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By James W. Dearing and Jeffrey G. Cox

# Diffusion Of Innovations Theory, Principles, And Practice

DOI: 10.1377/hlthaff.2017.1104  
HEALTH AFFAIRS 37,  
NO. 2 (2018): 183–190  
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The People-to-People Health  
Foundation, Inc.

**ABSTRACT** Aspects of the research and practice paradigm known as the diffusion of innovations are applicable to the complex context of health care, for both explanatory and interventionist purposes. This article answers the question, “What is diffusion?” by identifying the parameters of diffusion processes: what they are, how they operate, and why worthy innovations in health care do not spread more rapidly. We clarify how the diffusion of innovations is related to processes of dissemination and implementation, sustainability, improvement activity, and scale-up, and we suggest the diffusion principles that can be readily used in the design of interventions.

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In synthesizing many studies from different disciplines about how people respond to new ideas, Everett Rogers was answering a call set forth by the sociologist Robert K. Merton: theorize, but in empirical ways and with practical implications.<sup>1</sup> Now, fifty-six years past the first publication of Rogers’s book *Diffusion of Innovations*, we briefly review this theory, its principles, and the implications for practice as a fifteen-year update to the book’s last edition in 2003.

One of the best documented if frustrating principles of diffusion is that it can take a long time. Consider the case of Project ECHO (Extension for Community Healthcare Outcomes), previously reported in *Health Affairs*.<sup>2</sup> This innovation in how academic medical centers partner with rural primary care clinicians to extend specialty care began at one site in New Mexico in 2003. By November 2017 Project ECHO reported 158 sites across the US, with sixty more sites in twenty-four other countries.<sup>3</sup> The program has moved from hepatitis C care to include HIV/AIDS, geriatrics, psychiatric medication management, and more.<sup>4</sup> Or consider the Green House model of nursing home care, in which “house-like” facilities are built that emphasize an open kitchen, residents’ control in decision making, and empowered nursing assistants.<sup>5</sup> Underwritten by a

series of developmental, demonstration, and evaluation grants from the Robert Wood Johnson Foundation beginning in 2003, more than 200 Green Houses were in operation across the US in 2017 with 300 expected by the end of 2018.<sup>6</sup>

Project ECHO and the Green House model are evidence-based innovations that are spreading as new ways to deliver health care, but have they diffused? To assess the diffusion of an innovation, one must attend to its denominator. In these examples, the number of plausible and potential adopting sites for either of them is large, with 4,134 Medicare-certified rural health clinics in 2015 and 15,583 certified nursing facilities in the US in 2016.<sup>7</sup> In diffusion terms, even after fourteen years and like many other health care innovations, impressive innovations such as Project ECHO and the Green House model still have not reached “takeoff” or a tipping point in time on a national diffusion curve.<sup>8</sup>

## What Is Diffusion?

*Diffusion* is a social process that occurs among people in response to learning about an innovation such as a new evidence-based approach for extending or improving health care. In its classical formulation, diffusion involves an innovation that is communicated through certain chan-

nels over time among the members of a social system.<sup>9</sup> The typical dependent variable in diffusion research is time of adoption, though when complex organizations are the adopters, subsequent implementation is a more meaningful measure of change. Diffusion can be assessed among individuals such as members of Congress, organizations such as health care insurers, or larger collectivities such as cities and states. Exhibit 1 illustrates the relationships between rates of adoption and how we characterize diffusion under different scenarios, including when innovations are introduced and do not diffuse. When time-of-adoption data are graphed cumulatively, an S-shaped curve is common, with an initial slow rate of adoption giving way to a rapidly accelerating rate, which then slows as fewer nonadopters remain within the social system in question. Not all instances of diffusion play out this way, especially in policy diffusion—where time to adoption can be shorter because of the occasional convergence of national attention to a problem, financial incentives, readiness for change among elected officials, motivated and organized groups, and an innovative solution that is perceived positively.<sup>10</sup>

