



PROJECT MUSE®

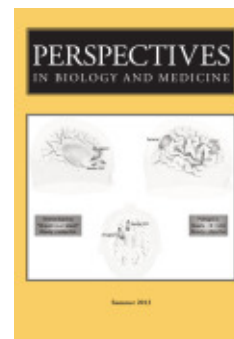
---

## A Theoretical Lens for Revealing the Complexity of Chronic Care

Liesbeth Borgermans, Jan De Maeseneer, Hub Wollersheim, Bert Vrijhoef, Dirk Devroey

Perspectives in Biology and Medicine, Volume 56, Number 2, Spring 2013, pp. 289-299 (Article)

Published by The Johns Hopkins University Press  
DOI: 10.1353/pbm.2013.0017



➔ For additional information about this article

<http://muse.jhu.edu/journals/pbm/summary/v056/56.2.borgermans.html>

# A THEORETICAL LENS FOR REVEALING THE COMPLEXITY OF CHRONIC CARE

---

LIESBETH BORGERMANS,\* JAN DE MAESENEER,†  
HUB WOLLERSHEIM,‡ BERT VRIJHOEF,§ AND DIRK DEVROEY\*

**ABSTRACT** The increasing prevalence of co-occurring multiple chronic conditions in an aging population has influenced the debate on complexity in chronic care and nowadays provides an impetus to the reform of numerous health systems. This article presents a theoretical lens for understanding the complexity of chronic care based on research and debate conducted in the context of multiple quality improvement programs over the last five years in Belgium and The Netherlands. We consider four major components of complexity in chronic care against a background of complex adaptive systems: (1) case (patient) complexity; (2) care complexity; (3) quality assessment complexity; and (4) health systems complexity. Each of these components represents a range of elements that contribute to the picture of complexity in chronic care. We emphasize that planning for chronic care requires equal attention to the complexity of all four components. It also requires multifaceted interventions and implementation strategies that target improvements in multiple outcomes related to the structural, process, and outcome components of care. Further empirical research is needed to assess the validity of our complexity framework in the health-care environment.

---

\*Department of Family Medicine, Vrije Universiteit Brussel, Belgium.

†Department of Family Medicine and Primary Care, University of Ghent, Belgium.

‡Scientific Institute for Quality of Health Care (IQ healthcare), University of Nijmegen, The Netherlands.

§Scientific Center for Care and Welfare, Tilburg University, The Netherlands.

Correspondence: Liesbeth Borgermans, Department of Family Medicine, Vrije Universiteit Brussel, Building K, Laarbeeklaan 103, 1090 Brussels, Belgium.

E-mail: liesbeth.borgermans@vub.ac.be.

THE STUDY OF COMPLEXITY in chronic care is an emergent discipline that has not yet developed a consistent theoretical framework. Thinking in the field of complexity encompasses complexity science and complexity theories, which represent a convergence of different types of ideas and theories that focus on the interactions of individual parts that make up a complex system. In this context, an important distinction is to be made between “complex” and “complicated.” If a system—despite the fact that it may consist of a huge number of components—can be given a complete description in terms of its individual constituents, such a system is merely complicated. An example could be computers. In a complex system, on the other hand, the interaction among constituents of the system and the interaction between the system and its environment are of such a nature that the system as a whole cannot be fully understood simply by analyzing its components. Health-care systems fall into this category (Cilliers 2002).

