Change Management: An Overview of 3 Models of Change

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Radiology has been on the forefront of change in the health care field since the discovery of the x-ray by Wilhelm Roentgen in 1895. Since this time, radiology has embraced advances and new technology, including new modalities (eg, computed tomography [CT], magnetic resonance [MR] imaging), the shift from film to digital images, and minimally invasive image-guided procedures. As a specialty, radiology continues to be a driving force for advancements in medical practice, moving toward a more patient-centered approach to care. With technological advancements come the potential for disruption throughout the health care field. With the advent of the PACS, now referred to as the *medical image management and processing system (MIMPS)*, radiologists were no longer the sole proprietors of an image because images could now be shared with the spectrum of the patient's caregivers. Advancements in equipment, image storage and sharing, and dictation have further allowed radiologists to be a disruptive force in health care, thereby streamlining diagnosis and treatment of patients through increased efficiencies. Although these advancements increased radiologists' efficiency, they also opened the door to commoditization of the specialty.

Recent innovations in health care have focused on changes in payment mechanisms, through bundled payments and capitation, and machine learning. Payment reform has shifted direction from fee-for-service to value-based purchasing. Under this paradigm, imaging is moving from a profit center for hospitals and large groups to a cost center.[1] Machine learning has a higher potential for disrupting radiologist workflows because of its potential to decrease overall costs and increase efficiencies in patient care. This potential for disruption causes much angst for many radiologists because of the potential for job displacement and decreased individual perceived value. Machine learning advances will change the landscape of radiologic practice, but radiologists will determine what radiological practice looks like in the future. One of the largest tasks that radiologists have is determining how to handle innovation and change at all levels of their organization while maintaining patient safety, security, and quality.[2,3]

Change management throughout an organization is challenging, but it is something that radiology leaders must be well versed in. In the business sector, there has been a large emphasis on adapting transformational tools to improve quality, safety, customer satisfaction, and profit margins. John Kotter's 8-step process for leading change was recently reviewed.[4] Another noteworthy example of adaptation tools is lean process improvement and its predecessor Toyota Production System. The objective of the Toyota Production System is to create a system that designs out inconsistencies, eliminates waste, and decreases unreasonable excessiveness—*mura*, *muda*, *muri* in Japanese.[5] Lean processing has evolved as an efficient way to implement the ideals of the Toyota Production System into the hospital setting. However, there often is a disconnect between implementing change in the clinical setting and understanding whether the culture of the staff is primed and ready to implement change at all levels of the organization. As a result, efforts to make improvements often are short lived.

There are several models of change in the business literature that give insight into leading organizations through change. Three models provide various tactics for implementing new paradigms into an organization. These include the transtheoretical model, the diffusion of innovation model, and plan-do-study-act (PDSA). Each of these models has strengths and weaknesses. Matching the model to the type of change needed, as

well as the organizational culture, is necessary to create successful organizational change.

Transtheoretical Model

The transtheoretical model of change was first proposed by Prochaska and DiClemente in 1983 as a biopsychosocial model of understanding behavioral change.[6] To date, this has been used most robustly in addressing addictive behaviors such as smoking, with much success in the health care space. More recently, this model of change has been used to improve mammography screening rates and follow-up.[7] This model stands on the premise that behavioral change progresses through 6 stages[6]:

- precontemplation
- contemplation
- preparation
- action
- maintenance
- termination

In addition, there are dependent variables, including decisional balance, self-efficacy, and temptation, as well as independent variables characterized as processes of change.[8] A key feature of the transtheoretical model is that the steps must be completed in sequence without skipping.