As exhibit 1 suggests, several contextual aspects of diffusion typically go unstudied. Competing or complementary innovations are important, since potential adopters usually have a choice in what to adopt. Failures are important, since most innovations do not diffuse. Deceleration is important in two ways, since the decision to adopt an innovation often means abandoning a prior one,<sup>11</sup> and nonadopters have their deci-

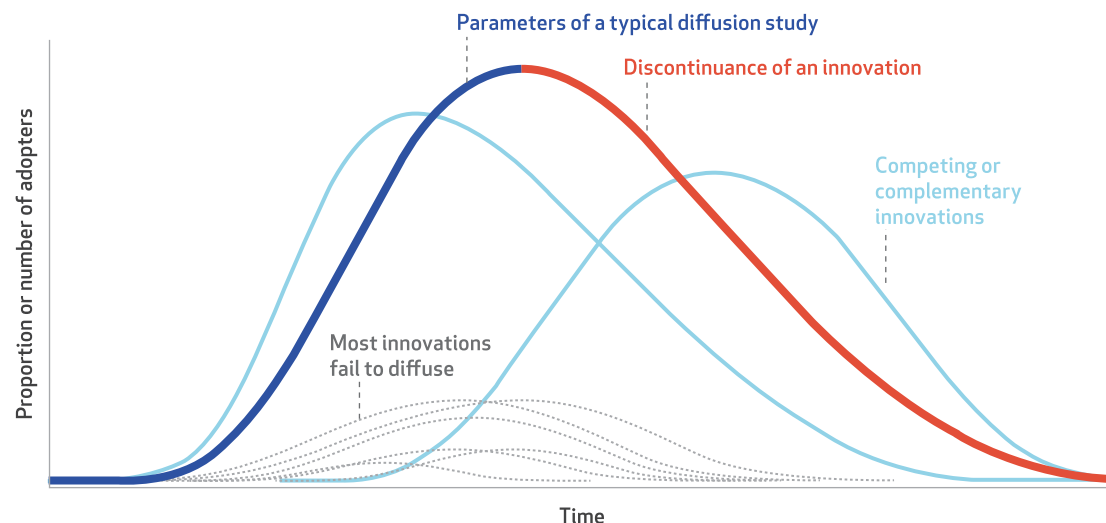
sion to reject an innovation socially confirmed.<sup>12</sup>

In the case of voluntary adoption decisions, acceleration in the rate of diffusion is usually the result of influential members of the social system making the decision to adopt and their decision being communicated to others, who then follow their lead. To use the example of efforts to reduce tobacco use, while a small subset of tobacco taxation policy experts, child welfare specialists, or mayors may make careful assessments of the evidence and other attributes of an innovation, most of their eventually adopting peers do not. When opinion-leading individuals and organizations adopt an innovation, social systems convert from one normative state (such as smoking in public being acceptable) to another (smoking being unacceptable). When opinion leaders do not adopt an innovation, systems do not change. Diffusion is an atypical outcome, since the vast majority of innovations fail to diffuse, never accelerating up an S-shaped curve.<sup>13,14</sup> This can be a wholly warranted result, since an *innovation* is defined simply as that which is perceived to be new—not necessarily better—by potential adopters. Unworthy innovations sometimes diffuse, and effective innovations are often stymied.

Over time through waves of innovations, diffusion changes societies. Sometimes these changes manifest as differences in knowledge, disproportionate access to government and commercial services, and worsening inequality because resource-rich communities tend to adopt innovations early relative to poor communities.<sup>15</sup> In this special issue of *Health Affairs*, for exam-

# EXHIBIT 1

## The context of diffusion



**SOURCE** Authors' analysis. **NOTE** Each curve represents a separate hypothetical innovation.

ple, researchers report that rates of adoption of annual wellness visits were lower among practices caring for poor communities.<sup>16</sup> Resource-rich communities with greater concentrations of professionals exhibit greater capacity to acquire and make use of innovations.<sup>17</sup> Even when low-income communities also benefit from innovation adoption, gaps between the haves and the have-nots can widen. A study of forty-four criminal justice policies and their diffusion from 1960 to 2008 shows that states are more likely to adopt policies that benefit privileged segments of the population and weaken marginalized segments.<sup>18</sup> Fortunately, diffusion principles can be used in ways that stimulate the spread of innovations specifically in low-resource settings,<sup>19</sup> a strategy known as purposive dissemination or designing for diffusion.<sup>20</sup>