The increasing incidence and prevalence of patients with multi-morbidity (physical and mental), and the relatively disappointing results of quality improvement programs targeting single chronic conditions and multi-morbidity have provided an impetus to research and to the debate on complexity thinking in chronic care (Drewes et al. 2012; Elissen et al. 2012; Lemmens et al. 2011; O’Neill, Cherubini, and Michel 2012; Schouten et al. 2008; Smith et al. 2012). Previous analysis of case and care complexity in chronic care have demonstrated that the traditional, biomedical perspective alone is no longer adequate to deal with the challenges related to chronic illness care (De Maeseneer et al. 2012; Humphrey 2006; Starfield 2011). Chronic care requires an “ecosystemic approach” to illness, one that describes the collective and adaptive responses of the patient, family, and health professionals to the changing biological and psychosocial manifestations of the illness over a long period of time (Soubhi 2007). But an ecosystemic approach cannot be understood and implemented without an understanding of the framework of complex adaptive systems (Plsek and Greenhalgh 2001). A complex adaptive system is a collection of interconnected individual “agents,” as is seen in primary care, that are part of larger systems. The framework provides a theoretical basis that incorporates a dynamic view of the world and replaces the traditional “reduce and resolve” approaches to clinical care and service organization (Cooper and Geyer 2009; Leykum et al. 2007).

In this article, we propose a theoretical lens for understanding and studying complexity in chronic care. Knowledge of complexity of chronic care is central to all quality improvement programs that target a more effective and efficient response to the challenges posed by chronic conditions at the structure, process, and outcome level of care. We consider four interrelated components: (1) case (patient) complexity; (2) care complexity; (3) quality assessment complexity; and (4) health systems complexity. Each component is considered against a background of complex adaptive systems. The theoretical lens is the result of research and debate conducted in the context of numerous quality improvement pro-

grams for patients with chronic diseases over the last five years in Belgium and The Netherlands.<sup>1</sup>

### **CASE COMPLEXITY**

The first component of complexity in chronic care is case or patient complexity. Case complexity cannot be understood without taking into account the basic principles of complex adaptive systems, especially the co-evolvement and the inherent unpredictability of the systems in which the patient operates, as well as the presence of internalized rules in patients that strongly influence the choices patients make.

The conceptualization of the complexity of cases or patients in clinical medicine is in the earliest stages, and it has only recently been raised as an important issue in terms of quality assessment (Haggerty 2012; Kernick 2012). Case complexity has been described in terms of the “case mix” and was previously used in the area of methodologies for grouping patients, statistical case-finding instruments, and theory-driven case complexity assessments (Fetter et al. 1980; Melfi et al. 1995; Winograd et al. 1991). These approaches have not provided clinically meaningful information (de Jonge, Huyse, and Stiefel 2006). The vector model of complexity (VMC), as described by Safford, Allison, and Kiefe (2007), has been developed in response to reductionist approaches of case complexity and is in line with the basic principles of complex adaptive systems. The vector model proposes that the complexity of an individual patient arises out of interactions between seven domains: biology, genetics, socioeconomic, culture, environment/ecology, behavior and the health system. These “forces” are not easily discerned but exert profound influences on the processes and outcomes of care for chronic medical conditions. Comorbidities in patients with chronic conditions potentially contribute to the overall complexity along the biological vector of the VMC. Complexity is also introduced along the behavioral axis, as most chronic conditions impose considerable demands on self-care (Russell, Suh, and Safford 2005). These specific demands can be especially difficult for patients who lack social support or the ability to access care due to financial limitations, which contributes to the complexity of their situation on the socioeconomic vector (van Dam et al. 2005).

The concept of case complexity becomes clearer when the unique journey of each individual patient with a chronic condition is considered. Each journey takes the individual through various pathways of health care across a wide range

---

<sup>1</sup>In these programs, we studied case and care complexity (Borgermans et al. 2008; De Maeseneer et al. 2012; Elissen et al. 2012; Goderis et al. 2009a, 2010; van Dijk-de Vries, Duimel-Peeters, and Vrijhoef 2011), quality assessment (Arts et al. 2012; Borgermans et al. 2009, 2011; Boyne et al. 2012; Dierick-van Daele et al. 2011; Goderis et al. 2009b; Voogdt-Pruis, Vrijhoef, and Beusmans 2011, Voogdt-Pruis et al. 2012), and health systems complexity (Erler et al. 2011).