A person in the precontemplation stage is characterized as currently not engaging in the target behavior and having no intention to do so. Typically, these individuals are not fully informed of the consequences of a behavior or lack of a behavior. In organizations, these people often are labeled as resistant or unmotivated to implement change. The contemplation stage is characterized by a person who is intending to act in the next 6 months. In this stage, there is an awareness of the advantages to making a change, however the disadvantages of making a change still have substantial weight. The preparation stage is one in which people are ready to act in the near future, usually in the next month. With this stage comes a plan of action. In the behavioral health care space this has typically included action items such as joining a gym, joining a group, or implementing a self-change approach. In the action stage, a person is performing specific tasks or modifications to implement the behavioral change they are seeking. This stage includes observable change such as cessation of smoking. In the maintenance stage, the individual is working to prevent relapse but does not need to apply change processes as often as those in the action stage. The final stage, termination, is one in which individuals have no temptation and are confident that their behavior will remain no matter what obstacles they may face. This behavior is now automatic and routine. Although termination is the goal of change, most people spend the majority of their time after a behavioral change in the maintenance stage.[9,10]

Often overlooked in the transtheoretical model of change is decision-making and decisional balance, which were conceptualized by Janis and Mann in 1977 as a balance sheet of cost and benefits that included 8 decision-making constructs[10]:

- approval from others
- approval from self
- disapproval from others
- disapproval from self
- instrumental benefits to others
- instrumental benefits to self
- instrumental cost to others
- instrumental cost to self

Although this model has been directed largely at health behaviors in patients, the basic construct of how people, and therefore organizations, manage change at a behavioral level is likely not much different. Understanding where people in an organization fit in the stages of change can allow for a more targeted approach to addressing needed change. For example, using structured and standardized reporting has been shown to decrease ambiguity in interpretating reports that can lead to confusion and medical errors and also promote adherence to guidelines.[11] This has been best represented by the implementation of the Breast Imaging Reporting and Data System.

Transitioning practices into standardized templates is a prime case for assessing the stages of the transtheoretical model of change. There are clear reasons to standardize templates for reporting purposes in radiology, in addition to those stated above, such as improving the search of reports for research purposes, improving patient care through standardized language, and allowing for review of diagnostic accuracy and outcomes.[12] However, the barriers can be high for radiologists who

are not used to standardized reporting and might feel that it will slow them down, decrease accuracy, and impede their communication styles. Radiologists at this stage, with no intention of moving into standardized reporting, are in the precontemplation phase. A radiologist in the contemplation phase understands the benefits of this type of reporting and plans to make changes but still has reservations. For radiologists in the precontemplation and contemplation phases in this scenario, data and information regarding the benefits of making this behavioral change are key. In the preparation phase, the radiologist is actively engaging in steps that will allow them to begin using standardized reporting in the group, either by creating templates for the group or giving constructive input to the group on what the templates should look like. A plan to move into standardized reporting is now in place. In the action phase, the radiologist is using standardized templates with the group as current practice. In the termination phase, there is no temptation to move back to the previous mode of operation, and standardized reporting is second nature.

If institutions seek to implement structured reporting throughout the department, an understanding of where an individual radiologist is along the stages of change is useful, and a targeted approach to that individual's needs can be implemented through education and evaluation of the pros and cons they are facing.

Diffusion of Innovation Model

The diffusion of innovation theory was developed in 1962 by Everett Rogers to explain how an idea or product spread through a specific population or social system.[13] Rogers defined diffusion as a kind of social change and a process by which innovation is communicated through certain channels. He determined 4 main elements in this theory: the innovation, communication channels, time, and a social system (see **Figure 1**).

An innovation is an idea or practice that is perceived to be new. The subject of an innovation can develop favorable or unfavorable views of the innovation. Different rates of adoption often are determined by a certain set of characteristics[13]:

- relative advantage – the degree to which the innovation is perceived as better than the idea that precedes it
- compatibility – the degree to which the innovation is consistent with the values, needs, and experience of the adopter
- complexity – the degree to which an innovation is difficult to understand and use
- trialability – the degree to which an innovation can be experimented with on a limited basis
- observability – the degree to which the results of an innovation can be seen by an adopter

There are multiple channels through which diffusion of innovation can occur. These include mass informational exchanges, such as via email, radio, social media, and television, as well as interpersonal channels (ie, one-on-one interactions). Research has shown that individuals with similar attitudes, beliefs, and values will disseminate communication more effectively than will a more heterogeneous population.[14] The larger an organization or practice, the more challenging it can be to communicate innovations and for them to diffuse throughout the system. This is likely why time is such an important element in the diffusion process.

