at caring for patients and their families that it was named a flagship program for a new Center for Brain Care Innovation and served as an innovative Alzheimer's disease care model for the nation. The experience of developing, evaluating, and implementing the evidence-based collaborative care models for Alzheimer's disease was very valuable. Such an extensive experience taught Dr. Boustani about the power of using insights from complexity science, network science, and behavioral economics to address inefficiencies in the translation of health discoveries to care delivery. His work is characterized by two processes: agile innovation and agile implementation. These processes rapidly and effectively developed, evaluated, and translated evidence-based collaborative care models into the Healthy Aging Brain Center as a clinical program serving the complex biopsychosocial needs of not only the patients but also the family caregivers living with the devastation of Alzheimer's disease. Since 2008, the Healthy Aging Brain Center has provided evidence-based care for families living within the catchment area of Eskenazi Health. Expanding this care beyond Indianapolis required using the insight and methods from the Healthy Aging Brain Center experience to transform thousands of clinical practices across the nation, including those serving rural communities. Thus, the success with Alzheimer's disease at Eskenazi Health was only the beginning.

In addition to the experience of implementing the Healthy Aging Brain Center at Eskenazi Health, the national Great Recession of the late 2000s and early 2010s affected the availability of federal and private financial capital to conduct clinical research activities. Prior to 2009, the National Institutes of Health, on average, were able to fund research applications that, when scored, were within the top twentieth percentile of all applications submitted. After the Great Recession, the funding line dropped to include only applications within the top tenth percentile. Securing resources for research and innovative projects became more and more difficult, and many senior and junior research faculty in numerous universities across the nation were out of sufficient funds to conduct important research.

However, as part of the Affordable Care Act, the federal government allocated funds for two crucial initiatives. The first initiative was the Center for Medicare & Medicaid Innovation (CMMI), intended to fuel the development and implementation of innovative models of care capable of enhancing the quality of care and improving the health of the population at a lower cost.

The second initiative was the Patient-Centered Outcomes Research Institute (PCORI). This institute was created to fund examinations and investigations into the effectiveness of various treatment approaches. The research administration at Indiana University School of Medicine under the leadership of Drs. Anantha Shekhar and David Wilkes recognized these two initiatives as opportunities to support the research mission of the university's medical school, but these two visionaries also realized that the medical school at Indiana University lacked much of the infrastructure and intellectual capital needed to pursue CMS and PCORI funds.

Because of the previous success in building and implementing the Healthy Aging Brain Center at Eskenazi Health, Drs. Shekhar and Wilkes asked Dr. Boustani to lead the development of a new center: the Indiana University Center for Health Innovation & Implementation Science. The center was chartered with building the necessary intellectual infrastructures to secure federal funds from the newly created CMS Innovation Center and PCORI to effectively and rapidly translate research developed at Indiana University and across the world into real-world healthcare delivery solutions. From the outset, the new center had to focus on the science of designing for sustainability and scalability, the science of implementation, and the science of diffusion.

In other words, the scientific aim of the new center was to transform current healthcare delivery organizations into agile networks equipped with an iterative problem-solving process. Such a process needs to start with a deep understanding of the problem and the current state of the healthcare delivery system. From there, the agile network generates solutions to problems that are evidence-based and testable through formal evaluation. Innovative solutions developed by the agile network must be based on existing knowledge and undergo testing, with frequent checking of assumptions to separate signal from noise. Solutions are localized and implemented in an agile way, with evaluation between sprints to detect the solution's effects. Evaluation requires significant investment in embedded sensors and effective feedback loops to detect and respond to both planned and unplanned changes. The agile network values speed and continual measurement, which permits quickly learning from failures and successes. Learning in an agile network results in identifying the minimum specifications for a solution, to allow for its broader implementation in localized ways, rather than attempting to completely specify a "perfect solution."

From lessons that Dr. Boustani learned from the development of the Healthy Aging Brain Center and through establishing the new Center for Health Innovation & Implementation Science, it was clear that he needed to expand the "Indiana laboratory" of available settings and environments to test and refine the model so that it would be robust enough for wider dissemination. Conducting research solely within the three affiliated healthcare systems of the Indiana University School of Medicine (Eskenazi Health, Indiana University Health, and the Indianapolis Veteran Affairs) was not sufficient. In 2014, the Center for Health Innovation & Implementation Science organized a think tank meeting at Turkey Run State Park in Indiana and named it the Healthcare Thinkathon. During this initial meeting, the center convened close to one hundred experts in healthcare transformation, healthcare delivery, pharmaceutical research, epidemiology, health services research, implementation science, and healthcare payment reform. With this large and diverse group, the Center for Health Innovation & Implementation Science had basically created a coalition of individuals committed to pursuing ideas and methods aimed at achieving the quadruple aim of high-quality, accessible, cost-efficient, and patient-centered care, mainly transforming the healthcare system into an agile network, or Healthcare 2.0.

During a long break designed for networking in this initial Healthcare Thinkathon meeting, Dr. Boustani went for a walk with Randy Hountz through Turkey Run State Park. At Purdue University, Randy had created a center to provide technical assistance in healthcare transformation across the state of Indiana, including rural communities. An engineer with a master's degree in business administration, Randy leveraged the intellectual capital in industrial engineering and business administration of the faculty and students at Purdue to provide important technical support in the form of consultation services.

Over two hours of uninterrupted dialogue, Randy and Dr. Boustani got to know each other's passions and shared stories about their work involving care delivery and the need to integrate their diverse perspectives from engineering and medicine. They realized that there was significant overlap in the interests and work of their two centers, and they agreed that they would seek opportunities to collaborate, preferably on a project with significant scope and impact.

As luck would have it, just seven days later, the Centers for Medicare & Medicaid Services announced the request for proposals to set up networks across the nation as part of the Transforming Clinical Practice Initiative. As soon as Randy and Dr. Boustani saw the announcement, they called each other simultaneously, thus both going to voicemail. They did not know it at the time, but each was attempting to call the other to talk about the opportunity. Later that night, they connected. The Transforming Clinical Practice Initiative seemed like the perfect opportunity for them to work together. Its mission to identify and test innovative solutions for improving care at the practice level appeared to be a natural collection of implementation science and healthcare transformation services. They knew, however, that to succeed, they would need to reach out and recruit other key individuals and create a larger network of those who shared their vision. They envisioned a network that would allow for time and space to build and develop ideas, while holding themselves accountable to always pursuing the end goal of improving care.

Together with Dr. Abel Kho, a mutual colleague and physician scientist with a passion for using health information technology to transform healthcare, they began to develop the first iteration of the blueprint for the Great Lakes Practice Transformation Network. They knew that it was crucial to leverage the entire intellectual capital of the proposed network to produce several iterative versions of the application. Using the agile innovation process, they developed the first prototype of the application in fewer than thirty days. Even though they knew the first version was rife with issues, they sent it out anyway and asked others to return it with feedback within three days. They were overjoyed with the response of the network. Over the next eight weeks, they repeated this process each week: incorporating feedback, developing a new version, and sending it out to the network for feedback. When they arrived at the final application for the development of the Great Lakes Practice Transformation Network, it was difficult to believe that the polished final version had come from that first imperfect prototype application they had developed less than three months earlier.

Approximately eight months later, the tireless efforts of dozens of individuals paid off, and the application was selected as one of twenty-eight awards within the Transforming Clinical

Practice Initiative. With the support from CMS, the blueprint of the Great Lakes Practice Transformation Network became a reality. All who were involved in developing the application were thrilled and committed to bringing the full weight of the network's knowledge and experience to bear to accomplish their goals—namely, to create agile networks capable of conducting iterative problem-solving processes that would meet the triple aim of better health, excellent quality of care at a lower cost, and great patient and provider experiences across the Midwest.

Great Lakes Practice Transformation Network
Reimagine your future. We can help you get there.

Figure 2. The GLPTN logo

To understand the groundbreaking approach of the Great Lakes Practice Transformation Network, it is imperative to understand the concepts upon which the agile network was based, concepts not previously deployed in healthcare systems.

3

THE SCIENCE OF COMPLEX ADAPTIVE NETWORKS

Introduction

When faced with the challenge of building the Great Lakes Practice Transformation Network as a large network of approximately two thousand practices of over thirteen thousand providers, it was clear its success depended on understanding how networks work. This meant gaining a deep appreciation of the structures, dynamics, and evolution of large social organizations. A social organization, especially a large one, is comprised of diverse, semiautonomous humans who engage, collaborate, coordinate, and exchange energy and information to accomplish tasks that cannot be completed by individuals. They interact in a physical and social environment that greatly affects how, and how well, they accomplish these tasks.

Anyone who has worked in a hospital, primary care clinic, ambulatory surgical center, nursing home, or other healthcare delivery organization can attest to this reality: the organization is a unique combination of people working together in a manner that depends upon their environment and external forces. In other words, a drastic change to individuals within the organization, their surroundings, or their interactions will change the organization and its performance. Although these are simple premises, the challenge facing the Great Lakes Practice Transformation Network and similar endeavors is to understand the science behind these interactions to create practical strategies for implementing and diffusing evidence-based innovations.

Years of study and analysis by members of the Great Lakes Practice Transformation Network helped identify the relevant theories from multiple scientific fields that would be most useful and most applicable. The result was a framework for agile networks, a model to guide transforming practices into agile organizations capable of providing excellent and personalized healthcare at scale.

In this chapter, we explore concepts from two scientific fields that shed light on transforming organizations: network science and complexity science. Together, these will paint a picture of how individuals who deliver care interact with each other and their environment. These fields also provide insights into how to create environments that encourage desired behaviors and promote changes that can be sustained over time.

Network Science

The discipline of network science has existed in one form or another for about a century. Initially, psychologists studied networks of individuals to understand social structures and dynamics. They studied, for example, the number and nature of interactions among individuals and how these interactions produced individual and group characteristics and behaviors. Later, probabilistic theories were applied to explain and predict how networks formed, functioned, evolved, and grew. Today, network science is an active pursuit in many fields, including technology, travel, economics, communication, biology, physics, and social sciences.

Various insights from network science directly apply to the healthcare delivery industry because all healthcare delivery organizations are networks of individuals. The collaboration of these individuals with each other and their environment (including the tools and technology used to deliver care) provides a higher and more extensive level of care than any individual could provide on their own. This notion, that the "whole is greater than the sum of its parts," applies to all social networks and reflects basic human tendencies to cooperate.

Consider Tommy's journey through the healthcare system. From the initial encounter with the mobile diagnostic center through his procedures, recovery, and eventual residence in long-term care, the network that cared for him was vast but interconnected and interdependent. The care provided to Tommy was a function of the system as a whole, even though it was made up of individual episodes where he interacted with specific caregivers.

Another social network phenomenon observed in healthcare settings is growth. Networks grow in size or scale, developing fractal (self-similar) structures to optimize the distribution of energy and information exchange. New professions, divisions, service lines, units, and organizations are continually being formed and replicated. Such structures are crucial to the fitness or survivability of the network in its surrounding environment. Knowing the basic principles behind these and other network phenomena can help intentionally direct the formation, and performance, of effective healthcare delivery organizations.

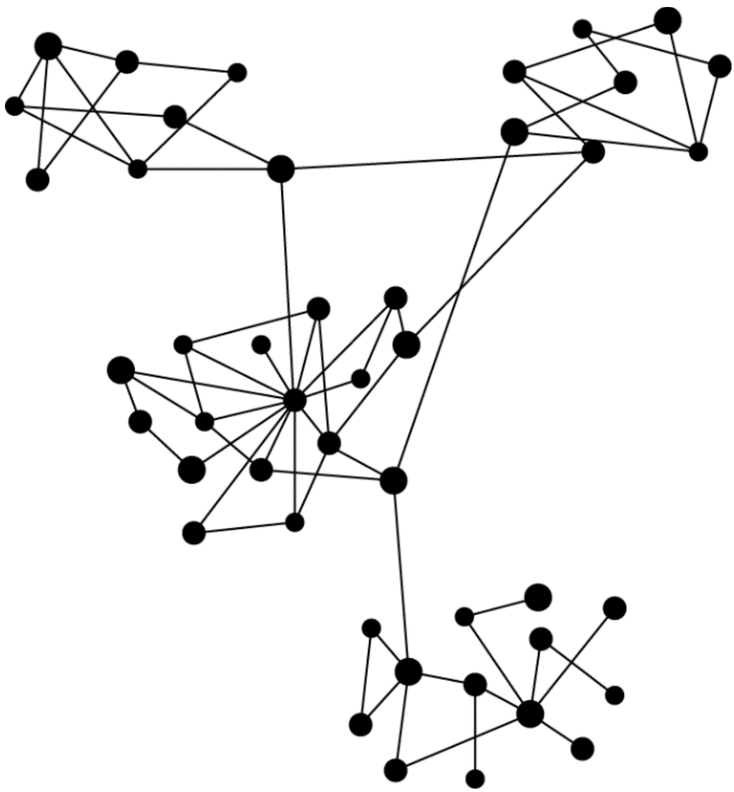


Figure 3. Nodes and links of a network

At a basic level, networks have individual members, or *nodes*, and interactions, or *links*, between those nodes. The number, fitness, and social or physical location of nodes, and the distribution and evolution of links, informs the properties, functions, and behaviors of the network. In a social network, the nodes are individual people, and the links are their social interactions, including information and energy exchanges. In other contexts, nodes and links operate similarly, but look different: in the US air travel network, the nodes are cities or airports and the links are routes; the World

Wide Web's nodes include documents and individual sites, connected by hyperlinks.

Figure 3 is an example of how networks are sometimes represented, with nodes (the dots) and links (the lines) between different nodes. If we can consider this as an example of a network, we can see that not all nodes are directly connected with one another. There are not direct flights between all US airports, not all websites have direct links to each other, and not all individuals in a social network have social interactions with every other member of the network. However, just like it is possible to travel between any two airports by traveling through intermediate airports (i.e., connecting flights), information can be passed between any two individuals via intermediate nodes. In figure 3, it is possible to get from any one node to any other node by going through one or more intermediaries.

How the connections between nodes are structured, intentionally or unintentionally, determines how many steps are needed to connect any two cities on the map or any two individuals in an organization. The number of links, their pattern, and how many or how few steps are needed to connect any two nodes affect the overall network performance, especially in the face of environmental disruptions, be it a change in weather, a virus, or misinformation.

In Tommy's story, there were a variety of individual health-care providers who were connected to one another. Some were connected more closely than others and had frequent interactions. Others were only peripherally connected. When considering the variety and complexity of these relationships, it becomes easy to see how clinical information about best practices and recommended guidelines may more quickly reach certain individuals or be more readily adopted.

To classify and describe networks, scientists have identified several quantifiable aspects that help specify a network's typology and dynamic (table 2).

Table 2. Quantifiable aspects of networks

Quantity	Definition or Explanation
N	The total number of nodes within the network; each network has its own N
Degree (k)	The number of links associated with any one node; each node in the network has a degree, and higher degrees indicate that the node has more links; nodes of the highest degree are called hubs
L	The total number of links across all nodes within the network (the sum of all individual degrees); each network has its own L
Pk	The probability distribution of node degrees across the network; can be used to calculate the probability that a randomly selected node will be of degree k
Clustering coefficient	A measure of a network's density of links; this can be calculated locally (for a subset of a network) or for the network as a whole; larger values represent more densely clustered nodes (i.e., where each member is connected to more of those who are close to them)

The clustering coefficient can be difficult to conceptualize, but it is enough to understand that it is a measure of how interconnected nodes are to their "nearest neighbors." When every single node is connected to all their near neighbors, it represents a network that is *highly ordered* (figure 4). This concept is easier to understand for a physical network like US airports. The distance between nodes of a social network is harder to conceptualize, but *nearness* can reflect a combination of physical space (e.g., having offices on the same floor) and individual characteristics (e.g., similar duties or responsibilities that may increase the likelihood that they would interact, knowing some of the same people, etc.).