### Factors That Affect Diffusion

Diffusion or the lack thereof is often well explained by three general sets of variables: each innovation's set of pros and cons, or attributes; the characteristics of adopters, especially potential adopters' perceptions of opinion leaders' reactions, or social influence; and the larger social and political context, including the salience of issues related to the innovation, how proponents and opponents frame the meaning of the innovation, and the timing of its introduction. Perhaps unsurprisingly, given diffusion's many concepts, diffusion studies have helped form the basis for a number of other areas of study,<sup>21</sup> such as dissemination and implementation science in health.<sup>22</sup>

When a person learns about an innovation that they think may have important consequences for them or those they serve, uncertainty about how to respond typically leads to a search for further information, so the potential adopter can better assess whether the innovation's attributes warrant further exploration. The following pros and cons are well codified: cost, or the perceived monetary, time, or other resource expense of adopting and implementing an innovation; effectiveness, or the extent to which the innovation is perceived to work better than what it would displace; simplicity, or how easy the innovation is to understand and use; compatibility, or how well the innovation fits with established ways of accomplishing the same goal; observability, or the extent to which outcomes can be seen; and trialability, or the extent to which the adoption decision is reversible or can be managed in stages.

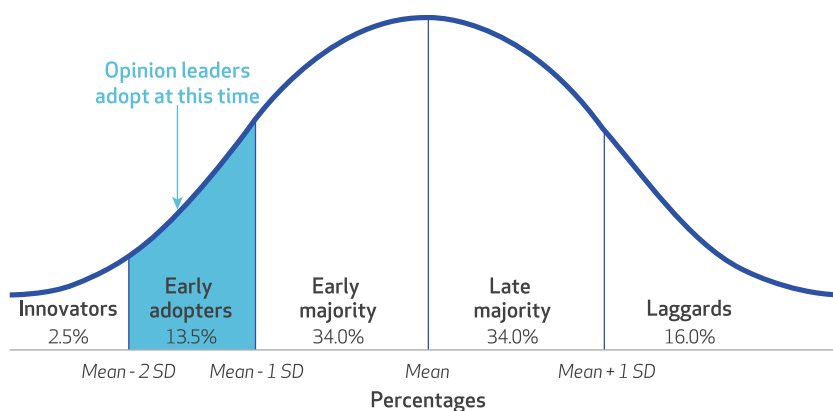
Whether or not people engage in such a cost-benefit assessment, if the innovation continues to seem promising and consequential to them,

they may engage in a secondary search for the evaluative judgments of trusted, expert, and accessible others—that is, opinion leaders—who are more discriminating and less susceptible to influence.<sup>23</sup> The seeking of advice or the modeling of one's behavior on what others do is a heuristic that often reflects an emotional desire for status and that allows the decision maker to save time while reducing uncertainty. Taken together, an innovation's attributes and social influence can be thought of as psychological and sociological barriers that serve to protect the potential adopter from unworthy innovations. At the level of the social system, this manifests as no or partial diffusion, or a very slow rate of adoption.

Needs and motivations differ among people according to their degree of innovativeness (exhibit 2). Based on Everett Rogers's meta-review of empirical studies,<sup>9</sup> the first to adopt (innovators) tend to do so because of excitement over novelty and feeling unconstrained by social norms; the next to adopt (early adopters, some of whom are opinion leaders) do so because of a measured appraisal that an innovation's advantages outweigh its disadvantages; and the subsequent early and late majorities adopt because they feel social pressure to do so. Laggards are, like innovators, less susceptible to social pressure and feel free to take their time. Campaigns to spread evidence-based innovations often target particular messages to the degree of innovativeness (or readiness to change) of potential adopters on the basis of data from formative evaluations. Innovativeness reflects individual thresholds for change: To adopt an innovation themselves, those who adopt early require few in their reference group to have already adopted;

#### EXHIBIT 2

Distribution of adopter innovativeness based on time of adoption



**SOURCE** Modified from Rogers EM, Diffusion of innovations (see note 9 in text). **NOTES** This exhibit is based on Everett Rogers's meta-review of empirical diffusion studies. SD is standard deviation.

those who wait need more of their contacts to have adopted.

