Complexity science
Complexity, leadership, and management in healthcare organisations

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This is the third in a series of four articles

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Series editors:
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BMJ 2001;323:746–9

Current management thinking largely assumes that a well functioning organisation is akin to a well oiled machine.[1] This leads to the notion that performance is optimised when work is specified in detail and shared out to distinct operational units.[2] Clinicians often object to these detailed specifications, while managers bemoan a lack of cooperation.[3]

The first article in this series introduced an alternative to the machine metaphor; that of a complex adaptive system (CAS).[4] In this article we describe applications of complexity thinking in the organisation and management of health care.

Whole system performance: managing generative relationships

The interactions within a complex adaptive system are often more important than the discrete actions of the individual parts. As the examples below illustrate, a productive or generative relationship occurs when interactions among parts of a complex system produce valuable, new, and unpredictable capabilities that are not inherent in any of the parts acting alone.[5]

Although health care depends largely on productive interaction, the organisation and management of its delivery surprisingly does not always reflect this insight. In the United Kingdom, for example, having separate budgets and performance targets for primary care, secondary care, and social services promotes an internal focus on the operation of each of these parts, but not necessarily the good functioning of the system as a whole.

Consider the administration of thrombolytic drugs, which greatly increase survival when given to patients within 60 minutes of the onset of myocardial infarction.[6] Following classic performance manage-

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Summary points

Management thinking has viewed the organisation as a machine and believed that considering parts in isolation, specifying changes in detail, battling resistance to change, and reducing variation will lead to better performance

In contrast, complexity thinking suggests that relationships between parts are more important than the parts themselves, that minimum specifications yield more creativity than detailed plans

Treating organisations as complex adaptive systems allows a new and more productive management style to emerge in health care

ment thinking, the current national service framework for coronary heart disease in the NHS has established an immediate priority target for acute care trusts to ensure by April 2002 that 75% of eligible patients receive thrombolytic drugs within 30 minutes of arrival at the hospital, while health authorities and primary care trusts are asked to aim for patients to receive them within 60 minutes of calling for professional help.[7] Each of these targets, along with others for ambulance response times, segments the timeline into intervals deemed controllable by the separate parts of the system. What if the patient delays for an hour or more hoping that the pain will go away before calling for help, and the ambulance journey requires an additional 25 minutes?[8] The acute care, primary care, and ambulance service trusts could indeed be meeting their individual targets, but the patient may not be getting the full benefit intended and receiving treatment within 60 minutes of the onset of infarction.

Complexity based organisational thinking suggests that goals and resources are established with a view towards the whole system, rather than artificially allocating them to parts of the system. We might therefore set a single, whole system, target for thrombolysis within 60 minutes of the onset of myocardial infarction and establish a pooled budget that provides funds for changes intended to meet this target. The pooled budget would include funds from acute care, primary care, ambulance, community, education, and health promotion budgets.

Whole system targets and pooled budgets encourage generative relationships among the various stakeholders that may provoke more creative ideas. For example, thinking together might lead to ideas about symptom awareness campaigns or paramedic support. In widening the focus to the whole system, we might further work to assure that the patient receives aspirin

on discharge from hospital and continues it when home. In the current situation, suggested enhancements typically focus only on changes within individual parts of the system and approaches that cross boundaries emerge less frequently. Attention to the overall aim—better patient care—can get lost.

Complexity thinking suggests that current organisational leaders in both policy and operations should begin looking more across the parts and at the system as a whole. The National Health Service might be better thought of as the National Health System.[9]

Minimum specifications replace complicated plans

Creative progress towards a difficult goal can emerge from a few, flexible, simple rules, or so called minimum specifications.[10] However, current organisational thinking is built largely on the assumptions that plans for progress must provide the "best" way, completely specified in great detail, and consistently implemented in that same level of detail across the board. This thinking, often reflected in the NHS in such things as national service frameworks or detailed guidelines with newly specified standards, fails to take advantage of the natural creativity embedded in the organisation, and fails to allow for the inevitable unpredictability of events.

Minimum specifications typically provide four things that create an environment in which innovative, complex behaviours can emerge: direction pointing; boundaries; resources; permissions. In the case of the administration of thrombolytic drugs, leaders from the system (primary care, acute care trusts, etc) would create a forum for the various stakeholders to engage in a dialogue that yields the set of minimum specifications for moving forward shown in box 1.