of primary, secondary, and tertiary care levels and palliative and social services. Case complexity is also reflected in the preferences of patients for their care and the relative importance that patients place on different health outcomes (Borgermans et al. 2011). Some patients will prioritize the maintenance of functional independence over intense medical management, while others would be willing to tolerate the inconvenience and risk of adverse effects associated with complex multiple medication regimens if this is linked to longer survival, even if this has a negative impact on their quality of life (Tinetti, Bogardus, and Agostini 2004). All of the sources of case complexity alone or in combination require clinical tradeoffs, in the framework of “ideal care” (Safford et al. 2009). The Institute of Medicine (2001) has defined ideal care as being “driven by shared decision-making and based on continuous, healing relationships.” However, the IOM recognizes that “good care” for complex patients will not necessarily lead to ideal (for example, biomedical) performance measures.

### **COMPLEXITY OF CARE PROCESSES**

The second component of complexity in chronic care is care complexity. As with case complexity, care complexity cannot be understood without taking into account the basic principles of complex adaptive systems, especially as it concerns the interdependence of actions of different caregivers and patients, the co-involvement of systems in which caregivers and their patients operate, as well as the presence of internalized rules in both caregivers and patients that influence outcomes of care.

While case complexity has been operationalized in several ways, the operationalization of care complexity has drawn much less attention (Mercer et al. 2012; Plochg, Keijsers, and Levi 2012). The complexity of clinical care is based on the number of the types of interventions and the number of disciplines that are required to make major interventions. Several other studies have operationalized the complexity of care as the subjectively and objectively perceived difficulty of managing patients through the process of health-care delivery (Kelleher 1993). Predictor variables of care complexity have been developed in the context of large multicenter studies that were carried out in both primary care and hospital settings. In this context, repeated hospital admissions have been found to be a risk factor for care complexity and an indicator for the chronicity of disease (Von Korff, Wagner, and Saunders 1992). Other indicators that predict complexity include observations and clinical judgments made within the first 24 hours of admission by a medical doctor; the number of medications; the degree of functioning of individuals as assessed by their capacity to perform activities of daily living; the patients’ emotional state, health perception, and level of pain; the attitude of patients toward their doctors; and the number of multidisciplinary interventions (Aarts et al. 2012; Clark et al. 1995; Schuling et al. 2012).

While care complexity can be challenging when addressing treatment goals

for one condition, it becomes even more complex when attempting to prioritize treatment targets for patients with multiple conditions (Plochg, Keijsers, and Levi 2012; van Weel and Schellevis 2006). Chronic illness with complexity (CIC) recognizes that the treatment of a single condition such as diabetes influences the care and outcomes associated with other conditions, such as cardiovascular disease or depression (Fortin et al. 2005). Clinical practice guidelines rarely address the treatment of patients with three or more chronic diseases, although such patients make up half of the population more than 65 years of age (Guthrie et al. 2012). Previous studies have tested the hypothesis that the complexity of ambulatory care of patients with chronic conditions has increased in the previous decades (Grant et al. 2004). Findings from these studies have shown that the management of patients with chronic conditions has changed significantly over the last decade, with a marked increase in the complexity of medication regimens, an increased provision of screening and counseling services, and a modest increase in the length of visits to health-care providers (Kerr et al. 2003).

The complexity of routine clinical care, as measured by the number of components of care that are being addressed and the number of medications and tests undertaken, has important implications for the safety and quality of life of patients, as well as the quality of chronic care delivery (Hawkes 2012; Huang et al. 2007). If diabetes is used as an example, documentation of the average number of medications attributable to diabetes is important for providing evidence to support public health concerns regarding polypharmacy. Predictors for polypharmacy include multiple prescribers, complex drug therapies, patient age, psychosocial contributions, and adverse drug reactions that may be interpreted as new medical conditions. As this number rises, we may be adversely affecting the quality of life of patients, and their perceptions may be important determinants of treatment adherence (Vijan et al. 2005).