Time is an integral piece in allowing for the decision process surrounding an innovation to occur and understanding rates of adoption. The innovation decision process describes the process of first having knowledge of an innovation and forming an attitude toward it. This process includes 5 phases[15]:

- knowledge
- persuasion
- decision
- implementation
- confirmation

Knowledge is when a person is exposed to the innovation. Persuasion is when the person forms a favorable or unfavorable attitude toward the innovation. The decision occurs when the person seeks to adopt or reject the innovation. Implementation is when the innovation is used. Confirmation is when there is reinforcement of the decision to implement the innovation or reject it.

In this process, the rate of adoption varies among individuals and groups. This has led to a classification of adopter categories: innovators, early adopters, early majority, late majority, and laggards. Innovators are those who seek out new ideas, often not needing much information to try a new product or idea. They are more

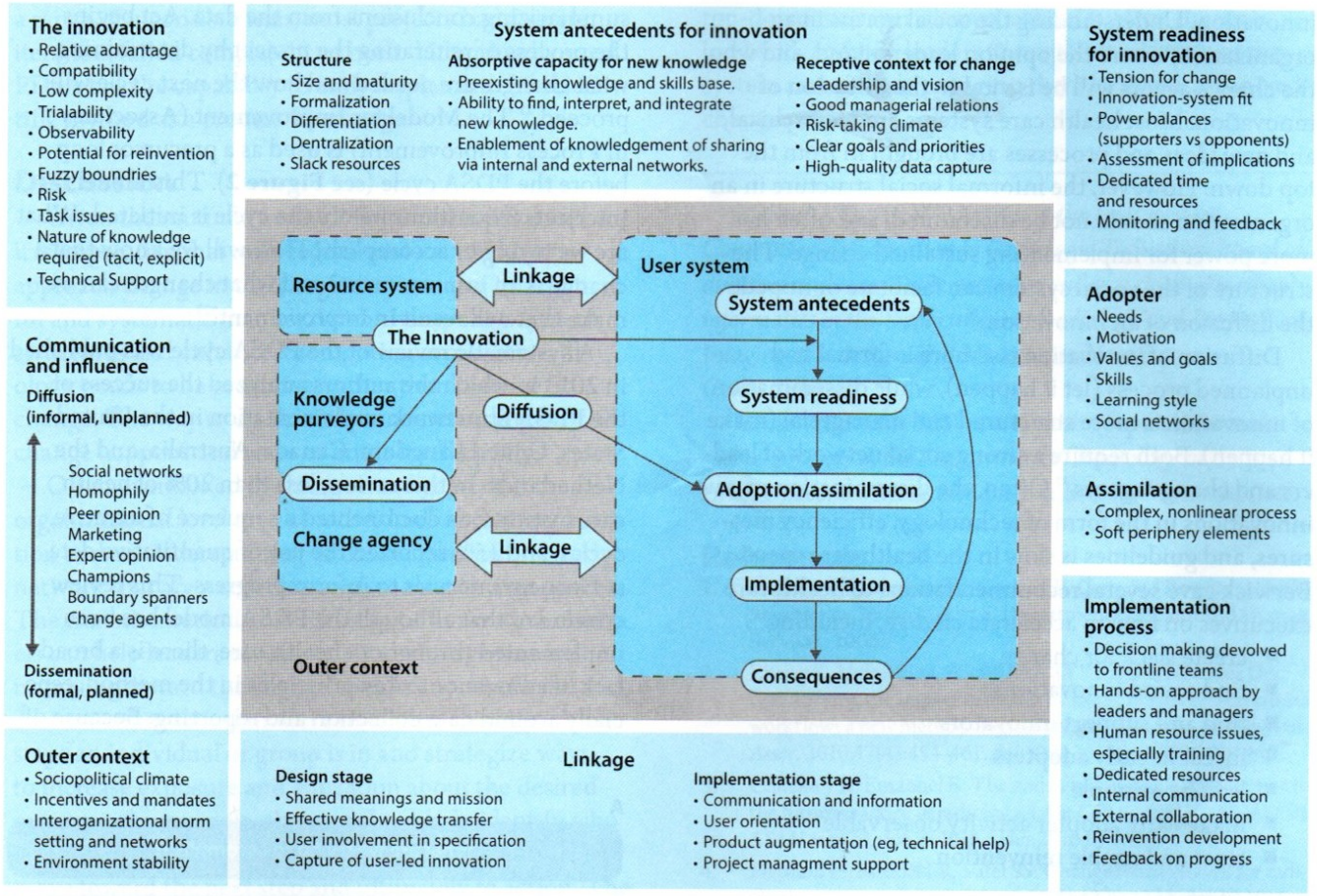

Figure 1. *Diffusion of innovation vs the dissemination of innovation. Figure courtesy of the authors.*

comfortable with uncertainty. Early adopters often represent key opinion leaders and are comfortable with adopting new ideas. The early majority often need to see evidence that an innovation works and is superior to the status quo before adoption occurs. The late majority are often skeptical of change and often wait until the majority are using the innovation successfully. Laggards are typically the hardest group to convince to adopt change, often requiring statistics and peer and managerial influence.

As a technology-centered field, radiology often is at the forefront of the adoption of new technologies. At the center of this discussion today is the implementation of artificial intelligence into the radiologist workflow. An individual radiologist can look at artificial intelligence in 2 different ways. It can be seen as technology that can augment image interpretation, optimize prioritization of worklists, and enhance scheduling practices, or it can be seen as potential threat to future livelihood and job security. In both cases, individuals have been exposed to a new technology (knowledge), formed a positive or negative view (persuasion), and moved toward a stance to reject or adopt the technology (decision). If a group decides to increase its exposure to artificial intelligence, a considerable amount of time must be spent in these 3 phases with the radiologists. Understanding who in the group is an innovator or early adopter, as these individuals will be champions for the change, and who in the group will be a late adopter or laggard, as these individuals will need more information and observable points of reference, is important. The social network is likely the most important aspect of diffusing

