



# Physician Networks and the Complex Contagion of Clinical Treatment

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One of the greatest challenges in contemporary research on quality of care is to understand unexplained regional variation in physicians' use of new medical treatments. Keating et al<sup>1</sup> offer valuable new insight into this problem by studying physicians' uptake of the biological cancer therapy bevacizumab. To identify the sources of variation, Keating et al<sup>1</sup> developed a compelling new approach. Over the course of 4 years, starting in 2005 to 2006, they examined the prescription behavior of 829 oncologists across 432 practices and 405 distinct communities.

Of the 44 012 patients in these communities, 9262 had never received treatment with bevacizumab before 2007. Using a novel longitudinal design, Keating et al<sup>1</sup> identified the factors associated with physicians' use of bevacizumab in the subsequent period, from 2007 to 2010. Controlling for a variety of patient, physician, and practice features in their model, Keating et al<sup>1</sup> found that the strongest indicator of physicians' adoption of the new therapy was their social networks. Specifically, the findings show that among physicians who were not prescribing bevacizumab in 2005 to 2006, their decision to adopt bevacizumab could be estimated by the prior level of adoption among peers within their medical community. Importantly, the findings show that physicians were significantly more likely to adopt the novel biological treatment if they had a greater number of peers within their social network adopting it (adjusted odds ratio, 1.64; 95% CI, 1.20-2.25;  $P = .002$ ).

Past research<sup>2</sup> shows that there are 2 fundamental ways that peer networks can influence decision-making, either through simple contagion or complex contagion. Simple contagion is typically a process of information flow. If the spread of a new therapy is a simple contagion, it means that new treatments spread virally through word-of-mouth networks. Simply having contact with 1 colleague who has adopted a treatment would be sufficient for another physician to start using it. In contrast, complex contagions do not spread virally.<sup>2</sup> They require social reinforcement. If physicians have concerns about the credibility of a new treatment, or about its perceived legitimacy within their medical community, then simply having contact with 1 colleague who has adopted it will typically not be sufficient to convince a clinician to start prescribing it. Social reinforcement from several peers is needed to demonstrate that a treatment is seen as legitimate within their medical community.<sup>3</sup>

The idea that peer networks can influence physicians' willingness to adopt new medical treatments is not new<sup>4,5</sup>; however, the novel approach of Keating et al<sup>1</sup> to this topic sheds new light on the reasons why social networks may affect the adoption of new treatments. Understanding the reasons social networks are influential—that is, identifying whether bevacizumab is a simple contagion or a complex contagion—has important implications for understanding why there is regional variation and how to improve the uptake of new treatments. For instance, if bevacizumab adoption were a simple contagion, then peer networks would be operating as channels of informational exposure for physicians who had been unaware of the new treatment. Conversely, if the adoption of bevacizumab were a complex contagion, then the primary role of peer networks would be not to spread informational awareness of the new therapy, but instead to make the new treatment more normatively acceptable.

Keating et al<sup>1</sup> offer strong evidence that new medical treatments are complex contagions. Prescribing practices diffuse through physicians' networks via a process of social reinforcement. These findings offer a crucial new insight into why there may be large regional variations in physicians' use of new therapies. They suggest that patterns of regional variation may be due to social norms within physicians' local medical communities that endorse some treatment practices

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and prohibit others. In the last several years, new studies<sup>6,7</sup> have begun to explore the role of physicians' social networks in enforcing these kinds of social norms within clinical settings. The study by Keating et al<sup>1</sup> provides a valuable leap forward for researchers working on this topic by identifying the dynamics of complex contagion in physicians' social networks and revealing how these dynamics may drive regional variation in the adoption of new treatments.

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#### ARTICLE INFORMATION

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#### REFERENCES

1. Keating NL, O'Malley AJ, Onnela J-P, Gray SW, Landon BE. Association of physician peer influence with subsequent physician adoption and use of bevacizumab. *JAMA Netw Open*. 2020;3(1):e1918586. doi:[10.1001/jamanetworkopen.2019.18586](https://doi.org/10.1001/jamanetworkopen.2019.18586)
2. Centola D. *How Behavior Spreads: The Science of Complex Contagions*. Princeton, NJ: Princeton University Press; 2018.
3. Centola D. The spread of behavior in an online social network experiment. *Science*. 2010;329(5996):1194-1197. doi:[10.1126/science.1185231](https://doi.org/10.1126/science.1185231)
4. Coleman J, Katz E, Menzel H. The diffusion of an innovation among physicians. *Sociometry*. 1957;20:253-270. doi:[10.2307/2785979](https://doi.org/10.2307/2785979)
5. Iyengar R, Van den Bulte C, Valente TW. Opinion leadership and social contagion in new product diffusion. *Marketing Sci*. 2010;30(2):195-212. doi:[10.1287/mksc.1100.0566](https://doi.org/10.1287/mksc.1100.0566)
6. Keating NL. Peer influence and opportunities for physician behavior change. *J Natl Cancer Inst*. 2017;109(8):d1x009. doi:[10.1093/jnci/d1x009](https://doi.org/10.1093/jnci/d1x009)
7. Pollack CE, Soulos PR, Herrin J, et al. The impact of social contagion on physician adoption of 354 advanced imaging tests in breast cancer. *J Natl Cancer Inst*. 2017;109(8):d1x330. doi:[10.1093/jnci/d1x330](https://doi.org/10.1093/jnci/d1x330)