Higher levels of care complexity often lead to more intensive modes of cooperation. The relationship between care complexity and cooperation is important, since a fit between the complexity of the demand for health care and the intensity of cooperation would indicate a positive reciprocity between the quality of health care and efficiency (Molleman et al. 2008).

### **QUALITY ASSESSMENT COMPLEXITY**

The third component of complexity in chronic care is quality assessment complexity. Basic principles of complex adaptive systems that we consider of particular importance to quality assessment are interconnectivity of actions of the caregivers involved, the internalized rules these caregivers apply, and the unpredictability of events.

Quality outcomes are inherently unpredictable, as in many circumstances quality is determined by a large amount of (unknown) factors following a non-linear pattern. Previous reviews of quality improvement programs for patients

with chronic care conditions have demonstrated the complexity and multidimensionality of the concept of quality (Ouwens et al. 2005). There is no universally accepted definition of high-quality chronic care, either in general or for particular chronic diseases. As a consequence, policymakers, researchers, health-care providers, and change agents are confronted with defining what “high quality” means for a given population in a particular setting and time. Systematic reviews and meta-analysis on the effectiveness of quality improvement interventions for patients with chronic conditions have raised the issue of the plethora of terminology involved in order to describe the different quality improvement interventions (Borgermans et al. 2008). Despite the valuable efforts to develop classification schemes for quality improvement interventions and indicators, it often remains difficult to understand the exact nature of these items (Grimshaw et al. 2001, Shojania et al. 2006).

Quality indicators that have previously been used to assess complex cases include the number of medical complications and admission to a nursing home after discharge (Hickam, Hedrick, and Gorton 1991; Iezzoni et al. 1994). These parameters demonstrate a reductionist approach to case complexity. Overall, there is a lack of tools to assess the quality of primary care delivered to those who have multiple and compounding conditions (Heath et al. 2009). Most existing quality measures exclude people with comorbidities and are not designed to assess their overall health care explicitly (Fortin et al. 2006).

### **HEALTH SYSTEM COMPLEXITY**

The fourth component of complexity in chronic care is health system complexity. Basic principles of complex adaptive systems with relevance to health system complexity are interconnectivity of actions of the caregivers involved, the internalized rules these caregivers apply, the co-evolution of systems, and the unpredictability of events.

Many policymakers think of improving chronic care by decomposing the overall system performance and management into component elements, including financing, health workforce, medical products and technologies, service delivery, and health information systems (Rouse 2008). This approach of hierarchical decomposition generally does not work for chronic care, as it is inherently complex (Wagner 1998). Decomposition may result in the loss of important information about interactions among phenomena of interest. As a consequence, policies to improve the quality of care for patients with (multiple) chronic conditions cannot be developed within separate “disease silos” (Lipsitz 2012). To help guide future policies on chronic care and avoid unanticipated consequences of regulation, we need to understand health care as a complex system and apply the principles of complexity science. The latter is even more important, since evidence shows that the effectiveness of quality improvement interventions and implementation strategies strongly depends on the context in which they are

delivered (Bailie et al. 2006; FitzGerald 2002; Schmittdiel et al. 2006). This phenomenon of context-dependence has led to calls for tailoring interventions to the cultural background of patients or for the adaptation of practice guidelines for health-care professionals among other suggestions (Bosch et al. 2007; Gravelle et al. 2007; Jansen et al. 2007).