innovation. Understanding the social norms in an organization, where the opinion leaders stand, and who the change agents will be is vital to the diffusion of innovation. Most health care systems are hierarchical, and new ideas and processes are brought in from the top down. However, the informal social structure in an organization should not be discounted, and often has more power for implementing sustained change. The structure of the social system can facilitate or impede the diffusion of an innovation.[16]

Diffusion of innovation is a more informal and unplanned process (let it happen), while dissemination of innovation is more structured and managerial (make it happen). Both require a strong social network of leaders and change agents.[17] Often, the dissemination of new innovations in the form of technology, efficiency measures, and guidelines is slow in the health care space. Berwick gave several recommendations to health care executives on how to accelerate change, including[18]:

- create slack for change
- find sound innovations
- find and support innovators
- invest in early adopters
- lead by example
- make early adopter activity observable
- trust and enable reinvention

Plan-Do-Study-Act

The PDSA model is used widely in health care quality improvement. PDSA is a systematic cycle for building knowledge and implementing a continual improvement process. The PDSA cycle evolved from earlier models developed by Walter Shewhart and Dr William Edwards Deming, including the Deming wheel.[19] The strength of the PDSA cycle is its foundation in the scientific method such as hypothesis formation, data collection, analysis, and results interpretation. This model was originally created for industry, but was translated into health care in 1996 by Gerald Langley.[20] In this adaptation, plan is characterized by identifying the objective and resources to carry out the cycle (including financial, human, structural, and system resources). Do entails executing the plan and documenting issues and unexpected observations. Study involves analyzing the data, comparing data to the initial hypothesis, and summarizing conclusions from the data. Act begins the process of reiterating the project by determining what changes are needed and how the next cycle will proceed.[21] The Model for Improvement (Associates in Process Improvement) is used as a precursor loop before the PDSA cycle (see **Figure 2**). This model interjects 3 questions before the cycle is initiated: What are we trying to accomplish? How will we know that a change is an improvement? and what changes can we make that will result in improvement?[22]