Motivations and time of adoption can be predicted by each adopter's structural position in the network of advice-seeking and advice-giving relationships that tie a social system—an organization, community, or virtual network—together. The pattern of diffusion often begins on the periphery of a relational network, as the first to try the innovation experiment with it. Central members of the network—the opinion leaders—observe the periphery and then adopt the innovation if they judge it to have important advantages over current practice. And the many others between the center and the periphery then follow by paying attention to what highly connected opinion leaders do and advise.<sup>24</sup> This form of social contagion, an outside-inside-outward progression of adoption, when graphed cumulatively, reflects the S-shaped diffusion curve.

Potential adopters also perceive the relevance of innovations when others like themselves adopt, even if they are not relationally connected. This sort of imitative effect can result from having the same job title, same type of employer, common training, same hometown, or shared beliefs or practices—all of these can lead potential adopters to reject or adopt innovations since homophilous others have done so. Modelers, forecasters, and experimentalists have spent considerable time testing the effects of both heterogeneous differences among units of adoption and homophilous characteristics of social system members on the decision to adopt<sup>25,26</sup> and have shown, for example, that lagged introductions of innovations across countries can actually accelerate diffusion by allowing potential adopters in later-adopting countries to better assess early adopters' experiences with an innovation.<sup>27</sup>

### Triggering Of Interest And Demand

While easy to confuse, dissemination activity and diffusion processes are wholly distinct. Dissemination refers to activities by proponents or intermediaries to inform others of an innovation, often in terms of segmenting targeted audiences. Information about an innovation is transmitted or advertised in what is usually a one-to-many process using social, mass, or specialty media channels—though simply making information available is probably more common. With innovations that require complex implementation, dissemination of information is joined with the establishment of branch offices, in much the same way that health care providers open new clinics; licensing affiliate organizations as franchises, much as the Center for Medi-

## While easy to confuse, dissemination activity and diffusion processes are wholly distinct.

care and Medicaid Innovation established agreements with accountable care organizations to partner with hospitals and practices to spread the principle of rewarding value over volume; or partnering with distribution networks as a pathway to scale, in much the same way as the Agency for Healthcare Research and Quality uses health extension networks to help small primary care practices institute preventive cardiac care in the EvidenceNOW innovation.<sup>28</sup> All of these pathways to scale still rely on the activation of demand from providers or patients as essential for sustained scale-up success.<sup>29</sup>

So diffusion is a form of social activation that may or may not occur after the dissemination of information or scaling up of services or products has occurred. Diffusion can also occur without organized, intentional dissemination.

### Implementation Science And Diffusion Processes

Implementation science is the study of what happens before, during, and after an innovation's adoption occurs, especially in organizational settings.<sup>30</sup> Many studies of implementation focus on the period before dissemination, on field-based tests of external validity to understand the extent to which an evidence-based innovation is effective under realistic practice conditions and thus a good candidate for dissemination. A smaller proportion of implementation research concerns postdissemination behavior, partly because of the oft-occurring lag for diffusion to occur.

An implementer is someone who will change their behavior to use an innovation in practice. In complex organizations, the users are often not the choosers of an innovation—which can make the study of implementation fascinating, since motivation to use an innovation in practice can be absent or can even contribute to sabotage. Historically, little attention to implementation has been a major limitation of diffusion research, most of which focused on physicians,



farmers, consumers, and other autonomous decision makers for whom adoption served as a reasonable proxy for use. In clinics and other types of organizations, the extent and quality of implementation and the responses of clients and constituents are outcomes at least as important as initial adoption. The same can be said about the sustained use of innovations after implementation and continued outcomes for patients or other end beneficiaries. Sustainability is the subject of increasing study by implementation science and organizational change scholars.<sup>31</sup>