At the other end of the clustering spectrum is a network where links are *completely random*, which means that the number of links and to whom each node is linked have no discernable pattern. This obviously impacts how information is transferred, and, when used to model a healthcare delivery system (like a hospital or clinic), is integral to understanding how new information in the form of innovations or process changes will be accepted and adopted. If different hospital departments are only loosely connected, patient information may not be passed as quickly or completely as if there were multiple and regular interactions. As we will see, the clustering pattern of a social network often falls between highly ordered and completely random: there are often clusters of highly interconnected individuals, but one or more of them have links to other individuals throughout the network.

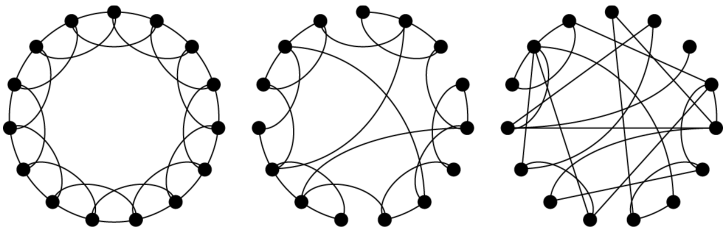


Figure 4. Patterns in networks
The network on the left is highly ordered, since all nodes are directly linked to those close to them and none are linked to those that are not close; moving to the right, the networks get increasingly random in their links. *Adapted from Watts DJ, Strogatz SH. Collective dynamics of "small-world" networks.* Nature*. 1998;393(6684):440-442.*

There are additional terms that are useful to describe aspects of the network as well:

Hubs: high-degree nodes, or those that are the most connected in the network.

Clique: a set or community of local nodes where each node is connected to every other node.

Path: the route by which two nodes are connected; the path length represents the number of links on the path.

Distance: the shortest path length between any two nodes; since each node has a distance to all other nodes, one can calculate the distribution or distances and summary values such as the average distance.

Diameter: the largest distance in the entire network; recall that the distance between any two nodes is the *shortest* path, so that the diameter represents the longest "shortest path" seen in the network.

Bridge: any link that, if cut, disconnects the network.

It should be noted that in many networks, including social networks, the number of nodes and links varies over time as individuals enter and leave the network and as interactions are created and deleted. To illustrate, consider a large hospital where new staff are hired, change departments, take on new roles, or leave to either retire or work elsewhere. These changes to the network result in changes to the quantities described. Understanding how the dynamic nature of the network influences behavior helps to describe how information spreads and informs the extent to which the network can survive changes in membership and interactions.

One of the key attributes of a network is its degree distribution (Pk). The degree distribution describes how many nodes have only one link, how many have two, three, four, and so on. When presented as a figure, the degree is plotted on the horizontal axis and the relative frequency on the vertical axis. In this way, one can quickly see patterns in node degree. For example, there may be many nodes who have a few links and only a handful who have a lot of links. Or perhaps most nodes have a degree that is clustered near the overall average, with very few having either a very low or a very high degree. The shape of the distribution describes much about the network and its members. In the previous example, if most individuals have degrees relatively near the average (K) and there are only a handful who have very high or very low degrees, then the distribution may resemble a normal distribution. Having a normal distribution is a characteristic of random networks, but social networks are not random.

Observations of social networks in the real world illustrate that their degree distribution often follows a power-law distribution.

The Power-Law Distribution

The power-law distribution reflects a situation wherein a lot of people have few connections and fewer and fewer individuals have many connections. More specifically, it says that the percentage of individuals with k connections is inversely proportional to k. Empirically, the relationship is often accurately described through: k^{-2} or k^{-3}. This produces a *scale-free* property, because the functional form of the relationship is the same regardless of the size or scale of the network and is maintained as the network grows. Network growth can occur through increases in either the number of nodes or the number of links, but the growth is not random. When new nodes are added, they do not randomly link to other nodes. Instead, they are more likely to connect to other nodes of high degree, especially hubs. This notion of *preferential attachment*[9] reflects real-life situations where new members are more likely to connect to "well-known" individuals than to others.

New clinical faculty, for example, are more likely to be connected to their department heads, the chief of medicine, or others who are well connected and in a good position to influence the new individual's success. It is no surprise that the network's hubs add connections faster than lesser-known individuals. This process helps to maintain the shape of the distribution as the size and scale of the network grows. The scale-free property is unique to networks with a power-law degree distribution; random networks are devoid of hubs because the random nature of the links prohibits any one node from accumulating a large number of links.

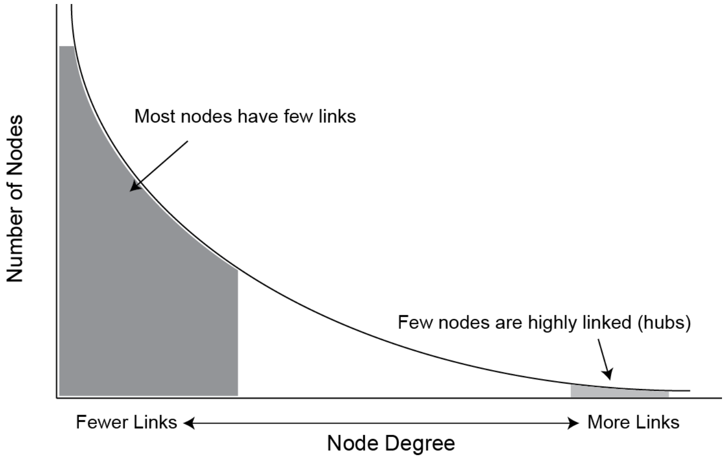


Figure 5. A power-law degree distribution

The paths between members allow any two members who are not directly linked to interact by going through intermediaries (akin to one or more connecting flights in the air traffic example). As described previously, characteristics such as the distance of the path between any two nodes are a function of the network and how it is organized. Shorter paths ensure that information spreads more quickly, while longer paths or more isolated cliques may inhibit dissemination and diffusion of important information.

For example, a nurse interested in brain health may be the only connection between those providing medical care to a patient and another group specializing in mental health who may also care for that patient. Or a technology-inclined informaticist may be the only one to introduce new decision support algorithms to their clinic.

In figure 4, the average distance between any two nodes is at its highest in the highly ordered network (the leftmost image in figure 4) and drops as you move toward more random networks. This is because in the highly ordered network, nodes are *only* directly connected to those close to them, so that connecting two nodes on opposite sides of the network requires many steps. In a more random network, there will typically be one or more links that stretch across the network to allow for a more direct route between any two nodes.

Clustering patterns of a network are important indications of the ability of the network to adopt innovations and adapt to its internal or external environment. For example, in response to changes to health policy or reimbursement, a health system may need to employ new methods to ensure certain patients follow a specific clinical pathway to satisfy the new regulation. The speed at which new processes are adopted throughout the health system will be a function, in part, of how closely individuals are clustered with one another.

In a network with a power-law degree distribution, the scale-free property and the amount of clustering dramatically reduces the average path lengths when compared to a highly ordered network with segregated cliques and a lack of hubs. Using the earlier example, health systems with several hubs and where most staff are either directly connected or only two or three links away may have greater success incorporating the new process more quickly.

Note that the survivability of such a network when change occurs is contingent upon the type of change: in a complex adaptive scale-free network, the network is resilient to random "death" of most nodes or links but is vulnerable to the exodus of hubs because they are highly connected and influential. This will be important when considering how information is diffused through the network in a later chapter.

Having examined healthcare delivery systems as social networks with impactful network properties, such as size, distances between members, and interconnectedness, it is important to introduce complexity science to understand what makes healthcare delivery networks creative and innovative.

Complexity Science

A complex adaptive network is open, dynamic, and evolving and involves numerous interconnected, semiautonomous, competing, and collaborating individuals. These individuals can learn, interact, self-organize, and coevolve with their surrounding environments in nonlinear, dynamic ways. The complex adaptive network is adaptive due to its learning capability and the diversity of its elements.

By receiving and storing lessons from its previous experiences and through modification of the connection patterns among its members, the network improves its survivability in the face of continuous unpredictable stress created by its surrounding environment. The notion that the behavior of the network is a function of the behavior of the individuals is referred to as an *emergent behavior*. We will explore this concept in more detail later on, but essentially, emergent behavior reflects the old adage mentioned previously that "the whole is greater than the sum of its parts."

Healthcare delivery organizations, such as hospitals, primary care clinics, memory care practices, and long-term-care facilities, can be viewed as complex adaptive networks. These social networks are composed of a variety of semiautonomous individuals who are working to provide the best possible care for their patients. These individuals consistently and repeatedly interact with each other in a nonlinear way. Additionally, they are continually faced with external and internal changes, such as patients' medical status, insurance requirements, regulations, new research findings, member turnover, daily workload, and public health policy.

This representation of a healthcare delivery system differs from more traditional models that often portray them as a linear, closed, and machinelike system. These traditional models treat care delivery as having replaceable parts and predictable behaviors that can be changed and reproduced based on past performance data. One of the reasons this view is falling out of favor is that it presumes that stability is the natural state of the healthcare delivery system; that hospitals consist of functions and roles that are carried out by replaceable nurses and physicians; and that financial incentives, regulatory policies, national guidelines, and best-practice initiatives offer recipes for predictable improvements in the performance of healthcare organizations.[10]

Those who have studied these systems, however, understand that the machine or assembly line conceptual model does not fit healthcare systems very well. Rather, healthcare delivery organizations are more accurately conceptualized as a complex adaptive network, with nonlinear interactions that produce unpredictable behavioral patterns and dynamics. Attempts to rigidly control this type of network typically fail and can even worsen the targeted problems and lead to other unintended consequences. Recognizing healthcare systems as complex adaptive networks provides an explanation for the limited impact of external evidence-based interventions that apply regulatory, or one-size-fits-all, strategies.[11]

Those with firsthand experience in healthcare delivery networks have a deep appreciation for their complexity. The properties of networks offer insights into how to model the behavior and decisions of individuals within the network (providers, patients, administrators) as well as the development and evolution of the network as a whole. We know, for example, that effectively caring for patients involves multiple individuals performing separate duties while simultaneously relying on each other's behaviors, all shaped by the surrounding physical and social environment.[12]

If we briefly return to Tommy's story, recall that the prognosis and course of action suggested by the mobile ultrasound facility was in conflict with recommendations of the latest clinical guidelines. This illustrates that delivering the best care to patients is not solely a function of updating guidelines of care; also at play is the extent to which new information is diffused, the experiences of those providing care, and the interactions they have with others who may or may not know about such changes in suggested practice.

Those providing care are influenced by the unique culture, organizational structure, social networks, physical environment, and other attributes of the specific healthcare delivery network within which they operate. Therefore, there is rarely a linear relationship between any one action and the resulting effects. Attempts to change behavior or decision-making face a variety of forces and influences rooted in the complexities and interconnectedness of the nodes within the network. A change in one aspect has ramifications across the network through the many complex connections of the individuals.

A model of a healthcare delivery network rooted in complexity science acknowledges the following:

Individual interactions: A provider or staff member of a healthcare delivery network is a node that will interact (link) with a variety of other nodes during any single day at work. They may meet with patients; confer with colleagues or referring providers; or consult with nurses, lab technicians, or any number of others within the healthcare delivery network or other nodes of other networks, such as community-based organizations (area agencies on aging, churches, local fitness centers, or workplaces) in the same county or state. These interactions are informed by not only the situation but by the physical or social environment, the organizational and social structure, and the individual with their unique experiences and knowledge.

Physical and social environment: Within a healthcare delivery network, there can be a variety of physical or social spaces that can evoke various interaction types. Interactions occur for different reasons and may occur in a patient's room, emergency department, operating room, cafeteria, hallway, or staff member's office, to name a few. Different physical and social spaces can promote or impede certain types of discussions or interactions. They may influence which network members choose. Decisions made in a boardroom or on the golf course are likely to differ from those made at the patient's bedside; in-person conversations may not resemble those mediated by the electronic health records system.[13]

Cultural dynamics: Every social network, including professional ones, have cultural dynamics influencing the timing, frequency, and types of interactions between members. Such aspects as seniority, years of experience, level of education, and role within the system will affect how individuals meet and interact. The chain of command or power differentials between professions (e.g., medicine and nursing) can affect which innovations are disseminated, to whom, and how quickly. For example, delirium or acute brain failure is poorly recognized in the hospitals.[14,15] Improving delirium recognition is much more likely via nurse-based interventions than via physician-based interventions. This is in part due to the fact that nurses spend much more time with the patient per day than do physicians,[16] but also because mental or brain status assessments fall under the purview of nurses, and therefore interventions that are led by a nurse champion have a much higher likelihood of success.

Budgets, regulations, and guidelines: All members of the healthcare delivery network are subject to internal and external forces or constraints that are out of their control. These forces can impose structure on the nature and content of the social interactions within the healthcare delivery network. Those exploring treatment options are likely to do so considering current practice guidelines; interactions regarding potential interventions, facility improvements, or overall network well-being often depend on budgets or economic constraints. Conversely, ignoring or not applying regulations, guidelines, evidence-based recommendations, or other constraints can alter performance.

Knowledge and understanding of diseases and treatments: Individual members (the nodes within the complex adaptive healthcare delivery network) are unique in their experiences of patient care and the depth of their knowledge and understanding of different conditions and courses of action (the fitness of each node). Even with guidelines and regulations, there is room for interpretation and often multiple alternatives to consider. This variability from member to member will color the interactions, behavior, and decisions that occur in the course of diagnosing, treating, and caring for patients. Additionally, the information available and used by patients and clinicians is consequential for performance, separate from knowledge.

The *adaptive* nature of a complex adaptive network is key to understanding the healthcare delivery network. The ability of the network to adapt to both internal and external forces depends on the individuals within the network. When change is introduced, individuals' behavior and decisions will be influenced by the complex combination of their interactions, the physical and social environment, cultural dynamics, and internal and external forces, as well as their unique experiences, clinical knowledge, and opinions. We will see later how leveraging inherent human biases and leveraging the physical and social architectures to nudge behaviors and decisions can be effective to more successfully bring about and sustain change.

Merging Insights from Network and Complexity Science into a Deeper Understanding of Complex Adaptive Healthcare Delivery Networks

Clearly, complex adaptive networks encompass a very specific paradigm within network and complexity sciences. While they boast some attractive attributes for a model of healthcare delivery organizations, it is necessary to consider how to integrate insight from both disciplines to fully describe how information and new behavior are diffused throughout the network and how planned changes are successfully implemented and sustained over time.

As it turns out, complex adaptive networks exhibit many of the key aspects of scale-free networks described previously. The degree distribution of a complex adaptive network follows that of a power-law distribution, including the existence of high-degree hubs. In several articles on complex adaptive networks, engineer and scientist Philip Lambert identifies and explains three main characteristics that all complex adaptive networks share: emergence, the order-chaos dynamic, and self-organization.[17–19]

1. **Emergence:** This is when the individual components or nodes come together to produce new or unpredictable characteristics or behaviors. One cannot predict behavior of the network by studying the individual components, which echoes the sentiment stated previously that "the whole is greater than the sum of its parts." This can occur on several levels, and it is also the case that the emergent behavior at the network level can affect the individual agents or nodes (called *downward causation*).

2. **Order-Chaos Dynamic:** In a complex adaptive network, there is a natural *push-pull* between pairs of extremes or opposing forces. The ability to adapt and even innovate requires a balance in the dynamics of the network, including the flow of information, diversity, the number and richness of interconnections, control, and the power differential across members. Incidentally, this dynamic is integral to creativity, in Lambert's opinion. He claims that highly creative individuals often blend or combine two potentially opposing extremes: knowledge-naïveté, psychological health–psychiatric disorders, mindfulness–mind wandering, introvert-extrovert, convergent-divergent thinking, and the like.