These minimum specifications provide wide space for innovation and encourage shared action. They are both a product of and a facilitator for future generative relationships. Minimum specifications build on whole system targets and pooled budgets and help those involved to translate these into concrete actions. Because these specifications are the product of organisational dialogue, they are not perfect and will evolve over time. They might include items that are idiosyncrasies of the stakeholders involved—for example, specifying that no new acute care beds are to be called for and the endorsement of at least three stakeholders will be required. These idiosyncrasies may be dropped over time but for now the members of the system may need them in order to deal with the anxiety naturally associated with taking a bold approach. Paradox, tension, and anxiety are natural byproducts of complex systems; in human systems, as the system evolves, we can use minimum specifications to help us cope with this anxiety.

The concept of minimum specifications is already being applied to redesign health care. A multiregional group in the United Kingdom concerned with care for elderly people produced the minimum specifications (box 2) for the better design of these systems. These rules emerged from a dialogue following a day of presentations by the various groups describing their recent innovations. Reflecting on innovations in the system offers pointers toward previously unexpressed minimum specifications that take us beyond the current

norm. A committee of the Institute of Medicine in the United States charged with articulating a design for the healthcare system of the 21st century used a similar process to identify transitions from a current set of simple rules to a new set (box 3).[11] Combining these with an understanding of intrinsic motivation— "attractors," as described in the next section—might enable hundreds of thousands of healthcare professionals to engage in the enormous task of transforming the US healthcare system.[12]

Understanding attraction for change rather than battling resistance

Best practices are often frustratingly slow to spread in health systems. Current thinking attributes this largely to the phenomenon of "resistance to change." If the organisation were running like a well oiled machine, then indeed we should be able to install a best practice in an organisation, just as we might install a higher performance carburettor on a car—if the new part fails

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Box 1 Improving the delivery of thrombolytic therapy in patients with acute coronary syndromes

Administer thrombolytic drugs within 60 minutes of the onset of chest pain *(direction pointing)*

Administration can occur in any safe environment and be done by any properly trained medical staff *(direction pointing, boundaries, permission)*

Remain within the overall project budget and do not add new acute care beds *(boundaries)*

Any group can access the pooled budget, but ... *(resources)*

The proposal must reflect active participation from at least three stakeholder groups; for example, a team of cardiologists, accident and emergency department nurses, and ambulance service personnel *(direction pointing)*

All proposals, expenditures, and results of pilots will be shared openly to stimulate comment and assessment *(resources, in this case, knowledge resources)*

Source: Product of a group on the NHS leadership programme for chief executives organised by the Health Services Management Centre, University of Birmingham, May 2001

Box 2 Minimum specifications for systems for elderly people

User focus—Drive the system through knowledge of patients', carers', and the community's needs, values, and definition of quality of life (not abandoning professional obligation to educate)

Networks of care—Build networks with multidisciplinary learning that places more emphasis on what the patient needs than on organisational boundaries

Easy access—Make access to care easy, one stop, always available, rapid, and responsive

Effective assessment—Focus on rapid, effective, appropriately shared, detailed assessment systems that mobilise needed services

Avoiding personal crisis—Practise prevention and education to intervene and help early and avoid crisis

Easy information flow—Make information flow so that what someone knows about the elderly person, everyone in the system knows (within constraints of confidentiality)

Blurred boundaries—Find ways to share budgets and resources to blur organisational boundaries (within legal constraints)

Continued feedback—Build in evaluation and feedback loops, be flexible, and continually review the whole system

Source: The Great Missenden Group (work group on the elderly people's integrated care system (EPICS)), November 1998

Box 3 Simple rules for the design of the 21st century healthcare system in the United States

Traditional approach	New rule
Care is based primarily on visits	Care is based on continuous healing relationships
Professional autonomy drives variability	Care is customised according to patients' needs and values
Professionals control care	The patient is the source of control
Information is a record	Knowledge is shared and information flows freely
Decision making is based on training and experience	Decision making is evidence based
"Do no harm" is an individual responsibility	Safety is a system property
Secrecy is necessary	Transparency is necessary
The system reacts to needs	Needs are anticipated
Cost reduction is sought	Waste is continually decreased
Preference is given to professional roles over the system	Cooperation among clinicians is a priority

Source: Institute of Medicine Committee on Quality of Health Care in America[11]

to fit smoothly, we just need to give it a good whack to get it in. In this view of organisations, strong leaders are needed to overcome resistance and install best practices from elsewhere.

The metaphor of complex adaptive systems acknowledges the behaviour that we label resistance to change, but suggests that, rather than resisting anything, behaviour follows natural attractor patterns in the system[13]—for example, a desire to focus attention on underserved patient groups (box 4). This helps to explain how the same person can be sometimes

Box 4 Example of understanding attractors in complex systems

Perceived problem
A GP practice seemingly will not use a new guideline on diabetes care.