### **CONCLUSION**

We have presented a theoretical lens for the analysis of complexity in chronic care that includes four essential components: case, care, quality assessment, and health system complexity. Each of these components represents a range of elements that contribute to the picture of complexity in chronic care. Despite a growing number of valid insights on what determines complexity in chronic care, current Western and developing countries continue to fund models and programs of health care that are intrinsically fragmented and often focused on a limited number of aspects related to complexity (De Maeseneer and Boeckxstaens 2012). We emphasize that the planning for chronic care requires equal attention to all four components, which should be considered jointly against a background of complex adaptive systems. Effective health-care reforms must involve adaptive change not only to the structure and process of the delivery of care of chronic disease, but also to the human experience and interfaces in care. This requires multifaceted interventions and implementation strategies that target improvements in multiple outcomes of care at the structural, process, and outcome levels. The so-called “vertical outcomes” of care in this context should be at least partially assessed at the level of the care of individual diseases. Horizontal functions of care—integrating, prioritizing, and personalizing care—are more difficult to assess but are equally important (Heath et al. 2009).

By better understanding the concept of complexity in chronic care and the relationships between its individual components, we will be better positioned to seek alternative ways of thinking about chronic care and related system reform, its determinants, and effective ways in dealing with this complexity. For this reason, further empirical research is needed to test the value of complexity science and its role in developing the components of our complexity framework in the health-care environment.

### **REFERENCES**

- Aarts, S., et al. 2012. The effect of multimorbidity on health related functioning: Temporary or persistent? Results from a longitudinal cohort study. *J Psychosom Res* 73(3):211–17. doi: 10.1016/j.jpsychores.2012.05.014.
- Arts, E. E., et al. 2012. The cost-effectiveness of substituting physicians with diabetes nurse specialists: A randomized controlled trial with 2-year follow-up. *J Adv Nurs* 68(6):1224–34. doi: 10.1111/j.1365-2648.2011.05797.x.
- Bailie, R. S., et al. 2006. Investigating the sustainability of outcomes in a chronic disease



- treatment programme. *Social Sci Med* 63(6):1661–70. doi: 10.1016/j.socscimed.2006.04.010.
- Borgermans, L. A., et al. 2008. Diversity in diabetes care programmes and views on high quality diabetes care: Are we in need of a standardized framework?" *Int J Integrated Care* 8:e07.
- Borgermans, L., et al. 2009. Interdisciplinary diabetes care teams operating on the interface between primary and specialty care are associated with improved outcomes of care: Findings from the Leuven Diabetes Project. *BMC Health Serv Res* 9:179. doi: 10.1186/1472-6963-9-179.
- Borgermans, L., et al. 2011. Patients' experiences with patient-centered care are associated with documented outcome of care indicators for diabetes: Findings from the Leuven Diabetes Project. *Int J Care Pathways* 15:65–75.
- Bosch, M., et al. 2007. Tailoring quality improvement interventions to identified barriers: A multiple case analysis. *J Eval Clin Pract* 13(2):161–18. doi: 10.1111/j.1365-2753.2006.00660.x.
- Boyne, J. J., et al. 2012. Tailored telemonitoring in patients with heart failure: Results of a multicentre randomized controlled trial. *Eur J Heart Fail* 14(7):791–801. doi: 10.1093/eurjhf/hfs058.
- Cilliers, P. 2002. *Complexity and postmodernism: Understanding complex systems*. New York: Routledge.
- Clark, D. O., et al. 1995. A chronic disease score with empirically derived weights. *Med Care* 33(8):783–95.
- Cooper, H. C., and R. Geyer. 2009. What can complexity do for diabetes management? Linking theory to practice. *J Eval Clin Pract* 15(4):761–65. doi: 10.1111/j.1365-2753.2009.01229.x.
- de Jonge, P., F. J. Huyse, and F. C. Stiefel. 2006. Case and care complexity in the medically ill. *Med Clin N Am* 90(4):679–92. doi: 10.1016/j.mcna.2006.04.005.
- De Maeseneer, J., and P. Boeckxstaens. 2012. James Mackenzie Lecture 2011: Multimorbidity, goal-oriented care, and equity. *Br J Gen Pract* 62(600):e522–e524. doi: 10.3399/bjgp12X652553.
- De Maeseneer, J., et al. 2012. Tackling NCDs: A different approach is needed. *Lancet* 379(9829):1860–61. doi: 10.1016/S0140-6736(11)61135-5.
- Dierick-van Daele, A. T., et al. 2011. Is it economically viable to employ the nurse practitioner in general practice? *J Clin Nurs* 20(3–4):518–29. doi: 10.1111/j.1365-2702.2010.03492.x.
- Drewes, H. W., et al. 2012. The effectiveness of chronic care management for heart failure: Meta-regression analyses to explain the heterogeneity in outcomes. *Health Serv Res* 47(5):1926–59. doi: 10.1111/j.1475-6773.2012.01396.x.
- Elissen, A. M., et al. 2012. Meta-analysis of the effectiveness of chronic care management for diabetes: Investigating heterogeneity in outcomes. *J Eval Clin Pract*. doi: 10.1111/j.1365-2753.2012.01817.x.
- Erler, A., et al. 2011. Preparing primary care for the future: Perspectives from the Netherlands, England, and USA. *Z Evid Fortbild Qual Gesundheitsw* 105(8):571–80. doi: 10.1016/j.zefq.2011.09.029.
- Fetter, R. B., et al. 1980. Case mix definition by diagnosis-related groups. *Med Care* 18(2 suppl.):iii, 1–53.