3. **Self-Organization:** In addition to having a scale-free degree distribution, the structure of a complex adaptive network is self-organized with no real centralized control. Despite what the title of certain positions within the network, such as the chief executive officer, may convey regarding the presence of centralized control, there is no one person or team of people who control the network fully. This self-organizing structure of the network has many hubs, high local clustering, and short global path lengths. It is neither highly ordered nor completely random but is instead somewhere in between.

The preceding characteristics reflect familiar attributes of most healthcare delivery networks and reveal important implications for how these networks function and evolve. Emergence is really the phenomenon where new outcomes unattainable by individuals are made possible through the network as a whole. The autonomous nature of individual members helps shape and develop rules that produce network-level behaviors and properties. As Lambert asserts, creativity and innovation are natural and expected results of these types of networks that exhibit both emergence and the order-chaos dynamic.

The fact that individuals within a complex adaptive network self-organize to produce high local clustering has important implications for how information spreads. As Lambert states, "While we might have a relatively small group of highly interconnected friends and acquaintances in our geographic area, we only need to know someone who knows someone in another geographic area to result in a relatively short path-length to anyone else in the world."[17] Applying that statement to a hospital or clinic instead of the world, it is clear that seeing the healthcare delivery system through the lens of a complex adaptive network allows for a unique understanding of how information is spread and adopted by those working and caring for patients.

In summary, complex adaptive networks offer a compelling model to understand healthcare delivery because they acknowledge the dynamic nature of the network as well as the crucial role played by individual members. Both complexity science and network science provide a framework for understanding how different types of social networks function and behave. Healthcare delivery systems can be modeled as a particular type of network, which displays three key characteristics that foster the necessary environment to encourage adaptation through the learning and growth of the individuals and inform the way information and innovation are diffused throughout the network. Complex adaptive networks can be understood through concepts of network science and complexity science, and this understanding of complex adaptive networks enables us to more accurately model the behavior of individuals within the network, as well as behaviors of the network as a whole. Armed with this understanding, it is possible to explore a new theory of information or innovation diffusion. First, however, it is necessary to acknowledge that any social network is a *human* network. Therefore, we need to explore how this human element comes into play in how the network behaves.

4

BEHAVIORAL ECONOMICS CONCEPTS

Network science and the properties of complex adaptive networks offer tools to explain the functioning of emergent, self-organizing healthcare delivery systems of various sizes and shapes, from a small, independent primary care clinic in rural Indiana to a multistate integrated healthcare delivery network across the Midwest. However, to more fully explain the behaviors of human members of complex adaptive networks, we turn to a set of behavioral and psychological theories that have come to be called behavioral economics. Behavioral economics shares with the network and complexity sciences the basic premise that human behavior is adaptive but greatly shaped by the social and physical environment.

Cognitive Biases and Heuristics

Scientists studying human behavior find that human adaptability to their environments and the processes they use to adapt, such as planning and decision-making, are remarkable but do not resemble what would be expected from the mathematic equations of traditional economic theory. Herbert Simon described human decision-making as "boundedly rational," meaning it is as rational as can be expected given people's cognitive and resource limitations of attention, time, and memory.[20]

Researchers Amos Tversky and Daniel Kahneman further explained that under conditions of limited resources, people rely on a mode of cognition that is fast, automated, and intuitive, making it well suited to rapidly reacting to the environment. Kahneman popularized the term *System 1* to refer to this fast form of cognition, contrasting it with *System 2*, a slow, deliberate, and resource-intensive mode of thinking that might resemble a computer's serial processing of a problem.[21,22] Tversky and Kahneman showed the many ways System 1 cognition is adaptive, and others, such as decision scientist Gary Klein, demonstrated that using System 1 to make rapid decisions from limited and uncertain data is what differentiates experts from novices.[23] Klein showed how firefighters, soldiers, intensive care nurses, and others leverage the speed and reflexivity of System 1 cognition to succeed in time-sensitive situations. However, people also appear to use System 1 in nonemergency situations because it requires less mental effort and is triggered automatically by environmental stimuli. Ironically, most people underestimate how much they use System 1 thinking and assume their decisions are usually deliberate appraisals of complete data.

Because System 1 is optimized to act quickly and without full information, it relies on shortcuts or rules of thumb, called *heuristics*. Heuristics often produce the correct decision or behavior, but because they are applied without deliberation, they are difficult to control and can lead to biases. Therefore, people appear to unknowingly apply them, even when doing so results in a suboptimal decision at the time. Scientists have described these heuristics and resulting biases, including the following:

Anchoring: This heuristic involves our tendency to use available information as a starting point when trying to understand or estimate something we have very little knowledge about. The famous experiment by Tversky and Kahneman in the early 1970s is still one of the best examples. At the United Nations, they asked individuals to spin a wheel that had the numbers one through one hundred on it, but the wheel was modified so that it would only stop at one of two numbers: ten (a low anchor) and sixty-five (a high anchor). Once the wheel stopped, participants were asked to answer two questions. The first was, "Is the percentage of African nations among UN members larger or smaller than the number on the wheel?" and the second was to guess the actual percentage. The average answers were noticeably different based on which anchor the participants received. The average guess of those who got the low anchor was 25 percent; their counterparts who received the high anchor guessed, on average, 45 percent. The reason is that our System 1 thinking makes an immediate judgment based on the information available, *no matter how relevant or strong that evidence is*. This bias is so powerful, in fact, that even when people are aware that they are being anchored, they are still influenced by the anchor to some extent.

Availability: The availability heuristic can occur when individuals are tasked with estimating or assessing the likelihood of certain outcomes. The more readily someone can call to mind the outcome or scenario in question (i.e., how *available* it is), the more likely they will consider its occurrence. Its availability may be due to the recency or familiarity of a similar scenario: if your city just endured a tornado in the last few weeks, you may overestimate the likelihood that a current storm will develop into a tornado. Or those who just watched or listened to news of a public shooting may worry more when they are in a crowded public space.

Representativeness: Similar to availability, the representativeness heuristic involves quick comparisons made by System 1 thinking. In this case, individuals assess whatever they are currently considering or judging by comparing it to some mental model. This can occur when someone decides whether they feel safe walking down a dark alley—how does it compare to one they would consider "safe" or "dangerous"? Or if you have ever been surprised when someone tells you what they do, it could be due to the fact that they didn't fit the mental model you have of someone in that profession. In the medical world, the representativeness bias may manifest when a provider sees certain symptoms and assesses the likelihood of certain diagnoses because they are comparing symptoms to their mental model of individuals with those diseases.

Gains and Losses: It may be no surprise that people hate losing something more than they like gaining it. This is why companies offer free trials or money-back guarantees. Once you have it, you assign more value to it than before it was in your possession. The research shows, in fact, that the ratio of how much individuals dislike losing something to how much they enjoy gaining it is around 2:1—that is, most of us would need to be paid twice as much money to give something up as we would be willing to pay to get it in the first place. If you have ever talked yourself into buying something because you knew you could return it, only to discover after thirty days that it is worth more to you than the money you would get back, you may have experienced this bias.

Status Quo: The status quo heuristic suggests that individuals have a general tendency to stick with the current arrangement or situation. Therefore, at lunch every day in the hospital cafeteria, we are likely to sit at the same table, even if other seats are available. Anyone who has changed cell phone providers, switched banks, or been forced to select a new dentist understands the difficulty involved in making those changes, *even when they know that it will be a better situation.* The major television networks are fully aware of this bias, which is why they want so badly to have a highly rated show right before the ten o'clock news: viewers are more likely to stay on that channel when the news comes on than to change it.

Framing: The notion of framing is that individuals are susceptible to how information is presented, even when the different presentations offer exactly the same information. For example, patients who are told that a procedure has a 90 percent survival rate are more likely to opt for it than if they were told it had a 10 percent mortality rate, even though the two are equivalent. Marketers and politicians understand this bias and go to great lengths to develop language that will leverage it. In the grocery store, beef is labeled as 95 percent lean instead of 5 percent fat; voters will often find themselves deciding whether to accept a levy as opposed to a tax; and so on. The idea of framing may seem silly, but remember that System 1 thinking uses very little effort, so it doesn't do the work to figure out what an equivalent statement would be if framed differently.

Priming: Just as with anchoring and framing, the priming heuristic is triggered by how information is presented to the System 1 process. Specifically, it says that simply being asked about an activity or behavior can increase its probability. For example, asking someone whether they plan to get a flu shot increases the likelihood that they actually will—it makes it top of mind and *primes* their brain for its occurrence. The physical environment can also serve as a primer: seeing the elevators before we notice the stairs may influence how we get to the second floor; posters mentioning the importance of a healthy workplace may make it more likely that we'll remember to wash our hands before lunch.

These are just a few examples. There are over 180 biases that have been identified by researchers.

Often, multiple heuristics occur together, further biasing individuals experiencing them. In Tommy's story, the experience of his friend's stroke primed him for the seriousness he assigned to such an event, and its availability in his mind may have influenced his perception of his own fate if he did not act immediately. When coupled with the fact that those first diagnosing him were authority figures, the effects of these heuristics were stronger than the pleas of his family to pursue alternative courses of care.

Heuristics have been well studied because they are a fascinating example of how the human cognitive system sometimes acts in surprising ways. These heuristics are not inherently bad; often, they permit individuals to function quite well and make fast everyday decisions without lengthy deliberation. It would be inefficient if humans deliberated on every decision every time, stopping for two minutes to decide how to operate every door, spending an hour weighing hundreds of lunch alternatives, or pausing an audiobook after every sentence. In other words, as humans, we use System 1 to our advantage, but we also use it even when it produces suboptimal results: when a door with a pull handle had to be pushed instead, we forget that our favorite lunch place is closed on Mondays, or we confuse two characters in a book. It is necessary to understand that at times we rely on System 1 more than we should or do not invest the resources needed to use System 2.

Ideally, one might hope that System 2 thinking would dominate in a healthcare delivery network when members face a variety of stimuli and situations that require them to make a decision or select a behavior. Unfortunately, effective System 2 processing requires time and information, two things that are often scarce for care providers in a typical hospital or ambulatory practice. And, as noted, System 1 thinking occurs involuntarily so that someone will almost always have an initial reaction to a situation that is subject and vulnerable to several biases that can be difficult to overcome.

To encourage certain decisions or behaviors, one could try to nurture and promote System 2 thinking. This would require increasing the amount of information and time available to deliberate, which may not be feasible in healthcare delivery. Alternatively, it is possible to adjust the characteristics of the complex adaptive network (interactions, physical environments, social structures) to influence the members of the network by leveraging the known human biases to ensure System 1 thinking leads to the desired actions.

Nudges and Choice Architectures

To influence System 1 thinking, intentional adjustments to the network are referred to as *nudges* and *choice architectures*. A nudge is an individual aspect of a process or the physical or social environment. Offering a free trial is a nudge; so is placing more expensive foods at eye level on grocery store shelves to encourage individuals to buy them. Designing nudges is a process by which we identify the associated heuristic and create a scenario that will attempt to leverage that bias to encourage certain behavior.

For example, knowing the power of priming (i.e., we are impacted subconsciously by environmental cues), one can alter the physical environment to encourage more frequent interactions between staff from different departments. To leverage the availability heuristic, one can remind staff of recent examples of the occurrence of certain adverse events to help them stay vigilant about their prevention. Because loss aversion is stronger than gain seeking, one can structure incentives such that members' success is dependent on avoiding loss as opposed to gaining rewards and then framing them in such a way to heighten the desire to avoid the loss, and so on. However, in addition to *how* to leverage these biases through nudges, it is important to also examine *when* to do so.

Previous studies have shown that nudges are most successful in situations where feedback is not immediate. The impact of failing to thoroughly discuss discharge instructions for a patient may not be realized by the provider for weeks or months, if ever; those ordering a myriad of tests (including those that are potentially unnecessary) may not experience firsthand the financial implications of that choice because that is not their role. Nudges in these situations can be effective in reminding those providing care of best practices and in reducing waste. Nudges are also effective when we have limited knowledge or experience with the action or decision (or their consequences).

A choice architecture is an entire system of nudges intended to promote a series of decisions and behaviors. It addresses aspects like what to use as the default choice (e.g., individuals are more likely to be organ donors if that is the default and they are required to opt out, as opposed to opting in), and how to leverage previously accepted norms (using the color green to mean safe or positive and red for stop or caution). Designing an effective choice architecture is no small feat. Nudges cannot be mandates, or they fail to serve their purpose. When encountering a nudge or a series of nudges, an individual must be free to avoid them (and their ability to recognize them as mechanisms trying to direct their behavior may influence their choice). Therefore, they need to be incorporated seamlessly so that they work on the reactive cognitive process (System 1) without raising suspicion about their true purpose.

When coupled with the information about social networks and interactions provided by network science, the insights regarding the human element provided by behavioral economics allows for the development of full models of healthcare delivery systems and an understanding of how information and innovations are spread and adopted. This, in turn, will facilitate the selection of the most effective strategies to implement change and ensure it will be sustained for the maximum effect.

5

THE THREE AGILE PROCESSES: AGILE INNOVATION, AGILE IMPLEMENTATION, AND AGILE DIFFUSION

A healthcare leader applying the concepts presented thus far understands that the capability of the healthcare delivery organization to adapt to an ever-changing environment depends on the skills and adaptability of its individual employees, their relationships and social interactions, and the organizational communication patterns within its environment. A leader must build a culture based on listening, enhancing relationships, and allowing creative ideas to emerge by creating small, nonthreatening changes that attract people. While the complex adaptive network framework helps contextualize a healthcare organization, it does not provide an explicit method to design, implement, and diffuse a healthcare innovation. To address this, over the past decade and with support from the National Institutes of Health and the Centers for Medicare & Medicaid Services, implementation scientists at Indiana University have developed the three processes of agile innovation, agile implementation, and agile diffusion.

These three processes are practical methods for introducing acceptable, locally customized, and effective change in a healthcare delivery system. Based in complexity and network sciences and behavioral economics, these processes promote flexibility, learning, reflection, and adaptation to develop and implement evidence-based innovations suited to the local environment. The three processes share a common set of principles:

1. View the healthcare delivery network through the lenses of complexity science, network science, and behavioral economics.

2. Invest in feedback loops that capture data from sensors embedded within the internal and external environment. These should provide timely, nonjudgmental, and actionable feedback by capturing the emergent behaviors within the network, including such informal feedback as gossip, rumors, and hallway conversations.

3. Foster the "good enough" degree of information flow across the network, including its hubs and its local communities.

4. Create a psychologically safe climate, allowing network members to feel comfortable giving and receiving feedback and direction.

5. Develop minimally viable prototypes and quickly test their performance in real systems through rapid experimentation and revision based on information gathered by the feedback loops.

6. Invest in creating time and space for network members to exchange information, to better adapt and learn.

7. Aim for "good enough," or the minimum specifications needed to succeed; further specifications will be added locally.

Agile Innovation

It might be said that creativity is necessary for innovation. Philip Lambert believes that creativity is a natural and expected result in a complex adaptive network. The existence of the order-chaos dynamic within the system is well crafted to produce creative and innovative discoveries. Lambert also believes that creativity is teachable[24] and points out that there are various definitions of creativity that appear in published literature; likewise for innovation. Before exploring a method for cultivating and encouraging innovation, it is necessary to specifically define what we mean. While *innovation* is a noun that can be defined as "the action or process of innovating," the active verb tense (*innovating*) can be defined as follows:

> To make changes in something established, especially by introducing new methods, ideas, or products.