Common management approach
Label the practice as "resistant to change" and devise a strategy of sanctions or strict budget controls to force change.

Understanding attactors approach
Ask: what changes and innovative practices have they previously adopted, or even pioneered?

We find that they are well known for outstanding care and cultural sensitivity to a particular ethnic subpopulation. The attractor pattern in the behaviour might be associated with serving underserved communities.

Ask: what is their understanding of good diabetes care and how does it differ from the guideline?

Widely adopted conclusions from the UK prospective diabetes study[14] may not be as certain as we thought.[15] Or perhaps they agree with the evidence for eye examinations for people with diabetes[16] but do not agree with the dictated targets for the number of ophthalmologists per region. The attractor pattern in the behaviour might be the desire to provide good care, but there is a genuine disagreement about how best to achieve it.

Ask: what effect will the guideline have on the practice?

Changes can have unintended consequences. The attractor pattern may be associated with a concern—real or imagined—on the part of the doctors or the staff that certain improvements in care for patients with diabetes may have negative consequences for other patients.

New insight and potential next steps
The behaviour in relation to the diabetes guideline is not so much a resistance to change as a local conclusion that the guideline does not resonate with what is especially meaningful to the practice. Adoption of the guideline is more likely if, for example, it is fitted with the concept of serving an underserved population, by perhaps pointing out that diabetes affects people of Asian descent disproportionately[17] and that poverty is associated with poorer outcomes.[18] Pointing out that the guideline was developed by a panel of experts or emphasising the need for conformity on all aspects of the guideline, even those where there is some degree of uncertainty or lack of full agreement, may only increase the so called resistant behaviour.

innovative and sometimes resistant to change; their behaviour might be associated with poorly understood attractor patterns. By asking the sorts of questions illustrated in the box, organisational leaders might find more positive ways to encourage change.

Simply understanding system attractors is not always sufficient to bring about change. For systems to change they generally require tension for change.[19] Careful sharing of meaningful information that touches natural attractors or creates new ones can lead those within the systems to feel they must change.[20]

Efforts within the NHS to identify naturally occurring better practices and beacon sites are consistent with the theory of complex adaptive systems. Problems occur, however, when learning is transformed into a recipe and attached to a centrally set target. The problem is compounded when those advocating the change construct the case for it in terms that match their own natural attractors, rather than explaining it in ways that match the attractors of others.

Leadership inspired by complexity theory recognises that change occurs naturally within the system and that individuals engage in this effort for a variety of reasons. Good practice will spread more quickly within the health care system if leaders acknowledge and respect the patterns reflected in the past efforts of others to innovate. The leader's role is to create systems that disseminate rich information about better practices, allowing others to adapt those practices in ways that are most meaningful to them.

The positive dimension of variation

Because of our desire to control the organisation as a machine, we are tempted to conclude that variation is undesirable. Certainly when common operation rates vary fourfold without any obvious clinical reason it is hard to dispute this.[21] However, variation is natural within any complex system where there is interaction between many different factors. Furthermore, innovation is, by definition, variation outside the norm. A strict call to eliminate all variation is simply an appeal to the machine metaphor, and it will have the byproduct of stifling innovation.

Complexity thinking helps us sort out the paradox of variation as both potentially desirable and undesirable. For issues where there is a high degree of certainty

about the outcome from an action, and a high degree of agreement among those who will take the action, it is appropriate to think in machine terms and reduce variation.[10] Taking aspirin after myocardial infarction in the absence of contraindications is a clear example. Even where high degrees of certainty and agreement have existed traditionally, occasional variation can still be desirable for the sake of learning. For instance, analysing variation of postoperative infection rates in a group of hospitals clearly showed that some were performing considerably better than the others.[16] Rather than chastising those who "fail to make the grade," it would be more advantageous to study how variations in structure and process in the more successful hospitals contribute to variations in outcome.

Leaders at all levels need to develop a more sophisticated view of the role of variation in complex systems. This can be accomplished by exploring with others the degree of certainty and agreement around both the "what" and the "how" of a given issue, along with an understanding that innovation requires occasional variation even when all seems certain and agreed.

Conclusions

The science of complex adaptive systems brings new concepts that can provide fresh understandings of troubling issues in the organisation and management of delivery of health care. We have argued that effective organisation and delivery of health care does not need detailed targets and specifications, nor should it focus primarily on "controlling the process" or "overcoming resistance." Rather, those who seek to change an organisation should harness the natural creativity and organising ability of its staff and stakeholders through such principles as generative relationships, minimum specification, the positive use of attractors for change, and a constructive approach to variation in areas of practice where there is only moderate certainty and agreement.