- FitzGerald, L., et al. 2002. Interlocking interactions, the diffusion of innovations in health care. *Human Relations* 55:1429–49.
- Fortin, M., et al. 2005. Prevalence of multimorbidity among adults seen in family practice. *Ann Family Med* 3(3):223–28. doi: 10.1370/afm.272.
- Fortin, M., et al. 2006. Randomized controlled trials: Do they have external validity for patients with multiple comorbidities? *Ann Family Med* 4(2):104–8. doi: 10.1370/afm.516.
- Goderis, G., et al. 2009a. Barriers and facilitators to evidence based care of type 2 diabetes patients: Experiences of general practitioners participating to a quality improvement program. *Implement Sci* 4:41. doi: 10.1186/1748-5908-4-41.
- Goderis, G., et al. 2009b. Type 2 diabetes in primary care in Belgium: Need for structured shared care. *Exp Clin Endocrinol Diab* 117(8):367–72. doi: 10.1055/s-0028-1103286.
- Goderis, G., et al. 2010. Start improving the quality of care for people with type 2 diabetes through a general practice support program: A cluster randomized trial. *Diabetes Res Clin Pract* 88(1):56–64. doi: 10.1016/j.diabres.2009.12.012.
- Grant, R. W., et al. 2004. Trends in complexity of diabetes care in the United States from 1991 to 2000. *Arch Intern Med* 164(10):1134–39. doi: 10.1001/archinte.164.10.1134.
- Gravelle, H., et al. 2007. Impact of case management (Evercare) on frail elderly patients: Controlled before and after analysis of quantitative outcome data. *BMJ* 334(7583):31. doi: 10.1136/bmj.39020.413310.55.
- Grimshaw, J. M., et al. 2001. Changing provider behavior: An overview of systematic reviews of interventions. *Med Care* 39(8 suppl. 2):II2–II45.
- Guthrie, B., et al. 2012. Adapting clinical guidelines to take account of multimorbidity. *BMJ* 345:e6341. doi: 10.1136/bmj.e6341.
- Haggerty, J. L. 2012. Ordering the chaos for patients with multimorbidity. *BMJ* 345:e5915. doi: 10.1136/bmj.e5915.
- Hawkes, N. 2012. Better training is needed to deal with increasing multimorbidity. *BMJ* 344:e3336. doi: 10.1136/bmj.e3336.
- Heath, I., et al. 2009. Quality in primary health care: A multidimensional approach to complexity. *BMJ* 338:b1242. doi: 10.1136/bmj.b1242.
- Hickam, D. H., S. C. Hedrick, and A. Gorton. 1991. Clinicians' predictions of nursing home placement for hospitalized patients. *J Am Geriatr Soc* 39(2):176–80.
- Huang, E. S., et al. 2007. The complexity of medication regimens and test ordering for patients with diabetes from 1995 to 2003. *Curr Med Res Opin* 23(6):1423–30. doi: 10.1185/030079907X199600.
- Humphrey, C. 2006. Ways of seeing: Biomedical perspectives on the social world. *J R Soc Med* 99 (12):602–6. doi: 10.1258/jrsm.99.12.602.
- Iezzoni, L. I., et al. 1994. Identifying complications of care using administrative data. *Med Care* 32(7):700–715.
- Institute of Medicine (IOM). 2001. Crossing the quality chasm: The IOM Health Care Quality Initiative. Washington, DC. <http://www.iom.edu/>.
- Jansen, Y. J., et al. 2007. Tailoring intervention procedures to routine primary health care practice: An ethnographic process evaluation. *BMC Health Serv Res* 7:125. doi: 10.1186/1472-6963-7-125.
- Kelleher, C. 1993. Relationship of physician ratings of severity of illness and difficulty of clinical management to length of stay. *Health Serv Res* 27(6):841–55.