Those who developed the agile processes believe innovation is a process of matching existing solutions to unsolved problems, rather than one of pure invention. The concept of adjacent innovation holds that many innovations are not brand-new but rather are old strategies applied to a different problem. Identifying novel matches and new ways to use old solutions is promoted by diversity. People who think differently, have different experiences, and interact with different members of the social network will bring more creativity to solving problems. Paradoxically, innovation thrives in limited-resource environments, where the need for innovation is more urgent and resources must be used creatively. The skills for innovation are *acquired* skills. Any individual can practice and develop mastery of innovation skills, such as questioning, observing, experimenting, networking, and associating.[25]

The eight-step agile innovation process has two stages—planning and execution—with four steps in each.

THE EIGHT STEPS OF AGILE INNOVATION

Planning

Step 1: Confirm Demand: The first step in this process is to verify support for solving the correct problem. This requires that a problem can be defined and that the value of solving the problem is known or can be discovered. During this step, the goal is not to create demand but simply to verify that demand exists and to confirm the value of meeting it. There are typically three types of problems: execution, efficiency, and discovery. Problems with execution are the most common and reflect instances when the right decisions and actions are known but are simply not being executed. Efficiency problems are when execution is present but uses more time or other resources than is necessary. Problems of discovery are ones that require new ideas or paradigms, because there is no known way forward.

Step 2: Study the Problem: Once demand is confirmed, it is necessary to investigate the current state of the process to identify what the core needs are. This often involves a quick study of the individuals and the system in which they operate, to understand how the complex system functions and adapts to internal and external forces. Additionally, it is important to focus on the most critical issues to avoid trying to solve all the issues simultaneously. As implied by the word *study*, this step involves data gathering and analysis and, when possible, relying on prior studies that have been done.

Step 3: Scan for Solutions: After developing a deep and thorough understanding of the problem and the system surrounding it, the next step is to scout and analyze existing solutions. Most innovation sprouts from leveraging previous ideas and concepts that are combined in a new way. There may be many sources for finding solutions, including potential competitors who may have already addressed the same problem, a similar problem, or some aspect of it. Innovators also look to their organization for clues about adaptations people have invented informally to solve local problems. Found solutions are gathered in accessible places for continual reference to avoid what is colloquially called *reinventing the wheel*.

Step 4: Plan Evaluation and Termination: The final step before beginning execution is to determine how the innovation will be evaluated and (if necessary) terminated. This step is intended to understand the criteria for when to continue with a solution versus when to stop, reflect, and regroup. During this planning step, it is necessary to determine how to evaluate the *outcome*, not the intervention or process. Establish specific circumstances and timelines for how and when to decide whether to proceed (and nurture the innovation) or to stop (and explore what went wrong). Plan to be efficient: fail fast, fail early, and fail cheaply to allow you to be as agile as possible to explore other avenues.

Execution

Step 5: Ideate and Select: The first step of execution involves collecting ideas and selecting the top candidates. This step should encourage divergent thinking and should seek to solicit ideas through forums, crowdsourcing, and brainstorming. Establish and apply clear criteria for how to select top candidates, and then converge on these candidates and expand on them to more fully develop them into pursuable ideas.

Step 6: Perform Innovation Sprints: Ideas become prototypes when they are ready to be tested. Prototype testing occurs in sprints: quick, iterative tests that provide feedback for revising the prototype in advance of the next sprint. Progress in this step typically moves from low to high fidelity and often requires the development of a minimally viable product that is testable but not complete. During this iterative process, feedback loops help eliminate weaknesses and build on strengths.

Step 7: Validate Solutions: After completion of the sprints, the remaining innovation(s) need to be more rigorously tested. Specific evaluation criteria are established to test whether the solution is, for example, effective, usable, and desirable. During validation, it is necessary to monitor for and address unintended consequences or unexpected benefits.

Step 8: Package for Launch: The final step is to create the "handoff package," which includes a business plan, a minimally viable product, and clear specifications for use. The package can undergo additional validation if needed or be customized for local deployment and implemented.

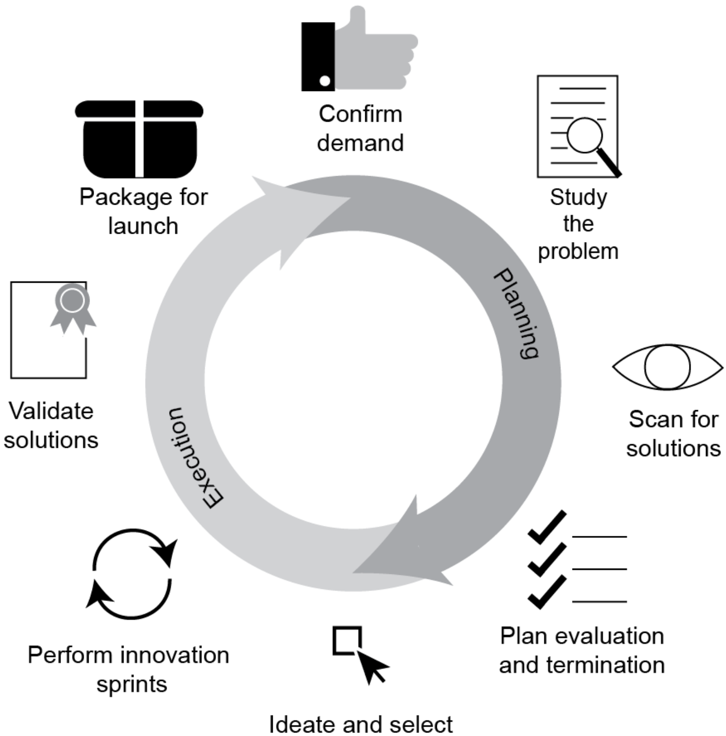


Figure 6. Agile innovation process

Innovation development is typically most useful in one of two cases. In the first, no evidence-based solution exists and a new one must be developed. This implies that prior solutions have not been appropriately tested or that no current solution will fit the needs of the organization. The second case is when innovation is needed to optimize a known solution—for example, improving the execution or efficiency of an evidence-based strategy, or creating an innovative implementation plan for the local deployment of a general solution. When, on the other hand, there is an available evidence-based solution, one can forgo agile innovation and instead move directly to agile implementation to address the issue.

Agile Implementation

Over the course of numerous projects and interventions, agile implementation developers identified key aspects in the implementation process that affected the success and sustainability of improvement efforts across the spectrum of care, including evidence-based solutions. When combined with the gained understanding of the theories and frameworks of behavioral economics, complexity science, and network science, these observations were molded into specific steps and activities that maximize the likelihood of achieving real and sustainable change in healthcare delivery. Specifically, it was determined that a successful implementation is one that is able to address

1. variation over the time needed to implement the solution and across the hierarchy of the organization,
2. interactions between individuals and with the physical and technological aspects of providing care, and
3. the functional systems of the organization to adapt to the broader sociocultural, legal-political, and regulatory environments.

The result of hundreds, if not thousands, of hours of thought and effort across dozens of individuals is the eight-step process of agile implementation.[26-30] Each step is informed by the theories and frameworks discussed already in this book, and each step acknowledges the uniqueness of each healthcare delivery system and the variability that exists throughout the system and among the individual members. The steps are designed to leverage natural biases to encourage individuals to make decisions and act in ways that promote the success and sustainability of the selected evidence-based solution.

To fully realize the benefits provided by this eight-step process, they should be facilitated by a trained agile implementation agent. This agent can be internal or external to the organization but must know how to identify an appropriate evidence-based solution and command a level of respect and authority to facilitate changes at multiple levels within the organization. An agent may receive formal training in aspects of the model, such as in the foundational theories and frameworks, and in more day-to-day techniques, such as conflict resolution and emotional and social intelligence.

THE EIGHT STEPS OF AGILE IMPLEMENTATION

Step 1: Identify Opportunities: The first step of the process is to identify and confirm the presence of an opportunity. While often overlooked, establishing sufficient demand within the organization is essential to ensuring that sufficient time, staff, and resources will be allocated to the implementation and refinement of the solution. To identify opportunities, the agent proactively works with leadership and clinical providers to understand the needs and goals of the organization. Sufficient demand is demonstrated when executive leadership and frontline clinical providers agree to allow or provide for the resources necessary to pursue the opportunity.

Step 2: Identify Evidence-Based Healthcare Services: After identifying an opportunity and establishing demand within the organization, the next step is to identify the appropriate evidence-based solution. These services must address the selected opportunity and promote the quadruple aim (high-quality, accessible, cost-efficient, and patient-centered care) for the patient, family, and providers. Unlike other implementation methods, the agile implementation model requires that evidence-based solutions that have been clinically tested in statistically rigorous studies are used. The most common sources for identifying these solutions are published literature and practice guidelines or recommendations by industry specialists or policy makers. Announcing the intention to improve the entire organization is a powerful use of the priming heuristic, and if coupled with language that anchors the targeted improvement at a high level, it can produce unity toward a common goal. If no evidence-based service exists, one should consider using agile innovation to create it.

Step 3: Develop Evaluation and Termination Plans: Prior to beginning the implementation, it is necessary to develop detailed plans for how the intervention will be tracked and evaluated in the local setting. This includes plans for determining when a solution should be terminated, by whom, and based on what criteria. These plans require that the agent fully understands the implications of the proposed solution on every level of the organization and system, as well as the potential for external ramifications. Therefore, the agent needs to have a solid grasp of both the solution and the organization (or needs to confer with someone who does) to conceptualize how system members will react and incorporate the solution within the current social system and organizational hierarchy. This process also involves identifying reliable and valid measures that are feasible and allow for timely feedback to frontline providers on both the success of the solution for the intended target and also on unintended and unexpected consequences or benefits. Some measure of the financial impact is also necessary, since the fiscal implications of the solution will determine its long-term sustainability.

Step 4: Assemble a Team to Develop a Minimally Viable Service: Together with the agent, a selected group of key system members meets in this step to convert the solution to the local setting. This conversion eases the implementation by localizing the content to align with current staffing, organizational structure, and social and cultural aspects of the organization or facility. However, this process must identify and preserve the essential features and attributes of the evidence-based solution to maintain the fidelity of the solution and ensure that the key drivers of change can still be applied to the opportunity. This process will likely be iterative, and the minimally viable service established in this step is likely to be refined in subsequent steps.

Step 5: Perform Implementation Sprints: At this point, the implementation truly begins, as the localized minimally viable service is incorporated into the care delivery system. This is also when the evaluation of the solution's performance begins and individual aspects of the solution that need adjustment or alteration can be identified. The agent and other key members facilitate "sprint" cycles, which are short, intense periods where the solution is tested and feedback is gathered from staff regarding potential improvements or modifications. These alterations may be to improve the efficacy of the solution, to more completely localize the solution to the setting and situation, or both. These sprints continue iteratively until all involved agree that no further improvements can be made to the solution. The success of these sprints relies on the full participation of staff, who must feel comfortable sharing their experiences and offering constructive (but potentially critical) feedback regarding the process. Here is where the agent's skills in facilitation and conflict resolution are often called upon to promote the necessary openness and dialogue and also ensure that activities remain in line with the parameters of budget and timeline that have been previously established. This is also where nudges and a choice architecture can be effectively utilized. To encourage compliance with a new protocol, reminders in the physical environment in the form of posters or electronic notifications use the priming and availability biases; regularly discussing situations applicable to the new protocol will leverage the availability bias by keeping it top of mind. If incentivizing staff, a reward system is less effective than a loss-avoidance system, especially when it is framed in terms of those potential losses.

Step 6: Monitor Implementation Performance: In this step, the agent and implementation team develop feedback loops to monitor the fidelity and performance of the localized evidence-based solutions. These results are communicated to the entire team, and lessons learned can be discussed and applied to improve the implementation process. This step, too, leverages biases of availability and representativeness to accomplish the goal of maximizing performance. Often, these lessons have less to do with the solution itself and more to do with the dynamics and social structure of the healthcare delivery system. This step is critical for defusing any tension and maintaining communication and teamwork throughout the remainder of the agile implementation process.

Step 7: Monitor Whole System Performance: Also necessary is feedback regarding the impact of the implemented service on the overall quality and financial performance of the entire organization. As described by complexity science, all areas of the healthcare delivery system are interconnected, so that any change in one area will affect the entire system. This process not only detects unintended or adverse consequences of the implementation; it also identifies emergent opportunities or additional benefits not previously recognized. A key in this step is to recognize the potential status quo bias: it may be necessary to deviate from the norm and create time and space outside of the normal routine to foster and encourage new ideas.

Step 8: Develop a Minimally Standardized Operating Procedure: Assuming that the implementation successfully met internal demands, solved the targeted problem, and proved to be financially viable, then it is necessary to document the details of the finalized solution in a minimally standardized operating procedure manual. This manual contains the key aspects of the solution and provides guidance for how to scale the solution or apply it to other settings. During subsequent application, this manual will likely be updated as additional learnings are gained from experiences across other areas of the organization or in other organizations.

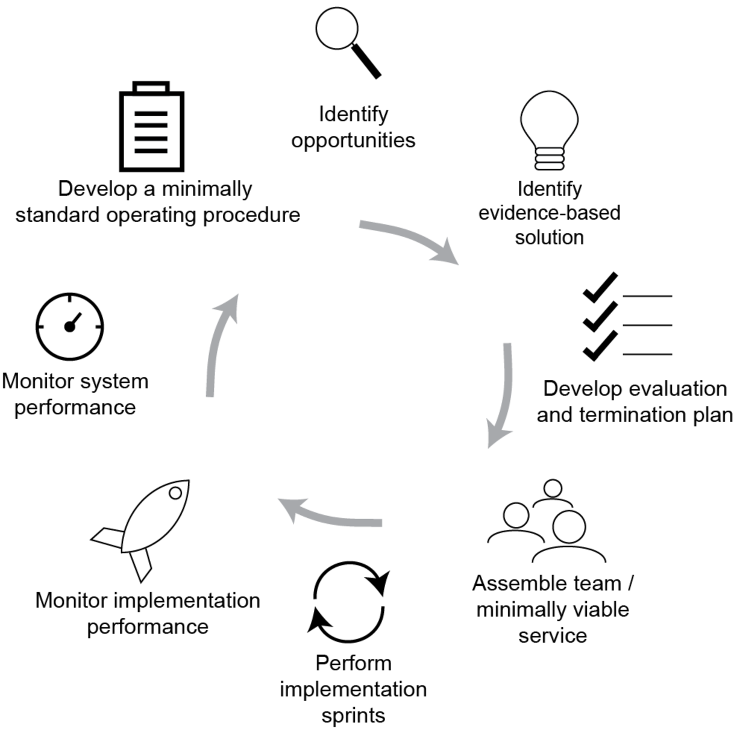


Figure 7. The agile implementation process

Throughout this process, the uniqueness of the local setting where the intervention is taking place and the members who work there is acknowledged and celebrated. While specific aspects of the evidence-based solution remain, there is room to adapt and tailor the solution to the local environment to maximize the chances for success.

Agile Diffusion: A New Theory for the Diffusion of Innovation

Adopting innovation within any social network is an emergent behavior of the various processes of information and/or energy exchanges across the various members or nodes of the social network. Individuals see or hear about others using a new and innovative product, process, or behavior and, through the use of their System 1 and System 2 cognitive processes, decide if and when to adopt the innovation. Such adoption is influenced not only by the actual capability of the innovation to solve various problems facing each individual or the entire network but also by the various cognitive biases discussed previously.

One of the heavyweights in the field of innovation diffusion is Everett M. Rogers, who first published his book *Diffusions of Innovations* in the 1960s, now in its sixth edition. There is much from his text that helps lay the foundation for what we will propose. First, Rogers posits that diffusion occurs by communication throughout a social system, and in general, the adoption of any innovation starts out slowly, then steadily increases until an inflection point at which point the rate slows again. This pattern reflects a cumulative adoption pattern that follows an S curve.