### Government Policies As Innovations

Policies have been long studied as innovations in the diffusion tradition, starting with a seminal US study about the spread of traffic-safety legislation among the states<sup>32</sup> to hundreds of diffusion studies about policies concerning education, health, civil rights, and lotteries.<sup>33</sup> While studies about policy diffusion among the states suggest rapid imitation once diffusion begins, the diffusion of policies sometimes demonstrates the same S-shaped curve as do other types of innovations in their cumulative distribution over time,<sup>34</sup> with long latency periods before media and public attention are able to propel policy adoption—as was the case with the issue of HIV/AIDS in the 1980s.<sup>35</sup> Researchers often conceptualize more or less time-ordered stages of policy consideration, adoption, and growth or scale-up,<sup>36</sup> though such stages have become compressed over the past century as communication technology has enabled faster and faster awareness of innovations.<sup>10</sup>

Policy diffusion researchers have found that beliefs about an innovation's effectiveness can be more important than knowledge of actual outcomes, again suggesting that who has previously adopted an innovation can be more important for decision makers than what was previously adopted and what effects it had.<sup>37</sup> This type of result echoes the importance of imitation and mimicry in studies of other types of innovations in other eras and in other countries.<sup>38</sup> Policy diffusion studies show that national policy and media attention can drive policy consideration at the state level,<sup>39</sup> as a contextual effect,<sup>18</sup> though there is evidence that policy attention and enactment in neighboring states and gubernatorial agenda-setting can be stronger predictors of state policy adoption.<sup>40</sup> There is also considerable evidence that local successes in cities and states can become noticed and highlighted at the federal level and then diffuse back out broadly to the states as new programs and policies, often with the incentive of funding mechanisms.<sup>33,41</sup>

Policy diffusion among the states accelerates with more federal attention to a problem area and its policy alternatives.<sup>42</sup>

Policy diffusion studies have also shown the importance of types of intermediary actors, such as professional associations, in diffusion processes.<sup>43</sup> Policy entrepreneurs are a particularly notable type of actor with the ability to pollinate political jurisdictions with innovations.<sup>44</sup> A policy entrepreneur combines the functions of a bridge who ties together disparate groups with that of a champion who represents an innovation from one city or state to high-level decision makers in other jurisdictions. Effective policy entrepreneurs are able to talk about innovations as solutions to public policy problems in ways that are politically palatable.<sup>45</sup> Policy entrepreneurs have been state representatives, leaders of nonprofit community organizations, and well-known experts within a profession. They work to exploit political windows of opportunity; frame solutions to problems in politically palatable ways; and join together disparate individuals, groups, and networks to diffuse policies.

### Fidelity, Reinvention, And Adaptation

Fidelity is the extent to which an innovation is implemented by others in the way intended by its developers. Fidelity is often measured as the correspondence between how a program is delivered in tests before scale-up and how the program is later offered by implementing partners in the field.<sup>46</sup> Innovation developers differ in the degree to which they modify innovations before dissemination, and how much they seek to maintain control over potential modifications by practice-based implementers. Although a strict adherence to the original procedures may be desirable to maximize effectiveness in the new setting, implementers often make changes—knowingly or not—to better fit an innovation to their organization and clients.

Fidelity can be affected in the process of diffusion in two ways: reinvention and adaptation. Reinvention refers to changes made by an innovation's developer to an innovation before its dissemination or scale-up to increase its likelihood of being adopted and effectively implemented. These changes often take the form of lessening a "perfect" but costly innovation so that it produces enough benefit to justify its dissemination to more beneficiaries. For example, the YMCA of the USA reinvented its Diabetes Prevention Program from a one-on-one counseling intervention led by a medical professional to a group intervention facilitated by YMCA personnel—which lowered the program's cost

and broadened its reach.<sup>47</sup>

Adaptation refers to changes made to an innovation by implementers who serve intended beneficiaries. Adaptations are made by staff in response both to the immediate context of a health care or public health organizational setting and to changes in the external environment that can make or break the sustained applicability of an innovation for improving health and health care. Developers who share or cede control of the implementation of an innovation, sometimes insisting on fidelity to its core components while encouraging customization of peripheral components, can achieve diffusion through ongoing course corrections and allowing the implementation strategy to evolve, as exhibited in the twenty-year history of Health Leads reported in this issue of *Health Affairs*.<sup>48</sup> Health Leads has successfully integrated social needs into clinical care partly as a result of developers' willingness to cede control. This result—that degrees of decentralized control can increase the rate and reach of innovation diffusion—is found in studies of educational and public health innovations, too.