- Kernick, D. 2012. A theoretical framework for multimorbidity: From complicated to chaotic. *Br J Gen Pract* 62(602):e659–62. doi: 10.3399/bjgp12X654740.
- Kerr, E. A., et al. 2003. Building a better quality measure: Are some patients with “poor quality” actually getting good care? *Med Care* 41(10):1173–82. doi: 10.1097/01.MLR.0000088453.57269.29.
- Lemmens, K. M., et al. 2011. Chronic care management for patients with COPD: A critical review of available evidence. *J Eval Clin Pract.* doi: 10.1111/j.1365-2753.2011.01805.x.
- Leykum, L. K., et al. 2007. Organizational interventions employing principles of complexity science have improved outcomes for patients with Type II diabetes. *Implement Sci* 2:28. doi: 10.1186/1748-5908-2-28.
- Lipsitz, L. A. 2012. Understanding health care as a complex system: The foundation for unintended consequences. *JAMA* 308(3):243–44. doi: 10.1001/jama.2012.7551.
- Melfi, C., et al. 1995. Selecting a patient characteristics index for the prediction of medical outcomes using administrative claims data. *J Clin Epidemiol* 48(7):917–26.
- Mercer, S. W., et al. 2012. Managing patients with mental and physical multimorbidity. *BMJ* 345:e5559. doi: 10.1136/bmj.e5559.
- Molleman, E., et al. 2008. How health care complexity leads to cooperation and affects the autonomy of health care professionals. *Health Care Anal* 16(4):329–41. doi: 10.1007/s10728-007-0080-6.
- O’Neill, D., A. Cherubini, and J. P. Michel. 2012. Epidemiology of multimorbidity. *Lancet* 380(9851):1383; author reply 1383–84. doi: 10.1016/S0140-6736(12)61795-4.
- Ouwens, M., et al. 2005. Integrated care programmes for chronically ill patients: A review of systematic reviews. *Int J Qual Health Care* 17(2):141–46. doi: 10.1093/intqhc/mzi016.
- Plochg, T., J. F. Keijsers, and M. M. Levi. 2012. The “multimorbidity generalist” is the future. *Ned Tijdschr Geneesk* 156(42):A5515.
- Plsek, P. E., and T. Greenhalgh. 2001. Complexity science: The challenge of complexity in health care. *BMJ* 323(7313):625–28.
- Rouse, W. 2008. Health care as a complex adaptive system: Implications for design and management. *Bridge* 38(1)17–25.
- Russell, L. B., D. C. Suh, and M. A. Safford. 2005. Time requirements for diabetes self-management: Too much for many? *J Fam Pract* 54(1):52–56.
- Safford, M. M., J. J. Allison, and C. I. Kiefe. 2007. Patient complexity: More than comorbidity. The vector model of complexity. *J Gen Intern Med* 22(suppl. 3):382–90. doi: 10.1007/s11606-007-0307-0.
- Safford, M. M., et al. 2009. Patient complexity in quality comparisons for glycemic control: An observational study. *Implement Sci* 4:2. doi: 10.1186/1748-5908-4-2.
- Schmittiel, J. A., et al. 2006. Effect of primary health care orientation on chronic care management. *Ann Fam Med* 4(2):117–23. doi: 10.1370/afm.520.
- Schouten, L. M., et al. 2008. Evidence for the impact of quality improvement collaboratives: Systematic review. *BMJ* 336(7659):1491–94. doi: 10.1136/bmj.39570.749884.BE.
- Schuling, J., et al. 2012. Deprescribing medication in very elderly patients with multimorbidity: The view of Dutch GPs. A qualitative study. *BMC Fam Pract* 13:56. doi: 10.1186/1471-2296-13-56.