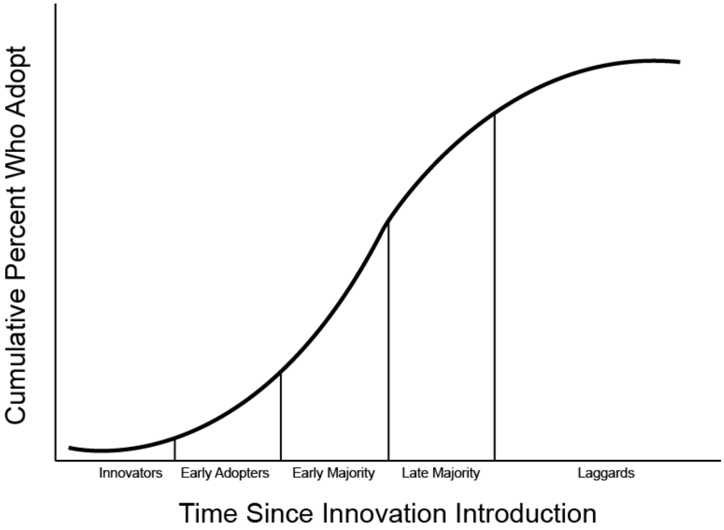


Figure 8. S curve from Rogers's theory

This S curve of cumulative adoption reflects an aspect of his theory that has made its way into popular culture: that the distribution of the timing of adoption by individuals in a social system follows a bell curve (i.e., a normal distribution), with those who adopt the soonest termed *innovators* and *early adopters*, while those who are the last to adopt an innovation are considered *laggards*. The S curve reflects the rate of cumulative adoption when the individual timing of adoption follows a normal probability distribution.

Rogers discusses several things that can influence the speed or rate at which an innovation is diffused, including the five main characteristics of an innovation (its relative advantage, compatibility, complexity, trialability, and observability).[31] However, he also acknowledges that the nature of the system (i.e., how interconnected it is) and the presence and behavior of "opinion leaders" or influential members of the system will also affect the rate of diffusion.

It should be noted that much of what Rogers and others have studied relates to what he refers to as *optional innovation-decisions*—those where individuals are free to decide whether to adopt or reject an innovation, regardless of what other members of their network decide (e.g., even if all your friends have the latest smartphone, you do not have to get one). He notes in his book that *collective innovation-decisions* (those chosen by a group through consensus) and *authority innovation-decisions* (those mandated by those in power) are more common in organizations and have a faster rate of adoption than those of optional innovation-decisions. In addition, the rate of adoption for authority innovation-decisions depends on characteristics of leadership, the presence of "champions," and certain organizational characteristics regarding attitudes toward following rules and the availability of time and resources to devote to change.[31]

However, Rogers's theory appears to be based, in part, on two assumptions that may not be supported by the current understanding or data from real social networks. Further, his is a theory of individuals' attitudes toward innovation. However, we now know that information and innovation diffusion are also dependent on the community, the degree distribution, the level of clustering, and other network characteristics.

The first assumption of Rogers's theory we find fault with is the one that assumes that the timing of the various levels of adopters within a social network has a normal distribution. If true, this would suggest that the social network through which innovation diffuses is a random social network with no hubs and where most individuals' proclivity to adopt a new idea is near the average. In reality, observed data of the phenomenon of innovation diffusion more commonly follow the power-law distribution and reflect a scale-free social network with hubs and nonrandom links. This has major implications regarding the speed and path by which innovation is diffused. In a 2005 article, Rogers and colleagues explore the role of complex adaptive systems (networks) in innovation diffusion, where they discuss the power-law distribution and its scale-free property and acknowledge that characteristics common to complex adaptive networks can lead to more rapid diffusion.[32] However, Rogers and his coauthors appear to maintain the assumption of a normal distribution for the timing of individual adoption, which is incompatible with the notion of a scale-free complex adaptive network. Others have noticed this as well; in reference to this 2005 paper, Lambert suggests that Rogers and his colleagues "failed to recognize that the cumulative distribution curve of a power-law distribution is not an S curve."[17]

For a healthcare delivery system viewed as a complex adaptive network with its hubs and power-law distribution, the notion that a deliberate or even mandated innovation introduced into the system would diffuse at a rate that follows an S curve is unlikely. Even Rogers noted that the structure of the network, its communication channels, and the existence of highly connected and influential members will affect the rate of diffusion. In truth, the speed and process by which an idea or innovation spreads through a complex adaptive network cannot be fully predicted because of the unique and complex nature of each network. Often, adoption requires multiple interactions to expose individuals to an idea multiple times and to provide reinforcement through multiple interactions with those who have adopted. Therefore, the degree distribution and the density of local clustering will influence how quickly new ideas are adopted.

In a complex adaptive network where member degrees follow a power-law degree distribution, new information (ideas, rumors, innovation, etc.) that is introduced to the network is likely to quickly find its way to one or more hubs. Then, because these types of networks have short global paths, the information will spread very quickly (figure 9).

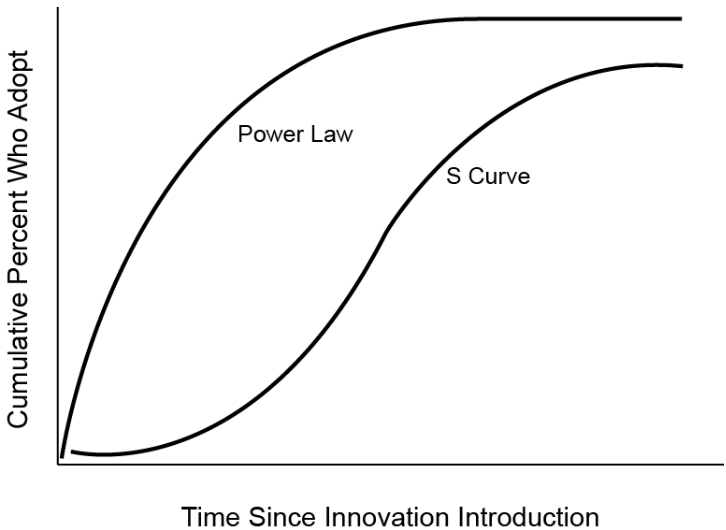


Figure 9. A comparison of Roger's S curve pattern of diffusion with that of a power-law distribution

As mentioned, the exact diffusion pattern of an individual innovation cannot be known and is dependent on the makeup and nature of the network. This is a function, in part, of the fact that a complex adaptive network is always changing. Individual members adapt based on their previous experiences, which in turn alters the structure of the network. Additionally, there is natural variability regarding the interactions that individuals have with each other on any given day. Each innovation is subject to several parameters of the network, the innovation, and the network individuals that will influence the diffusion of innovation.

Within the network as a whole, the scale-free nature of the network is specified by the appropriate functional form of the degree distribution. The shape of the power-law distribution may be steeper for some networks and more gradual for others. This will certainly impact how quickly innovation spreads. In addition, the level of local clustering (also called *local community*) can vary and will affect the global path length of the network as a whole, which will also affect the speed of the innovation diffusion.

The second assumption of Rogers we take issue with is the notion that the individuals adopting the innovation are logical decision-makers who decide whether (or when) to adopt an innovation based on a clear determination of what is in their best interests. As outlined in the previous chapters, this is almost never the case, as human beings will use System 1 thinking to make many decisions and are influenced by inherent biases that reflect unique experiences, interactions, and emotions.

It is possible to develop a more applicable theory for the diffusion of innovation based on the scale-free properties of complex adaptive networks and the cognitive biases of network members. This will allow for the creation of more effective tools, processes, and strategies that will promote innovation diffusion. This, in turn, will ultimately help the network to successfully implement and sustain changes that will improve care quality and patient outcomes.

Describing a New Theory for the Diffusion of Innovation in Healthcare

Individuals generating healthcare innovations diffuse their ideas only to those they interact with. Thus, the innovation spreads through the complex adaptive contact network based on the characteristics of that network. As previously noted, these networks are often scale-free, such that the average number of contacts for the network (K) is insufficient to characterize the topology of the network. In a scale-free network, the hubs are some of the first to be exposed to the innovation through the many social or physical links they have. Once exposed to an innovation, a hub may or may not broadcast the innovation to the rest of the network, thereby functioning either as a super-spreader or super-stopper. Additionally, most member interactions are brief and infrequent. Therefore, an accurate model of innovation diffusion must consider the timing, frequency, and duration of interactions.

Data show that the distributions of time between social interactions among networked individuals also follows a power-law distribution.[9] This means that the sequence of social contacts between two individuals is characterized by periods of repeated or intense exchanges within a relatively short time frame, as well as occasional extended gaps between encounters.

Furthermore, many social networks are assortative, implying that high-degree nodes tend to connect to other high-degree nodes. Assortative correlations increase substantially the power of hubs to be super-spreaders or super-stoppers of any healthcare innovation.

It should be noted that most individuals will not immediately adopt an innovation after a single encounter or interaction. Adoption often requires reinforcement through repeated contact with several individuals who have already adopted the innovation. To repeat a previous example: the more of your friend group who starts using a new device or application, the more likely you will also. In complex diffusion, communities have redundant ties and social links and offer social reinforcement that exposes individuals to multiple examples of adoption. Hence, communities can incubate a healthcare solution and enhance its adoption.

It is clear, then, that several characteristics of complex adaptive networks affect the speed and depth of the diffusion of a healthcare solution, from the degree distribution to the links and the nature of the contact pattern. Most networks facilitate the transfer of many attributes along their links, including those of trust, knowledge, habits, or information. To understand this transfer of information, we must understand how the network topology affects these dynamic processes. The goal, then, when developing a model for innovation diffusion, is to develop specific steps that facilitate diffusion as efficiently and expediently as possible, and in such a way as to maximize the likelihood of adoption. However, the creation of this model needs to occur while considering the network characteristics and human tendencies already described.

Greenhalgh et al.[33] proposes that innovation can be diffused within organizations through three approaches: (1) completely organically, or "letting it happen"; (2) facilitating and nudging, or "helping it happen"; or (3) dictating and rule-making, or "making it happen." These are similar to the distinctions Rogers makes between *optional*, *collective*, and *authority* innovation decisions. Some suggest that innovators in general hope or advocate for the authority or "making it happen" process to diffuse their innovation in a social network.[34] Those who promote that notion attribute the tendency to select the centralized approach of diffusion to its low variation across different end users (one size fits all), its simple implementation, and the fact that it requires only passive decision-making from all adopters.

In their article cited in the previous paragraph, Callahan et al. used multiple examples of an authoritative diffusion approach, including the policy mandate of no antipsychotics in long-term-care facilities and the health insurance requirements of prior authorization for certain high-priced healthcare services. However, the authors recognized three main disadvantages of the centralized approach of diffusion. First, it requires that the innovation has a significant relative advantage. Second, it can take a long time to convince national policy makers to adopt such a national policy. Third, it may fail to improve health outcomes for certain medical conditions that require changing the health behaviors of highly engaged end users.

To facilitate faster implementation of healthcare innovation within a complex adaptive healthcare delivery organization, a group at Indiana University and others over the past decade started exploring new "helping it happen" diffusion strategies, including an elusive search for scalability and understanding how end users assign relative advantage within their local social network.[11,35–42]

While both the agile implementation and agile innovation processes lie squarely in the Greenhalgh concept of "helping it happen," the two processes seek to overcome disagreements in the perception of relative advantage by aligning the solution with the market demand for such a solution. Given the structure and nature of complex adaptive networks, lessons learned from the work done by Lambert and others suggest that successfully diffusing innovation in social networks can be optimized by

- first, accessing a known hub;
- second, if unable to identify hubs or access them, identifying small clusters of tightly connected individuals (local community) and targeting them

with the innovation, subsequently helping to build a bridge from this community into other clusters until the innovation reaches one of the hubs; and

- third, using a variety of approaches with multiple starting points and times within the complex adaptive network to cope with the high degree of uncertainty, unpredictability, and constant-change nature of the complex adaptive network and its adoption of any innovation.

Diffusion of innovation and the sustainability of a new product, behavior, or processes also require that the network remains relatively intact and functioning as a whole. As described in chapter 3, a complex adaptive scale-free network is robust to changes or deletions of most individual nodes or links but potentially vulnerable to the actions of hubs. Low-degree members have a role to play, but in social networks, if they decide to leave or delete certain connections, it likely has little impact on the functioning of the organization as a whole. If, instead, a high-degree member exits or loses a portion of his or her connections, there could be ramifications that stretch across the entirety of the network.

However, these key individuals may also be less likely to leave. They are likely to be more established within the organization and committed to its mission and direction; less connected individuals may be those early in their careers still open to opportunities in other locations or systems and therefore more likely to leave. This information is valuable for developing and using effective tools to help encourage rapid adoption of innovation. It also suggests that the structure of a complex adaptive scale-free network can help to insulate the entire network when individual providers or practices leave or alter their connections. As long as the network's hubs remain intact and functional, the network as a whole will be resilient to changes in membership and participation.

Putting all this knowledge together, we propose a new agile diffusion process to facilitate the rapid diffusion of an evidence-based solution that involves the following steps:

1. Get to know deeply the complex adaptive network, where the innovation or the evidence-based solution is targeted for diffusion by
    - mapping the scale-free complex adaptive network to detect its small-degree nodes, its large-degree nodes (the hubs), the various communities of nodes with high links among them, and the vital bridges or links within the network;
    - estimating the total number of nodes, the total number of links, the average path link, the maximum distance of the network, and the average clustering coefficient;
    - estimating the exponent of the power law that describes the network degree distribution; and
    - estimating the various moments of degree distributions in scale-free networks; the first moment is the average k $\langle k \rangle$; the second moment helps us calculate the variance $(\sigma^2) = \langle k^2 \rangle - \langle k \rangle^2$ that measures the spread in the degrees—its square root (σ) is the standard deviation; and the third moment, $\langle k^3 \rangle$, determines the skewness of a distribution, telling us how symmetric the degree distributions are around the average $\langle k \rangle$.

2. Develop agile feedback loops within the complex adaptive network to constantly record and measure the network's problem and challenges within various communities and hubs by
   - embedding the right sensors in communities, hubs, and at the individual level; and
   - constantly mapping the changes in network properties, including birth or death of hubs and communities, and the number of new arriving or departing individual members.
3. Constantly profile the various messengers within the complex adaptive network at the individual, community, and hub levels by specifying their profile, emotion, audience, and communication channel.
4. Create a *minimally viable story* of the evidence-based solution by identifying the minimal standard processes and converting them into the essential component of the story. An effective story will clearly describe the villain (the problem), the hero (the evidence-based solution), the struggle or drama, and the resolution. Such a minimally viable story will provide the why for the creation of market demand for the innovation and allow personalization at the node level, the community level, and the hub level within the targeted complex adaptive network.
5. Start various experiments and sprints to test the story to identify what works within each community, hub, and entire network.

Leveraging the Three Agile Processes to Develop the Agile Network

The agile network framework, with its three agile processes (innovation, implementation, and diffusion), emphasizes the vital rule of creating market demand for any evidence-based innovation prior to even designing, packaging, and distributing such an innovation within any social network. Two parallel strategies—*zoom in* and *zoom out*—create such a market demand.

The zoom-out strategy involves using a centralized process of creating new market demand by changing certain network rules and/or creating new fitness goals for the entire network. An example would be creating an alternative payment model to cover a new process of care. The payment model could be structured to encourage the use of the new process and incentivize certain behaviors of care providers.