A systematic review of the PDSA cycle was published in 2013 in which the authors analyzed the success of the PDSA framework implementation in the United States, United Kingdom, Canada, Australia, and the Netherlands. In this review, less than 20% of health care institutions documented a sequence of iterative cycles, and 15% reported the use of quantitative data at frequent intervals to inform progress. This review concluded that although the PDSA model has been implemented throughout health care, there is a broad lack of adherence to key principles in the method, especially around data collection and reporting. Because of

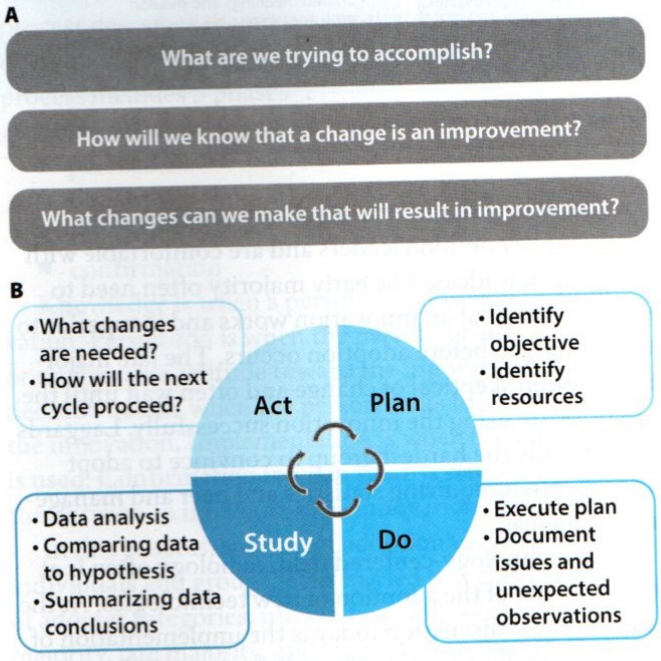

Figure 2. *A. Model for improvement framework. B. Plan-Do-Study-Act cycle. Figure courtesy of the authors.*

a range of inconsistencies, most projects had a single iteration, failed completely, or both.[23] If optimally used, PDSA has the capability to truly implement the scientific method as a process for change.

Discussion

Given the mutuality of radiology and innovation, it is imperative that radiologists understand how to approach change in their organizations in a thoughtful and systematic manner. With changes in payment structures and enhanced computing capability, radiology needs to be proactive, rather than reactive, to change. The way to do this is by understanding how change happens and ways to guide it effectively.

Often overlooked in change management at the organizational level are the individuals in that organization and an understanding of the social structure and network that are needed to implement a change process. The transtheoretical and diffusion of innovation models can help leaders reveal who in their organization is moving toward the change sought and who is not. The transtheoretical model can further identify which stage an individual or group is in and strategize ways to increase exposure and education about the desired outcome; for example, the model can help identify who is in the precontemplation phase and devise ways to move toward the next step and ultimately to action. The diffusion of innovation model can help identify change agents and opinion leaders in an organization, which can be used strategically to disseminate change everywhere. Although these models focus on the types of individuals involved in making positive improvements, the PDSA model puts a scientific framework around change and allows for data collection and tracking of progress through several iterative cycles. The authors propose that using these models will affect positive change for radiology organizations and groups.

Conclusion

Technologists are constantly faced with new technology and the need to redesign, improve, or replace existing processes. By applying these methods to proposed changes, change management projects can be implemented successfully and benefit long-term patient care and quality. This is not completed with a top-down managerial approach, as is often the case, but by identifying leaders throughout all levels of the system and actively engaging them in a well-organized change process.