- Shojania, K. G., et al. 2006. Effects of quality improvement strategies for type 2 diabetes on glycemic control: A meta-regression analysis. *JAMA* 296(4):427–40. doi: 10.1001/jama.296.4.427.
- Smith, S. M., et al. 2012. Managing patients with multimorbidity: Systematic review of interventions in primary care and community settings. *BMJ* 345:e5205. doi: 10.1136/bmj.e5205.
- Soubhi, H. 2007. Toward an ecosystemic approach to chronic care design and practice in primary care. *Ann Fam Med* 5(3):263–69. doi: 10.1370/afm.680.
- Starfield, B. 2011. Challenges to primary care from co- and multi-morbidity. *Prim Health Care Res Dev* 12(1):1–2. doi: 10.1017/S1463423610000484.
- Tinetti, M. E., S. T. Bogardus, Jr., and J. V. Agostini. 2004. Potential pitfalls of disease-specific guidelines for patients with multiple conditions. *N Engl J Med* 351(27):2870–74. doi: 10.1056/NEJMsb042458.
- van Dam, H. A., et al. 2005. Social support in diabetes: A systematic review of controlled intervention studies. *Patient Educ Couns* 59(1):1–12. doi: 10.1016/j.pec.2004.11.001.
- van Dijk-de Vries, A. N., I. G. Duimel-Peeters, and H. J. Vrijhoef. 2011. An instrument to assess the needs of patients with type 2 diabetes mellitus for health-promotion activities. *Patient* 4(2):115–23. doi: 10.2165/11538390-000000000-00000.
- van Weel, C., and F. G. Schellevis. 2006. Comorbidity and guidelines: Conflicting interests. *Lancet* 367(9510):550–51. doi: 10.1016/S0140-6736(06)68198-1.
- Vijan, S., et al. 2005. The burden of diabetes therapy: implications for the design of effective patient-centered treatment regimens. *J Gen Intern Med* 20(5):479–82. doi: 10.1111/j.1525-1497.2005.01117.x.
- Von Korff, M., E. H. Wagner, and K. Saunders. 1992. A chronic disease score from automated pharmacy data. *J Clin Epidemiol* 45(2):197–203.
- Voogdt-Pruis, H., H. J. Vrijhoef, and G. H. Beusmans. 2011. Benefits of nurse-led cardiovascular prevention for patients with type 1 diabetes. *Evid Based Nurs* 14(4):104–5. doi: 10.1136/ebn.2011.100051.
- Voogdt-Pruis, H. R., et al. 2012. Quality improvement of nurse-led aftercare to outpatients with coronary heart disease: Report of a case study. *Int J Qual Health Care* 24(3):286–92. doi: 10.1093/intqhc/mzs002.
- Wagner, E. H. 1998. Chronic disease management: What will it take to improve care for chronic illness? *Effective Clin Pract* 1(1):2–4.
- Winograd, C. H., et al. 1991. Screening for frailty: Criteria and predictors of outcomes. *J Am Geriatr Soc* 39(8):778–84.