The zoom-in strategy involves local, grassroots, and personalized approaches. The goal is to convert patients into empowered consumers who will have full control of the payment for any new innovation. Such empowerment might prompt the innovation designer to put the patient first in the design process. To do so, any such designer must deeply understand the consumers' needs and the local context. For example, a simple first step in the right direction for creating market demand for the adoption of the evidence-based behavioral health integration model could be to allow for health savings account spending and to distribute the monthly payments from the Centers for Medicare & Medicaid Services into these health savings accounts. A patient could then use those funds to select the right providers of the evidence-based care model.[43]

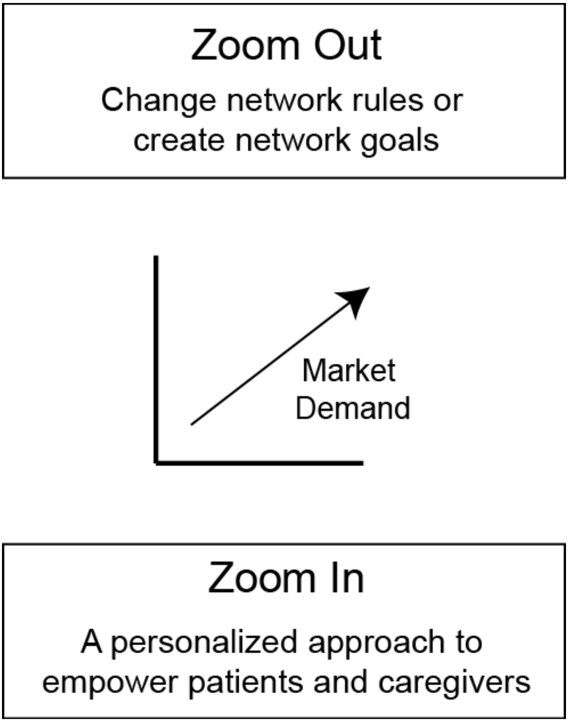


Figure 10. Zooming in and out to create market demand

The zoom-in strategy centers on the patient or user of services. This person's perception of the new innovation's value and its status within her local community or social organization creates demand and therefore a pathway for the innovation's adoption. If the user sees value in the service, she will use her influence within her community and social network to advocate for the service's implementation. As we explained in previous chapters about behavioral economics and network science, cognitive biases in decision-making and the degree distribution of any social network dictate that any innovator must either become an effective choice architect and network scientist or must partner with one (or more) individuals who are. Thus, the perceived value for the new evidence-based innovation by the innovator is not important in the adoption journey.[34] Any plan to facilitate diffusion within complex adaptive social networks, including healthcare delivery organizations, must account for social networks, human cognitive biases, systems within systems, and shared decision-making. These concepts are crucial to the successful practical application of the theories and frameworks responsible for the development of an agile network, capable of facilitating rapid, scalable, and sustainable diffusion of evidence-based healthcare innovations.

When combined, the concepts covered to this point allowed Dr. Boustani and others to effectively plan, develop, and administer the Great Lakes Practice Transformation Network. Their goal to create a network capable of conducting iterative problem-solving processes that provide better health, higher care at lower costs, and excellent patient and provider experiences was realized through the efforts of all members of the GLPTN.

6

THE FOUR-YEAR JOURNEY OF THE GREAT LAKES PRACTICE TRANSFORMATION NETWORK

The Overall Goals of the Network

Using insight from network science and complexity science, the network was intentionally structured to combine targeted clinicians into several sets of local communities that were linked to state-based hubs. With this structure, the diffusion of evidence-based innovation would start from the local practice, incubate in the local community on its way to a hub, and then spread quickly via the hubs throughout the rest of the network. The network was established with plans to transform the practices of 11,500 clinicians across the three states of Illinois, Indiana, and Michigan into learning practices capable of providing better health and improved care at a lower cost for a population of more than 10 million Americans. The stated goals of the network were lofty, to say the least. They included the intent to

1. provide cost-efficient technical assistance for 11,500 clinicians over a period of four years, assisting with their achievement of the five phases of a patient-centric practice transformation and supporting their participation in

incentive programs, practice models, and payment systems that reward value;

2. improve health outcomes for millions of Medicare, Medicaid, and CHIP beneficiaries and other patients;
3. reduce 410,000 unnecessary hospitalizations among 5 million patients, which would represent more than 8 percent of the national total targeted by the TCIP;
4. generate $1–$4 billion in cost savings to the federal government over a period of four years through reduced Medicare, Medicaid, and CHIP expenditures;
5. sustain efficient care delivery by reducing unnecessary testing by 17 percent and reducing unnecessary procedures; and
6. build the evidence base on practice transformation so that effective solutions can be scaled.

Using the stated budget and the aspiration to enroll 11,500 member clinicians, the network estimated the cost of accomplishing the above goals to be roughly $4,332.67 per clinician over four years: an incredibly modest sum for the amount of change that was being pursued.

The Minimally Specified Plan

The network was conceived as a five-state coalition (Indiana, Illinois, Michigan, Ohio, and Kentucky) of thirty-two healthcare partners, including four regional extension centers, three state Departments of Health, five regional health information exchanges, and eight universities. The five lead organizations—Indiana University (central operation), Purdue University (Indiana), Northwestern University (Illinois), Altarum Institute (Michigan), and the University of Kentucky—served as the main hubs of this complex adaptive network so as to insulate the network from losing an individual practice or physician and allow for the effective diffusion of information and evidence-based innovation.

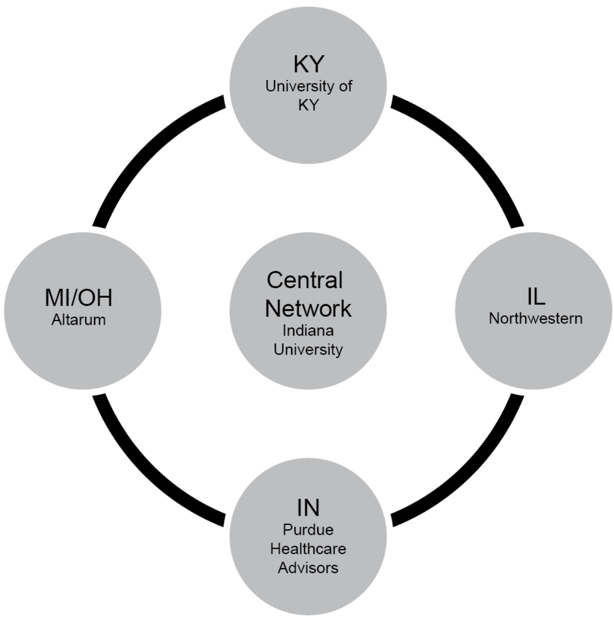


Figure 11. The agile network structure for the GLPTN, with centralized strategy, reporting, analytics, and management, and localized operations led by each state

Given the complex adaptive network of each practice, the leadership focused on developing a minimally specified plan to accomplish the larger network's overall goal. The leadership coupled this minimally specified plan with the development of timely, actionable, and nonjudgmental feedback loops to monitor the performance of the plan and adjust the plan in agile and locally sensitive ways. The minimally specified plan also included minimally specified time and space for group-based reflection on the plan's performance. This reflection was used to make necessary adjustments in iterative, rapid, locally sensitive, and agile ways.

The network's overall strategies were led and monitored by a board of directors. Within each individual state, there was an operations team comprised of a program manager, a clinical lead, a quality lead, and a data analyst. This team was charged with executing the daily activities of the network at the state level, such as recruiting, retaining, and training the clinicians. A central network operations team and a centralized consortium of faculty experts in preventive health, behavioral health, chronic disease management, geriatrics, pharmacy, and pediatrics health services research convened to synchronize operations and share resources and lessons learned across the entire network. The plan also included the development of a stakeholders advisory board that included patient and family representatives from each state. The intention was to leverage the existing resources across the three states, including:

- the regional health information exchanges, to provide data-based feedback to meet both the reporting requirements of the sponsor agency (Centers for Medicare & Medicaid Services) and the timely detection of any emerging change in the local and national environment for the sole purpose of optimizing in real time the performance of the entire network;

- the regional extension centers and their existing relationships with the local practices and communities to reengage, enroll, and facilitate the transformation of 11,500 clinicians;
- a national network of community health centers with expertise in converting primary care practices into certified patient-centered medical homes; and
- the intellectual capital of six medical schools to provide training in change management and practice transformation tools, processes, and strategies to the quality improvement advisors; these advisors were deployed as locally embedded coaches to support the 11,500 clinicians during the five phases of practice transformation. The practice coaching model was developed by the Agency for Healthcare Research and Quality.

Table 3. The five phases of transformation

Phase 1	Setting Aims and Developing Basic Capabilities
Phase 2	Reporting and Using Data to Generate Improvements
Phase 3	Achieving Aims of Lower Costs, Better Care, and Better Health
Phase 4	Getting to Benchmark Status
Phase 5	Demonstrated Capability to Generate the Triple Aim

The faculty experts within the network developed a Transformational Change Tool Kit that integrated three practice transformation approaches:

1. applying insight from network science, complexity science, and behavioral economics theories to deliver evidence-based and locally sensitive healthcare solutions (Indiana University and Altarum Institute);

2. transforming clinical practices into high-reliability practices, using Lean and Six Sigma process improvement tools to improve operational efficiencies, safety, and reliability (Purdue University and Altarum Institute); and

3. instituting the emerging principles of patient-centric, personalized health management to coordinate care across the medical neighborhood (Northwestern University and Indiana University).

The plan for supporting clinicians through assistance by the quality improvement advisors involved three waves dependent on the readiness of the individual practices. Those most ready to advance through transformation would receive minimum training and be involved in the first wave, while the second and third waves would involve those requiring more extensive training. It was anticipated that quality improvement advisors would use the Transformational Change Tool Kit to provide direct coaching to participating practices to progress them through the Transforming Clinical Practice Initiative Phases of Transformation.

Table 4. Integrations for the Tool Kit

Transformational Change Tool Kit
Evidence-based practice and evidence-based management
Lean and Six Sigma process improvement tools
Patient-centric, personalized population health management
Data-driven decision-making: Meaningful Use, Physician Quality Reporting System (PQRS)/ Value-Based Payment Modifier (VBM), Merit-Based Incentive Payment System (MIPS)

Each member practice would go through a baseline assessment and ongoing annual assessments to determine their readiness for transformation and current position in the continuum of transformation. Based on the results of the assessments, quality improvement advisors tailored coaching strategies and interventions to help practices meet the milestones associated with their current phase of transformation. Each engagement began with a one-to-two-day exploration period where the quality improvement advisor focused on becoming familiar with the practice operations and infrastructure of each member practice. The quality improvement advisor created process maps to identify performance gaps and surface-level opportunities for the members' improvements. Practices were then given the flexibility to determine for themselves their priorities for quality and process improvement. This was in addition to focusing on the network core measures for proceeding through the Transforming Clinical Practice Initiative Phases of Transformation.

Actionable Nonjudgmental Timely Feedback Loop to Guide the Network Transformation Activities

The Practice Assessment Tool (PAT) was created by the Centers for Medicare & Medicaid Services to assess progress. Individual practices are expected to progress through five transformation phases and toward sustainability and high performance in a value-based payment environment. The Practice Assessment Tool was used to gauge the transformation phase in which practices were performing at baseline and determine follow-up intervals over the duration of the practice transformation initiative. The phase determination was based on the extent to which a practice displays characteristics defined by a series of milestones captured by the Practice Assessment Tool.

Each milestone is scored on a 0–3 scale: not yet implementing that milestone (score 0), getting started with implementation (score 1), implementing and partially operating (score 2), or functioning and performing well (score 3). The network administered two versions of the Practice Assessment Tool: one for primary care practices with twenty-seven milestones, and one for specialty practices with twenty-two milestones. The quality improvement advisors worked with each practice to reflect on results of their Practice Assessment Tool and to compare their results with other practices within their local community, within their state, and against the practice of the entire network. The quality improvement advisors also used the Practice Assessment Tool as a nonjudgmental, timely, and actionable feedback loop to codevelop a personalized transformation package for each practice and to modify such a package on a regular basis.

Activities with the Network

There were a number of activities conducted during the contract period (from October 2015 to September 2019) that helped the network accomplish its stated goals. Each of these activities was planned and executed with insights from network science, complexity science, and behavioral economics to sense and monitor the needs of each practice (node) within the local community, develop an individualized change management plan, design and implement various nudges, and facilitate the rapid network-wide diffusion of lessons learned within individual practices.

Because of the significant number of participating clinicians belonging to small, rural, and under-resourced practices, the network offered individualized Lean training programs to build operational capacity within each practice or healthcare delivery organization. These programs complemented the quality improvement advisors' focus on the completion of the Practice Assessment Tools (the feedback loop), the development of individualized transformation change plans, and the successful implementation of such plans. Through these iterative activities, practices learned how to implement the presented initiative and eliminate waste by building a Lean foundation. Quality improvement advisors worked with practices and helped them optimize their capabilities by developing scalable and sustainable plans. Once a Practice Assessment Tool was completed, the quality improvement advisors met with the practice to review their progress and set goals that were measurable and attainable. Practices received additional resources and information to further their journey through the phases of transformation.

There were also activities intended to assist practices with federal quality monitoring and reporting programs. To help practices navigate the Merit-Based Incentive Payment System

(MIPS), quality improvement advisors aided practices in their efforts to report progress and prepare to transition into value-based payment models. To ensure practices were up to speed on how best to measure their performance on clinical quality measures (CQMs), quality improvement advisors offered educational sessions and information on empanelment and continuity, as well as on data collection. Some states even implemented quality improvement advisors' clinical "office hours": designated, scheduled time periods in which quality improvement advisors were available to answer questions and address concerns. This arrangement allowed participating clinicians to ask about guidance on clinical workflows, best practices, and clinical protocols.

The network also identified "clinical champions," those who represented a variety of specialties, including pediatrics, family medicine, and cardiology. These practices were identified as hubs or high-degree (linked) members who were integral in quickly diffusing new ideas and encouraging their adoption. Quarterly in-person networking events gave quality improvement advisors a chance to discuss relevant topics and to examine and explore ideas regarding effective implementation strategies. Knowing the importance of frequent and repeated interactions, the network intended this activity to facilitate sharing and diffusion of best practices.

To proactively diffuse knowledge and lessons learned across the network, Indiana University deployed the Innovation Forum.[38] Innovation Forum is a group-based problem-solving platform. It recruits a diverse group of individuals who work within the healthcare system or are impacted by the healthcare system. These individuals include but are not limited to physicians, nurses, social workers, medical assistants, certified nurse assistants, administrators, and even patients and patients' family members.

When a healthcare leader is faced with a challenge, the Innovation Forum is used to generate solutions for the challenges faced. Using the insight from complexity science, the Innovation Forum requires strict adherence to a minimally valuable process to ensure maximum participant engagement and produce minimally valuable solutions for those involved. The Innovation Forum includes the following supporting team and functions (table 5).

Table 5. Innovation Forum member functions

Team Member	Function
Forum Coordinator	The primary organizer of the event; responsible for ongoing monitoring and evaluation of the event as well as maintaining communication with the presenter on any forum-related needs or preferences.
Presenter	Owns the challenge and is responsible for identifying a small group of individuals to whom a personal invitation will be sent.
Administrative Coordinator	Provides logistical and administrative support throughout the planning process and during the event.
Solution Tracker	Takes and distributes notes during various Innovation Forum meetings as well as records solutions during the day of the event.
Facilitator	Conducts the Innovation Form, ensures smooth knowledge transfer between presenter and audience, and profiles and engages the audience while clarifying meaning during discussion. The facilitator is not a content expert but rather promotes conversation and understanding.

The minimally specified time and space for each Innovation Forum are organized as described in table 6.

Table 6. Specified time and space for an Innovation Forum

Activity and Time	Description
Opening 30 minutes of networking	Allows time and space for attendees to connect.
10 minutes for presentation of challenge	Reserved for the identified speaker to present his or her implementation or delivery challenge; the speaker may use whatever visual aids he or she feels are necessary (PowerPoint, handouts, etc.).
5 minutes of clarifying questions from the audience	Utilized to clarify anything within the scope of the presentation. The facilitator must ensure there are no solutions generated during this time, and the facilitator must also advocate that the called-upon person state his or her concern in question form.
45 minutes of discussion and generating solutions	Used for generating solutions, brainstorming, and question-storming.
Closing 30 minutes of networking	Intended to provide closure to the discussion in a more informal environment as people are encouraged to move around the room.