Feedback from field-based implementers so that ongoing results can contribute to an evolving implementation strategy need not end with developers. The sharing of real-time insights from implementers to other implementers is a key takeaway lesson from the Center for Medicare and Medicaid Innovation's experience, as reported in this special issue.<sup>49</sup> Performance improvement methodology does not suit all innovations, but health care services in particular seem well suited to the incorporation of stakeholders' perspectives into service redesign.<sup>50</sup> Enabling and supporting adaptation by stakeholders can produce sustained use of innovations because of a stronger sense of ownership by implementers,<sup>51</sup> as long as adaptations are fidelity consistent.<sup>52</sup>

### Using Diffusion Concepts To Affect Rate And Reach

Purposive dissemination, or designing for diffusion, means taking additional steps early in the process of creating an innovation to increase its chances of being noticed, positively perceived, adopted, adapted, and implemented—and, thus, successfully crossing the research-to-practice chasm.<sup>53</sup> First of all, one wants to be certain that an innovation should be diffused and that, in so doing, its reach is extended to those communities and population segments where need is greatest and capacity is sufficient to adopt and implement the innovation to good effect. In purposive dissemination, external validity—the in-

## Getting off on the right foot in the stimulation of a diffusion process is important.

novation's ability to achieve positive outcomes across a diversity of sites—needs to be assessed (ideally on the basis of theory as well as data) from the vantage points of stakeholders who will implement the innovation.<sup>54</sup> Other measures of readiness also should be assessed, including how potential adopters perceive the attributes of the innovation and the availability of implementation support in anticipation of demand from providers and patients.<sup>55</sup>

Formative assessment of advice-seeking networks among potential adopters of an innovation is an important key to the stimulation of diffusion. Such data can statistically and visually identify which few potential adopters are particularly influential when the vast majority of others are deciding whether or not to adopt, as illustrated in the work of the Translating Research in Elder Care group, based at the University of Alberta. A recent formative study by this group assessed advice-seeking ties across 958 nursing homes in nine of Canada's eleven provinces and territories. The results identified opinion leaders within each jurisdiction, as well as advice-seeking ties across provinces, so that future resources can be focused on intervention with small proportions of influential individuals and organizations for eventual system change.<sup>56</sup>

Getting off on the right foot in the stimulation of a diffusion process is important. Diffusion processes often exhibit path dependence, whereby initial conditions determine how rapidly and to what extent an innovation will spread.<sup>57</sup> Relatedly, the timing of dissemination can be critical to diffusion.<sup>58</sup> If potential adopters are attending to a different type of problem than the innovation addresses, waiting to disseminate can be the right decision.

Learning about and addressing barriers to diffusion for both end beneficiaries and the health care practitioners who serve them is important. Many health care innovations require multiple levels of adoption—for example, by a chief medical officer and organizational sponsors, clinical chiefs, head nurses, and patients and families.

Formative evaluation along the entire supply chain that needs to coordinate for the dissemination, supply, delivery, and support of an innovation can reduce barriers before launch.<sup>59</sup> This includes attention to perceived incentives, both monetary and intrinsic, which can be tailored to address types of stakeholders where formative evaluation suggests that barriers to adoption are high—thus contributing to a climate for change.<sup>60</sup>

## Conclusion

The research and practice paradigm known as the diffusion of innovations offers a ready set of concepts and approaches that can be used to explain receptivity to health care policies and practices by individuals and organizations. Diffusion principles can also be operationalized to accelerate the rate of adoption and broaden the reach of health innovations. ■

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