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References

1. Shekelle PG, Morton SC, Keeler EB. *Costs and Benefits of Health Information Technology.* U.S. Department of Health and Human Services; 2006.
2. Zheng K, Haftel HM, Hirschl RB, O'Reilly M, Hanauer DA. Quantifying the impact of health IT implementations on clinical workflow: a new methodological perspective. *J Am Med Inform Assoc.* 2010;17(4):454-461. doi:10.1136/jamia.2010.004440
3. Chockley K, Emanuel E. The end of radiology? Three threats to the future practice of radiology. *J Am Coll Radiol.* 2016;13(12 Pt A):1415-1420. doi:10.1016/j.jacr.2016.07.010
4. Fleishon H, Muroff LR, Patel SS. Change management for radiologists. *J Am Coll Radiol.* 2017;14(9):1229-1233. doi:10.1016/j.jacr.2017.02.053
5. Kim CS, Spahlinger DA, Kin JM, Billi JE. Lean health care: what can hospitals learn from a world-class automaker? *J Hosp Med.* 2006;1(3):191-199. doi:10.1002/jhm.68
6. Brookes E. Transtheoretical model: stages of health behavior change. SimplyPsychology. Updated November 9, 2023. https://www.simplypsychology.org/transtheoretical-model.html
7. Rakowski W, Dube AC, Goldstein MG. Considerations for extending the transtheoretical model of behavior change to screen mammography. *Health Educ Res.* 1996;11:77-96. doi:10.1093/her/11.1.77
8. Armitage CJ. Is there utility in the transtheoretical model? *Br J Health Psychol.* 2009;14(Pt 2):195-210. doi:10.1348/135910708X368991
9. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot.* 1997;12(1):38-48. doi:10.4278/0890-1171-12.1.38
10. Prochaska JO. Decision making in the transtheoretical model of behavior change. *Med Decis Making.* 2008;28(6):845-849. doi:10.1177/0272989X08327068
11. Schwartz LH, Panicek DM, Berk AR, Li Y, Hricak H. Improving

communication of diagnostic radiology findings through structured reporting. *Radiology*. 2011;260(1):174-181. doi:10.1148/radiol.11101913

12. Kahn CE Jr, Langlotz CP, Burnside ES, et al. Toward best practices in radiology reporting. *Radiology*. 2009;252(3):852-856. doi:10.1148/radiol.2523081992
13. Dearing JW, Singhal A. *Communication of Innovations: A Journey with Ev Rogers*. Sage; 2006:15-28.
14. McPherson M, Smith-Lovin L, Cook JM. Birds of a feather: homophily in social networks. *Ann Rev Soc*. 2001;27:415-444. doi:10.1146/annurev.soc.27.1.415
15. Dobbins M, Ciliska D, Cockerill R, Barnsley J, DiCenso A. A framework for the dissemination and utilization of research for health-care policy and practice. *Online J Knowl Synth Nurs*. 2002;E9(1):149-160. doi:10.1111/j.1524-475X.2002.00149.x
16. Rogers EM. *Diffusion of Innovations*. The Free Press; 1983.
17. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Q*. 2004;82(4):581-629. doi:10.1111/j.0887-378X.2004.00325.x
18. Berwick DM. Disseminating innovations in health care. *JAMA*. 2003;289(15):1969-1975. doi:10.1001/jama.289.15.1969
19. The Deming Insitute. PDSA cycle. Published May 28, 2015. Accessed June 13, 2017. https://blog.deming.org/2015/05/the-history-and-evolution-of-the-pdsa-cycle/
20. Langley G. *The Improvement Guide: A Practical Approach To Enhancing Organizational Performance*. Jossey-Bass Publishers; 1996.
21. How to improve. Institute for Health Care Improvement. Published 2017. Accessed June 9, 2017. http://www.ihi.org/resources/Pages/HowtoImprove/ScienceofImprovementTestingChanges.aspx
22. Lee CS, Larson DB. Beginner's guide to practice quality improvement using the model for improvement. *J Am Coll Radiol*. 2014;11(12 Pt A):1131-1136. doi:10.1016/j.jacr.2014.08.033
23. Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Qual Saf*. 2014;23(4):290-298. doi:10.1136/bmjqs-2013-001862