The Clinicians of the Network

As of June of 2019, there had been more than 18,000 providers enrolled, including more than 10,000 active members and more than 3,500 who had graduated from the program.* These individuals represented more than 1,600 different practices. Between 2015 and 2019, there were approximately 4,800 clinicians who were voluntarily disengaged or became ineligible due to early participation in an accountable care organization. The network clinicians were notably diverse. The large majority (89 percent) of practices had 15 or fewer clinicians, and 95 percent had rural or underserved populations. The clinicians spanned a large spectrum of specialties (representing 65 percent of all enrolled clinicians), including 4,842 in primary care, 2,460 in behavioral health, and 2,346 in surgery.

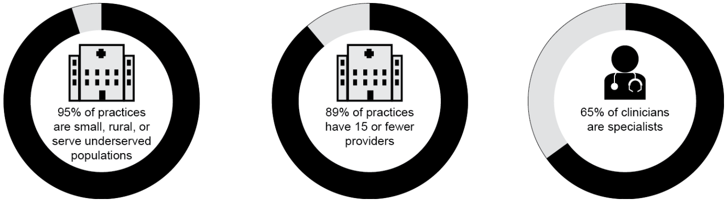


Figure 12. Network participation

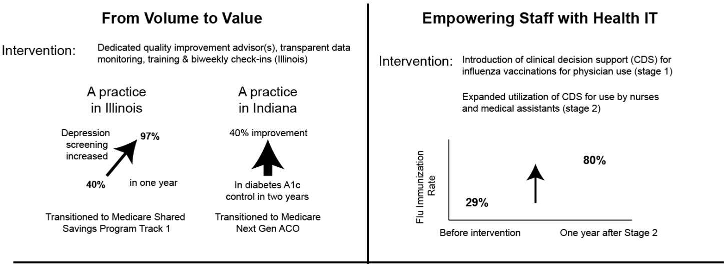
Within the surgical specialty, there were more than a dozen subspecialties, including orthopedic, otolaryngology, and neurosurgery.

* These results and all subsequent results reported are subject to confirmation by the Centers for Medicare & Medicaid Services.

Table 7. Achievement of goals

Aims	Commitments as stated in award document	Total commitment achieved Sept. 29, 2015–Sept. 28, 2019
1. Support more than 140,000 clinicians in work to achieve practice transformation	11,500 clinicians enrolled	13,725 clinicians enrolled
2. Improve health outcomes for 5 million Medicare, Medicaid, and CHIP beneficiaries and other patients	453,610 clinical quality measure improvements	972,949 clinical quality measure improvements
3. Generate $1–$4 billion in savings to the federal government and commercial payers	$850,000,000	$1,008,719,847
4. Reduce unnecessary hospitalizations for 5 million patients	42,660 reductions	62,590 reductions

5. Sustain efficient care delivery by reducing unnecessary testing and procedures	2,715 reduced unnecessary tests and procedures	46,141 reduced unnecessary tests and procedures (including opioid prescriptions)
6. Preparing 75% of practices completing the program to participate in alternative payment models	8,625 clinicians	8,580 clinicians
7. Build the evidence base on practice transformation so that effective solutions can be scaled	1,000 exemplary practices	1,207 exemplary practices



Specialist Bright Spot

A practice in Indiana

Intervention: Collaborative care model with multidisciplinary team to support trauma patients after discharge for acute care of injuries

Outcome	Treatment Group	Matched Controls
Days between ED visits	234 days	184 days
ED visits per year	1.6 visits	2.1 visits
Hospitalizations per year	1.3	2
Mortality rate	8%	15%

Improving Outcomes

Intervention: Increased access to surgical specialists, complex chronic disease management, patient engagement surveillance, change management strategies, programs to improve medication adherence

Outcome	Number of patients experiencing improvement
Diabetes A1c control	61,468
Controlled blood pressure	42,354
Depression remission at 12 months	747
Depression screening & follow-up	319,975
Influenza immunization	325,887

Figure 13. Examples of activities and successes within the Great Lakes Practice Transformation Network

Lessons Learned

There were several challenges that the network faced related to data collection, enrollment in Merit-Based Incentive Payment System (MIPS), transition to alternative payment model (APM), completion of the Practice Assessment Tool, and engagement of clinicians in practice transformation. Many clinicians want to help their patients, but with limited staff time and resources, they face challenges in maintaining the motivation to continue to improve due to the small size and location of most of the practices within the network. MIPS was relatively new when the network was first initiated. Therefore, incorporating this program was difficult, and as incentives decreased over time, practices became more disillusioned and less interested in the program because they failed to realize any returns on their investments.

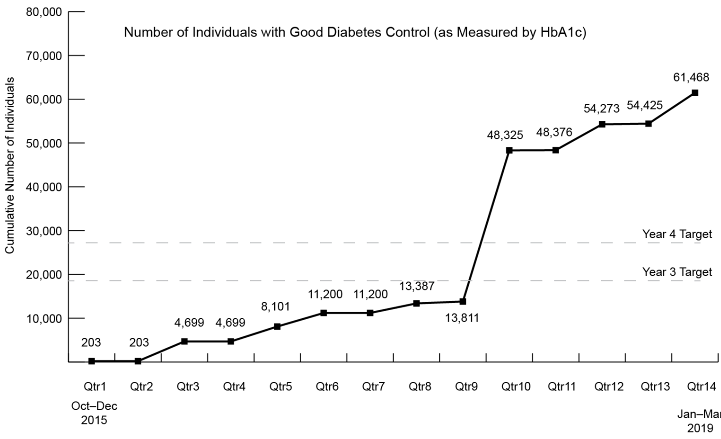


Figure 14. Improving diabetes control

Transition to alternative payment models was also a significant challenge for the network. To a large degree, this was due to the fact that the majority of practices were small and independent. Many of these practices preferred to stay this way and feared that joining an alternative payment model could jeopardize their independence. In general, alternative payment models are not favorable to small practices, and to generate revenue, they need to combine with a large system, as they could not regularly meet the related regulations on their own. Other challenges that served to slow or even stop the transition of practices were the lack of availability of applicable models, a lack of targeted data that demonstrate whether a practice could be successful in an alternative payment model, and the significant cost associated with membership in an alternative payment model.

Over the course of the program, a significant amount of information and education on alternative payment models were shared. This was done to leverage case examples of successful transitions across the US. The hope was that the program could mitigate barriers before they arose. During the course of these information exchanges, it became clear that in general, practices had a negative connotation of alternative payment models. This stemmed from the perception that these were formalized models, rather than an alternative way to receive payment for providing the best care for patients.

Therefore, a key role of the network was to address this disconnect so that practices would be open to exploring such models and discover how best to utilize them for current and future success.

To do this, the network shared two tools specifically developed for participating practices. The first was a readiness assessment for practices so they could gauge their level of readiness to transition to an alternative payment model. This assessment revealed where they were lacking and what would be necessary to become ready. The second tool was designed for practices to use when talking to representatives of existing alternative payment models. This tool was developed in response to the discovery that practices often do not know what questions to ask. This tool provided specific questions and prompts so that practices could more fully understand the benefits of joining and so they could make informed decisions regarding membership. In addition to these tools, an Innovation Forum was held to produce additional tools and resources. The Innovation Forum focused on how to create clinician buy-in for transitioning into alternative payment models.

A variety of solutions were posed by the group, such as having a designated person work with the practice to help them navigate the application process, increasing clinician literacy, outlining the financial cost and margin for clinicians to help define the value, engaging national legislators in conversations, and others. Each of those solutions employed concepts relevant to the agile processes described earlier. Through the intentional interaction of key members of the network, getting their buy-in, and providing regular feedback loops, the chosen solutions could be quickly diffused throughout the network and incorporated to address many of the barriers faced by physicians and practices.

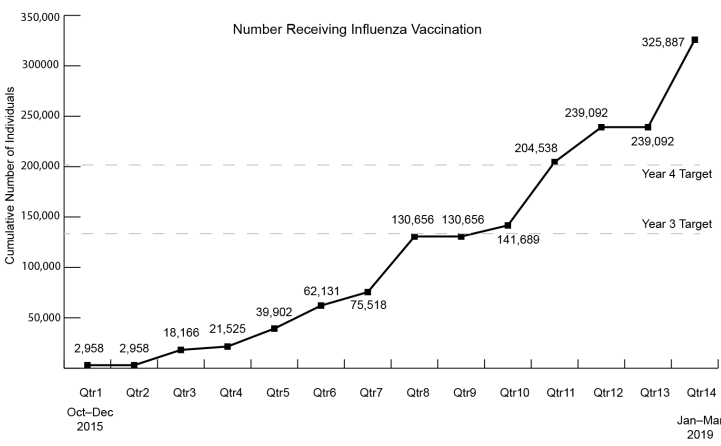


Figure 15. Improving influenza vaccination rates

There were a number of other barriers faced by providers and practices that required additional attention. For example, the Practice Assessment Tool lacked a value proposition. This caused practices to fail to adopt the proposed tactics, ultimately hindering them from progressing into another phase. Data collection also was a significant barrier. Electronic health records are difficult for small- and midsize practices to navigate and can result in clinical quality measure reports that are erroneous or offer limited choices of clinical quality measures, which may or may not relate to the practice.

Small- and midsize practices also faced limited availability of reports or high fees to generate reports, which, in turn, hindered quality improvement efforts. One solution to the data barrier was to connect the practice to a population health tool, but a lot of practices lacked the funds to invest and were reluctant to do so without a clear return on investment. Switching systems was also an option, but the cost and practice disruption are barriers. Some electronic health record issues were mitigated by utilizing the expertise of health information technology advisors who were well versed in some of the nuances of the various systems. This allowed hands-on support to clinicians who previously depended upon their vendor for support to run reports. Another challenge encountered was a lack of tools and infrastructure inherent to the electronic health record system to support population health functions, which created challenges in helping clients risk stratify their patients to focus on the sickest, most chronically ill patients in an outpatient setting.

The level of interoperability among systems posed yet another challenge. Without full interoperability, data transparency is limited, and care coordination becomes a struggle. Those in Kentucky were able to work with some clients on connecting with the Kentucky Health Information Exchange (KHIE) to overcome this barrier. But in general, the majority of barriers faced with clients were related to electronic health record system limitations. When systems became “certified” at the start of the meaningful use (MU) program, most were built with those measures in mind. However, the quality payment program (QPP) has expanded the use of technology to include a large component built around quality, and many systems are simply not built to support quality reporting or improvement efforts as currently installed across clinics. For smaller, independent clients (not part of an enterprise system), this created additional work and stress.

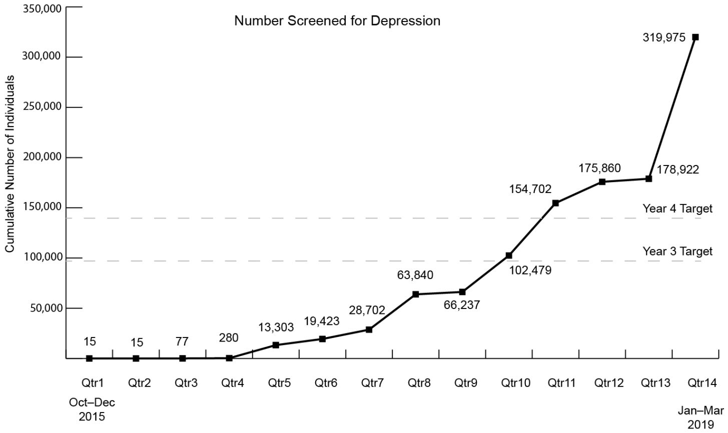


Figure 16. Improving depression screening

There were challenges faced by the network quality improvement advisors. The network encompassed five states, and at times, it appeared that we were not working together and/or sharing tools and resources with one another, even though we were working toward the same goal. These issues were mitigated by allocating time and space for in-person events or via video calls to enhance connection and interaction and convert the diverse quality improvement advisors into one community. The in-person events were the most beneficial because that was where the most collaboration between the state teams occurred. Other challenges included significant, time-consuming documentation requirements and short turnaround times.

The success of the Great Lakes Practice Transformation Network is a validation of the efforts of all of those involved, including the participating physicians and practices. Additionally, the experiences and stories from the network are motivation for continuing to grow and scale our efforts to increase the reach of what we have been able to accomplish. To this end, Indiana University was recently named one of the Network for Quality Improvement and Innovation Contractors (NQIIC) under an indefinite deliverable, indefinite quantity (IDIQ) contract by the Centers for Medicare & Medicaid Services. The goal within the parameters of this contract is to develop and establish a more extensive agile network, which will seek to recruit over twenty-two thousand clinicians across Florida, Kentucky, Illinois, Indiana, Michigan, and Ohio. We will work closely with community coalition partners to ensure that our new agile network has maximum reach to clinicians serving vulnerable populations in underserved communities, including federally qualified health centers within rural, suburban, and urban practices. Furthermore, we plan to continue to work closely with each state's Medicaid agencies and Departments of Health to identify additional practices that focus on care to underserved patient populations. Achieving sustainable quality improvement across such a wide geographic area and for so many individual patients will require collaborative approaches. This will include a strong foundation based on shared commitment, strong leadership, effective partnerships, capacity building, and communication at every level of engagement.

7

OPERATIONALIZING THIS MODEL AND TRANSFORMING HEALTHCARE: CHANGING TOMMY'S STORY

Operationalizing the Agile Network Model

The goal of the agile network is to transform healthcare so that Tommy—and everyone who is interacting with healthcare systems—will have better healthcare experiences and ultimately better outcomes. We aim to decrease fragmentation in care coordination and improve access to information, data transparency, and utilization of advanced analytical support. The agile network will offer a variety of communication modalities to promote collaboration and dissemination efforts. We understand the need for timely implementation of innovations and for quick knowledge transfer. Therefore, in addition to developing traditional academic publications and presentations, we will leverage our stakeholder advisory board to coordinate a variety of emerging dissemination channels, including social media, white papers, podcasts, videos, and learning health system venues. We aim to reach academic stakeholders, policy makers, the lay public, and health systems with our messages.

The dissemination process will be operationalized through the board's committee structure that includes representatives from the entire consortium within the agile network to ensure broad participation among our partners.

As part of this mission, the new agile network will use a multitiered approach to systematically engage patients, families, and caregivers. As outlined in figure 17, we view such an engagement as an inherently relational process of two-way communication, which, due to being embedded within a local context, affords patients, families, and caregivers a voice that is heard, while simultaneously delivering valuable information to providers.

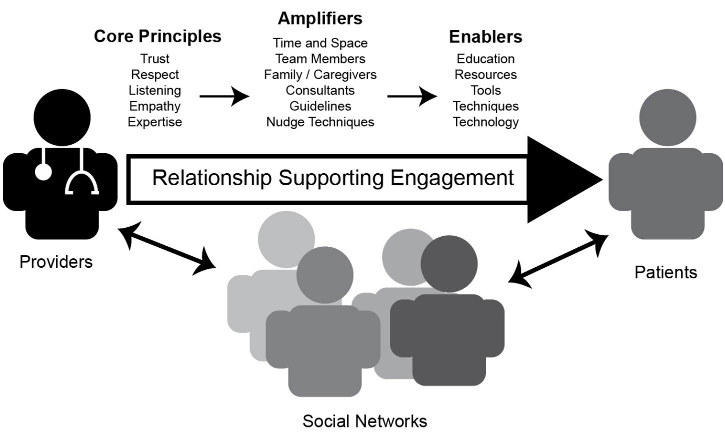


Figure 17. Patient and family engagement as an inherently relational process

At the center of this framework is the relationship between providers and patients. Around this relationship, we view core principles, amplifiers, and/or enablers as potential levers, or *targets*, to improve provider engagement in quality improvement. We also view social networks as an often unrecognized but incredibly powerful conduit for good provider-patient relationships and shared decision-making. Thus, we consider social networks, including opinion leaders and the media that supports communication among social networks, as a largely untapped resource for supporting engagement.