Perhaps the biggest barrier to these approaches prompted by complexity thinking are the incumbent leaders of health systems who have risen within the hierarchy based on command and control methods. It is encouraging to note that the army, the stereotypical example of command and control leadership, is one of the pioneers in embracing new approaches based on complexity theory.[22] We are also encouraged by the fact that health systems around the world, including the NHS, are putting great emphasis on the development of leaders who can work in ways different from what

has traditionally been expected.[23] If the military can successfully replace the field general with the facilitator, we have high hopes that the NHS can make a similar transition.

1 Morgan G. *Images of organization.* 2nd ed. Thousand Oaks, CA: Sage, 1997.
2 Taylor FW. *The principles of scientific management.* New York: Harper, 1911.
3 Egger E. Like herding cats, herd physicians by making them want to come. *Health Care Strateg Manage* 2000;18(7):18-9.
4 Plsek PE, Greenhalgh T. The importance of complexity in health care. *BMJ* 2001;323:625-8.
5 Lane D, Maxfield R. Strategy under complexity: Fostering generative relationships. *Long Range Planning* 1996;29:215-31.
6 Lau J, Antman EM, Jimenez-Silva J. Kupelnick B, Mosteller F, Chalmers TC. Cumulative meta-analysis of therapeutic trials for myocardial infarction. *N Engl J Med* 1992;327:248-54.
7 Department of Health. *National service framework for coronary heart disease.* London: Department of Health, 2000. www.doh.gov.uk/nsf/coronary (accessed June 2001).
8 Ruston A, Clayton J, Calnan M. Patients' action during their cardiac event: qualitative study exploring differences and modifiable factors. *BMJ* 1998;316:1060-5.
9 Foote C, Plsek PE. NHS plan: thinking out of the box. *Health Serv J* 2001;111:32-3
10 Zimmerman BJ, Lindberg C, Plsek PE. *Edgeware: insights from complexity science for health care leaders.* Irving, TX: VHA Publishing, 1998.
11 Institute of Medicine. *Crossing the quality chasm: a new health system for the 21st century.* Washington, DC: National Academy Press, 2001.
12 Kelly MA, Tucci JM. Bridging the quality chasm. *BMJ* 2001;323:61-2.
13 Goldstein J. *The unshackled organization: facing the challenge of unpredictability through spontaneous reorganization.* Portland, OR: Productivity Press, 1994.
14 UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998;352:837-53.
15 McCormack J, Greenhalgh T. Seeing what you want to see in randomised controlled trials: versions and perversions of UKPDS data. United Kingdom prospective diabetes study. *BMJ* 2000;320:1720-3.
16 Mohammed A, Mohammed MA, Cheng KK, Rouse A, Marshall T. Bristol, Shipman, and clinical governance: Shewhart's forgotten lessons. *Lancet* 2001;357:463-67.
17 Greenhalgh T. Diabetes in British south Asians: nature, nurture, and culture. *Diabet Med* 1997;11:10-4.
18 Roper NA, Bilous RW, Kelly WF, Unwin NC, Connolly VM. Excess mortality in a population with diabetes and the impact of material deprivation: longitudinal, population based study. *BMJ* 2001;322:1389-93.
19 Gustafson D, Cats-Baril WL, Alemi F. *Systems to support health policy analysis: theory models and uses.* Chicago: Health Administration Press, 1992.
20 Miller WL, Crabtree BF, McDaniel R, Strange KC. Understanding change in primary care practice using complexity theory. *J Fam Pract* 1998;46:369-76.
21 Coulter A, McPherson K, Vessey M. Do British women undergo too many or too few hysterectomies? *Soc Sci Med* 1988;27:987-94.
22 Petzinger T. *The new pioneers: the men and women who are transforming the workplace and the marketplace.* New York: Simon & Schuster, 1999.
23 Department of Health. *NHS plan.* London: Stationery Office, 2000.

One hundred years ago
British practitioners in Italy

With regard to the question of foreign practitioners in Italy, Dr. Santini a few months ago brought forward a short Bill consisting of a few lines to the effect that no foreign medical men shall be permitted to practise in Italy, even among their fellow countrymen, unless they have obtained a diploma from an Italian university or a diploma from a foreign country which granted an equal right to Italian medical men to practise in that country. Dr. Santini also wished to make the law retrospective. The question was referred to a Committee with Santini as

reporter. The Foreign Minister, however, recommended the Committee to modify Santini's project to the extent that the foreign doctors who have been practising in Italy for several years should be allowed to continue to practise here. According to the statements in the political papers it appears that the Committee has approved in full of Santini's project, and consequently has not accepted the modification of the Foreign Minister.

(*BMJ* 1900:i:295)