We view patient engagement on a continuum from a low to a high level of complexity. At the low end of this continuum, we will invite a patient, family, or their caregiver to participate in a survey to assess satisfaction. At the high end, we will encourage a patient, family, or their caregiver to participate in a complex self-management program, which unfolds over many years and promotes several lifestyle or behavioral changes.

This same continuum of engagement exists for quality improvement efforts seeking to engage patients, families, and caregivers through their providers or teams of providers. Our strategy in all these settings is the same. Simply stated, our strategy is built on relationships. We initiate relationships by facilitating the time and space for us to listen to the patients, families, and caregivers (or providers) we seek to engage. We strengthen relationships through trust, mutual respect, and continuing to listen to both verbal and nonverbal cues, including cues emanating from the cultural context. These core principles hold true whether we are building relationships with opinion leaders, stakeholders, providers, patients, families, caregivers, or their respective social networks.

Contrary to the common assumption that *provider* is synonymous with *physician*, we emphasize that providers include the much broader scope of caregivers as well as groups of providers acting as teams. Providers seek resources, tools, and supports to assist in the delivery of excellent patient care as defined by their local context and their day-to-day experiential interactions with their patients. Providers also seek healing relationships with their patients and a positive professional environment that facilitates provider and patient satisfaction. Because our entire team has experience in direct patient care or experience in quality improvement in clinical settings, we understand that engagement and interventions targeting providers will fail unless they meet providers' basic requirements.

Patients, families, caregivers, and providers belong to social networks that influence their behaviors. People often engage in behaviors unconsciously, and they may remain unaware that these behaviors emanate from their participation in social networks. Furthermore, these behaviors are influenced by emotions (positive and negative). In both subtle and overt ways, engaging in a behavior consistent with personal social networks elicits positive emotions and thereby reinforces the behavior. Social networks also exert influence through shared decision-making in which we participate with others in determining the relevance of behavior change. We emphasize that health systems also participate in and are influenced by their social networks. Influential health systems, for example, sometimes make decisions that other health systems simply copy. In all these situations, there are members of the network who experiment, those who are early adopters, and those who are late adopters.

Creating an Agile Network of Change Agents

To optimize the full potential of the agile network, it needs to be spread across the nation and even the world. Only then will we be able to effectively transform healthcare delivery. A process of "helping it happen" diffusion is necessary to intentionally create a network that allows for widespread interactions and fosters emerging innovations. The agile network aligns solutions with the current healthcare market demand by maximizing value (quality/cost) and doing so in an environment that delivers a positive experience for patients, consumers, and providers. The agile network, structured as a complex and adaptive network, will be made of passionate change agents who are

1. known hubs and engage their own network of change agents,
2. small clusters of tightly connected change agents (small communities), or
3. individual change agents who connect with the network at multiple starting points through a variety of approaches.

This network (or networks) will need to have an effective mechanism for rapid experimentation, rapid feedback loops, and rapid analytics capable of distinguishing a change signal from noise. It will also require transparent, free-flowing, and personalized exchange of knowledge and discoveries to facilitate emergence of local innovations. The external and internal pressures on the network, as well as a "free-market" competition for improvements/innovations, will foster innovations that are aligned with demand to meet the desired goals.

We believe that this network, which can balance the national demands for healthcare transformation with the passion-fueled adaptive behaviors that can occur within local and grassroots emergent sectors, will be successful in preventing patients and consumers of healthcare from suffering like Tommy did.

How Would Tommy's Story Be Different?

How would Tommy's story be different if the agile network were successful and healthcare were transformed?

Tommy wanted to receive personalized care locally that was consistent with his values. He also wanted care that was informed by his personal network of messengers (trusted friends) and was designed to work through his intuitions, his fears, and his aspirations. He needed care that was evidence-based but delivered to him in a way he could relate to and understand. The healthcare delivery system was too centralized, too rigid, and too impersonal to give him that care. Even his family members in the healthcare field were unable to overcome the barriers implicit to the healthcare delivery systems they operated within.

If the agile network is successful at transforming the healthcare delivery system, it will be able to design care that is evidence-based, personalized, and effective at behavior change. Under a transformed system, Tommy may still have developed delirium, but his risk factors would have been mitigated. Tommy and his providers would have been able to access and better understand all the risks associated with his surgery. His delirium and Alzheimer's disease would have been identified earlier, and he would have had access to evidence-based treatments in his local community. In short, Tommy would have encountered a healthcare system that was designed to be compassionate, earn his trust, and develop a long-term relationship with him and his community.

In an agile network, care would be decentralized, and access to evidence-based care would not be limited to large tertiary care centers; it would be available to all patients and consumers of healthcare in a personalized way that would maximize their outcomes and their experience within their own communities.

Information would be available through a variety of channels that fit different needs and styles. Clinical decision aids would be customized to the needs of the person and would consider individual biases.

Essentially, Tommy would have been poised to avoid the unintended harm he encountered from his interactions with the healthcare system. An agile network would have been able to optimize his physical, emotional, and financial health, even if his final outcome of dying from Alzheimer's disease was unavoidable.

What Will You Do?

This journey is very personal to us because of what we have seen and experienced. Since you are reading this book, it must also be personal to you.

Healthcare will not be transformed by policy alone, or research and publications alone, or even a few systems experimenting with novel delivery models, or a few nonhealthcare companies disrupting it from outside. Healthcare will require a large network of passionate change agents who will leverage all the external and internal drivers, as well as the science of networks, complex adaptive systems, and behavioral economics, to make healthcare better for everyone.

If this sounds like a worthy enterprise to you, join us on this mission. Connect with us and let us know how you will make healthcare better.

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Second of all, let me tell you about my position, my widely important goal, and my experiences. Currently I am the Richard M Fairbanks Professor of Aging Research at Indiana University Center for Aging Research, the Director of Senior Care Innovation at Eskenazi Health, and the Founding Chief Innovation and Implementation Officer of the Indiana University Center for Health Innovation and Implementation Science. I am a geriatrician, a neuroscientist, and an implementation scientist with a goal of using insights from behavioral economics, complexity science, and network science to develop, implement, and distribute an innovative, sustainable, and scalable "blueprint" of the twenty-first-century learning academic healthcare delivery system. Such an agile social organization will be able to reduce the seventeen-year cycle of developing and translating innovative, cost-effective, and scalable medical innovations. At the same time, the learning system will be capable of delivering personalized, evidence-based, and valued healthcare with a great experience for clinicians, learners, and patients.

Over the past decade, I have mastered skills in the science of design, implementation, and diffusion. I have used these skills to build the Indiana University Center for Health Innovation and Implementation Science (CHIIS). CHIIS acts as an integrated and catalytic platform that provides transformational support services for the three healthcare systems affiliated with Indiana University. In 2015, CHIIS launched the Graduate Certificate in Innovation and Implementation Science, the first in the nation. This graduate certificate (www.hii.iu.edu) aims to support the development of a cadre of interdisciplinary transformational change agents who are skilled in the agile methodology and passionate about transforming healthcare.

The specific focus of my clinical research work is improving the brain health and the brain care quality at lower cost for older adults suffering from dementia or delirium in both inpatient and outpatient settings. My studies have included patient surveys, development of new clinical assessment tools, testing of new treatment models, and implementing such models in a very rapid, scalable, and sustainable way. My most important methodological contribution to research in this area has been my application of complexity science to the vexing problem of improving the performance of healthcare providers and healthcare systems. My most important clinical care contribution to date has been my work elucidating the role of total anticholinergic load and anticholinergic medications in the development and clinical course of dementia and delirium. My most important policy contribution has been my research on understanding the risks and benefits of routine screening for dementia.

Throughout my journey in healthcare transformation, I have been supported by amazing family, friend, mentors, and mentees. My wife, Mary, has been guiding me and keeping me nimble and in check! Her support of my long hours and my crazy ideas is second to none. My daughter, Katreen, and my son, Zayn, have been the sources of innovation, inspiration, and strength. My family together has been the fuel that kept me going. I also would like to thank my mentors, Dr. Callahan and Dr. Shekhar. They were the mirror who constantly gave me the precious feedback on my research and leadership growth and career. I also would like to thank my mentees who kept me going and provided me with hope that tomorrow will be better. Thank you Babar, Noll, Nicole, Nadia, Heidi, Sikandar, Randy, Kate, Jill, Andrew, Beth, Eric, Archita, Sophia, Ashley, and all the graduate students of the IU Certificate in Innovation and Implementation Science. And finally, thank you Craig, Rich, and Jose for your intellectual partnership in producing this book.

—Malaz Boustani

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in my own limited experience were widespread and, indeed, far worse for some. Bentzi was the first to help me realize where my life's passion lay: to improve health and healthcare. He was also the first to invite me to actually improve healthcare as an applied researcher and engineer.

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John Donne famously wrote, "No man is an island entire of itself; every man is a piece of the continent, a part of the main." My most precious pieces of continent are my wife Carly and my son Roman. For keeping me grounded and sane, I thank them along with my family, friends, and coworkers.

Last but not least, thank you to coauthors Malaz, Jose, and Craig, and all the contributors to the Great Lakes Practice Transformation Network and Center for Health Innovation and Implementation Science, who made this book possible.

—Rich Holden

I am grateful for all the experiences and opportunities I have been given along this journey.

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—Jose Azar

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—Craig Solid

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—Malaz Boustani, Rich Holden, Jose Azar, and Craig Solid

ABOUT THE AUTHORS

Malaz Boustani, MD, MPH is the the Richard M. Fairbanks Professor of Aging Research at Indiana University (IU) Center for Aging Research, the Director of Senior Care Innovation at Eskenazi Health, and the Chief Innovation and Implementation Officer of the Indiana University Center for Health Innovation and Implementation Science. He teaches the Graduate Certificate in Innovation and Implementation Science at IU (www.hii.iu.edu). He has published more than 150 peer-reviewed scientific papers and received funding from the NIH, AHRQ, and CMS. Dr. Boustani's most scientific contribution has been his application of complexity science to the performance of healthcare delivery systems. His most important clinical care contribution has been his work elucidating the role of total anticholinergic load and anticholinergic medications in the development and clinical course of dementia and delirium. Dr. Boustani's most important policy contribution has been his research on understanding the risks and benefits of routine screening for dementia.

Richard J. Holden, PhD is the Chief Healthcare Engineer for the Center for Health Innovation and Implementation Science and an Associate Professor of Medicine at the Indiana University School of Medicine. He earned a joint PhD in Industrial

Engineering and Psychology from the University of Wisconsin. Dr. Holden specializes in the design and evaluation of innovative interventions to improve health outcomes. He has led multiple projects to develop and test technologies for vulnerable individuals, including older adults, the chronically ill, and cognitively impaired. Dr. Holden's contributions to the human factors discipline are recognized by the William C. Howell Young Investigator Award, Bentzi Karsh Early-Career Service Award, and election to the executive council of the Human Factors and Ergonomics Society. He lives in Indianapolis with his wife, Carly Schall, and son, Roman Holden-Schall. His passions include cooking, biking, travel, and bad puns.

Joze Azar, MD is passionate about eliminating suffering from cancer and from healthcare delivery systems. He aspires to achieve this goal by developing agile learning organizations and leading diverse, interprofessional teams to rapidly and effectively implement best-evidence and discover innovative solutions to healthcare. Fom an initial interest in quality and patient safety, Jose became a student, then an educator, leader, innovator, and a developer of the novel method of Agile Implementation. Dr. Azar then disseminated this method by co-founding the Center and the Certificate for Health Innovation and Implementation Science, where he is now developing a network of passionate and resilient change agents capable of transforming healthcare to a safe, high-quality, equitable, affordable, and personalized service. He is the Chief Quality and Safety Officer at the IU Health Academic Health Center as well as the co-founder and Chief Engagement Officer at the Center for Health Innovation and Implementation Science. Dr. Azar is also a practicing Hematologist/Oncologist at the IU Health Simon Cancer Center.

He graduated from medical school at the American University of Beirut in Lebanon, and completed his residency in Internal Medicine and Fellowship in Hematology/Oncology at the Indiana University School of Medicine.

Craig A. Solid, PhD is the Owner and Principal of Solid Research Group, LLC in St. Paul, Minnesota. He has worked in healthcare research and quality for over twenty years, focusing on issues related to data, measurement, and value. He has also authored *Return on Investment for Healthcare Quality Improvement* and coauthored *Agile Implementation: A Model for Implementing Evidence-based Healthcare Solutions into Real-world Practice to Achieve Sustainable Change*. He lives in St. Paul with his wife, Emily, and their three children, Vieva, Emmett, and Kipp.

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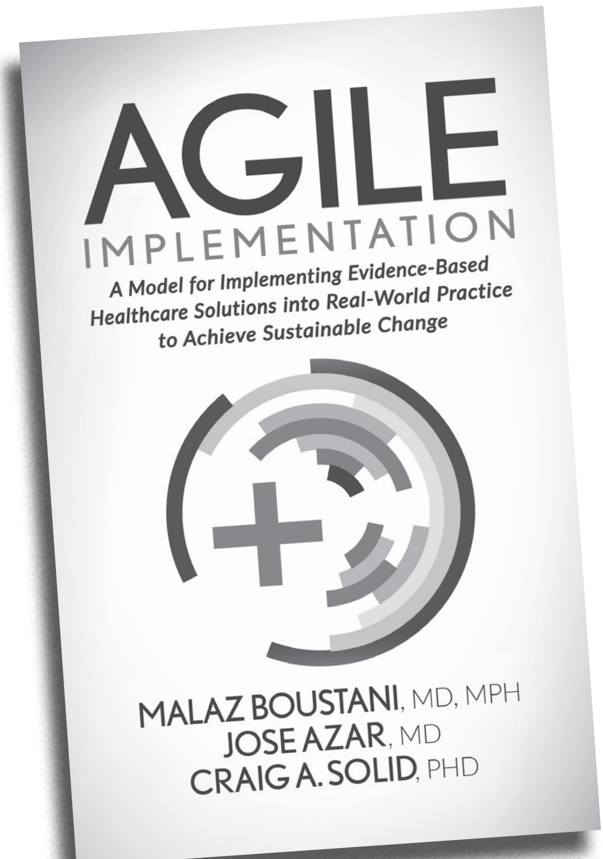

Agile Implementation details the origins of a model originally developed by Malaz Boustani, MD, MPH and Jose Azar, MD. In addition to illustrative examples that visually show how the model is applied to real-world situations, the book describes the underlying theories and frameworks that explain health delivery systems and lays out the eight steps of the Agile Implementation Model.

In today's complex healthcare environment, implementing evidence-based care into real-world practices is difficult and time-consuming. Even methods that are known to be effective allow for limited flexibility and therefore fail as often as they succeed. Through much study and experimentation, Malaz Boustani, MD, MPH, Jose Azar, MD, and Craig A. Solid, PhD have come to understand how individuals' interactions within the complex social systems of hospitals, clinics, and other care delivery organizations shape the decisions and behaviors of those involved. Upon this foundation and through leveraging theories of behavioral economics, they have developed the Agile Implementation Model, a process for selecting, adapting, implementing, evaluating, sustaining, and scaling evidence-based healthcare interventions.

This model acknowledges the uniqueness of each individual facility and considers individuals within the system to be semiautonomous but interconnected. Upon completing *Agile Implementation*, readers have a better understanding of why certain quality initiatives succeed while others fail and have tangible, actionable tools for implementing effective and sustainable change in the healthcare setting.

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