

Complexity and uncertainty as the links between science and the humanities in general practice

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In medical school we were taught the mantra: history, examination, diagnosis and treatment. Each was supposed to follow the other in a rational and linear sequence with a single diagnosis suggesting appropriate treatment. Yet, in practice, it is almost never like this. A patient has hypertension – so far so good – but she also has bronchiectasis after many years of smoking. She has just been diagnosed with cancer of the oesophagus. She has a child with severe learning difficulties and she is fearful, not only for herself but also about what will happen to her child. She is married and the relationship is difficult. Her sister has lung cancer and is already very ill. The sister's children have problems and children of their own and this is only the beginning of a story which has become richer and richer over the almost 30 years that I have known this patient and her family. It is a story with multiple components each of which interacts with the others unpredictably.¹ Each of the components has its own history, which affects the interaction, and each has the capacity to affect my patient's blood pressure and to support or undermine the treatment that I am prescribing for her. Seeing this situation as a complex adaptive system is much more useful than trying to stick to the medical school mantra. Sensitivity, intuition, commitment and a pragmatic preparedness to muddle through become as important as a sound grasp of biomedical knowledge.

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The membership of the UK's Primary Care Complexity group² suggests that two quite distinct groups of general practitioners are interested in complexity theory. The first group has a talent for mathematics and is excited by the possibility of using mathematical modelling of chaos and complexity to enhance our understanding of what happens within human bodies³ and within health care organisations. I am part of the second group which uses a much more limited understanding of complexity theory to provide new metaphors which help to make sense of our experiences of caring for patients. This use of complexity as metaphor was roundly dismissed by a vituperative correspondent to the British Medical Journal as '*intellectual snake oil*',⁴ but I think he was wrong and, in this paper, I will try to demonstrate the usefulness of complexity metaphors and to show that even a limited understanding of a few of the key features of complexity theory provides echoes between science and the humanities and underlines

the relevance of both to the work we do in general practice.

We all use metaphors to provide us with ways of imagining and understanding the world and events within it. Poets use them explicitly; some scientists aspiring to an objective rationality regard them as slightly reprehensible and have less insight into the pervasiveness of metaphor at the root of all thinking.⁵ Most biomedicine is based on the principles of Newtonian science using a metaphor of the body as a machine with every effect having an identifiable cause. Anyone who has worked with the uncertainties of clinical practice is painfully aware of the limitations of this model and the capacity of complexity science to offer different metaphors is enormously welcome. We are enabled to look at old and intractable situations in a new way and provided with new defences against the simplistic and deterministic reductionism that informs much biomedical science and much of the organisation and evaluation of health care.⁶

Time's arrow

Complexity theory acknowledges the power of time much more than traditional Newtonian science. Newton's laws can be extrapolated either backwards or forwards in time but, within complex systems, changes over time are irreversible making such systems inherently evolutionary and historical⁷. This single difference makes the complex adaptive system much more effective than the machine as a metaphor for the human body. Human bodies decay over time and many of the changes brought by disease may be controllable but are essentially irreversible. Newton's laws are deterministic because they imply that anything that happens at any future time is completely determined by what happens now, and moreover that everything now was completely determined by what happened in the past so that, for any given system, the same initial conditions will always produce the same outcome.⁸ In medicine, we can never extrapolate either backwards or forwards in time with any degree of certainty. Two individuals with the same diagnostic label and given the same recommended treatment can have quite different outcomes. Consultations and a sequence of consultations are irreversible. A tenth consultation between a particular doctor and patient is inherently different from the first one. Every interaction between people, including between doctor and patient, contains the possibility of regret and lost opportunity. Information or pharmaceuticals or fear, once given, cannot be taken back.

Michael Frayn's magnificent play *Copenhagen* provides an example of literature interacting directly with science. The play has three protagonists Niels Bohr, Bohr's wife Margrethe, and Werner Heisenberg.

Between 1924 and 1927 in Copenhagen, Bohr, a Dane, and Heisenberg, a German, revolutionised atomic physics with the Copenhagen Interpretation, which incorporated the twin principles of uncertainty and complementarity. In the play⁹ these principles are summarised by Bohr:

'Particles are things complete in themselves. Waves are disturbances in something else... They're either one thing or the other. They can't be both. We have to choose one way of seeing them or the other. But as soon as we do we can't know everything about them.' – Bohr

The play is also about the inexorability of time and the inevitability of regret. One of the Bohr's six sons died in a sailing accident:

'Those short moments on the boat, when the tiller slams over in the heavy sea, and Christian is falling.' – Heisenberg

'If I hadn't let him take the helm ...' – Bohr

'Again and again the tiller slams over. Again and again ...' – Heisenberg

The first-person view of agency

In *Copenhagen*, Michael Frayn draws a parallel between the uncertainty principle of the wave and the particle and the uncertainty and unpredictability of human thought and action.

'...Exactly where you go as you ramble around is of course completely determined by your genes and your upbringing and the earth's magnetic field and the gravitational pull of the moon. But it's also com-

pletely determined by your own entirely inscrutable whims from one moment to the next. So we can't completely understand your behaviour without seeing it both ways at once, and that's impossible, because the two ways are mutually incompatible.' – Heisenberg

Part of the impossibility of predicting human behaviour is to do with conscious decisions made by self-determining autonomous individuals, but another part, is to do with the randomness of thoughts and ideas.

'...There's no reason at all. I didn't tell Speer simply because I didn't think of it. I came to Copenhagen simply because I did think of it. A million things we might do or might not do every day. A million decisions that make themselves.' – Heisenberg

For doctors and patients there are also a million decisions that make themselves – whether to consult the doctor, whether to consider a particular diagnosis, whether to think of prescribing a particular medication, whether to mention a particular worry. No amount of advice or guidance will change the shifting and elusive nature of thoughts and intentions.

Emergent properties

George Henry Lewes, the 19th-century English philosopher and common-law husband of the novelist George Eliot, distinguished between resultants and emergents: phenomena that are predictable from their constituent parts and those that are not. Emergent phenomena are a key feature of complex systems and the emergence of poetic meaning from combinations of words provides one example. Thought, meaning, ideas and language can be seen as existing in a multidimensional phase space, reinforcing and changing each other in a continuously evolving process. The London Language Line provides telephone translation for one hundred different languages and 'the informing reciprocities between grammar and vision'¹⁰ is slightly different for each of them.

William Carlos Williams was both a general practitioner and a poet and he experienced the words spoken by his patients, in the pri-

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vacy of the consulting room, as the closest that many of them would come to the creation of poetry – words chosen to express the deepest of feelings and fears.¹¹ The patient's presentation of his or her symptoms emerges rather than results from their experience of the symptoms themselves. Each individual chooses and uses words differently and gives different expression to his or her symptoms. And, similarly, each dyad of doctor and patient will generate a different response to the particular patient's predicament.¹²

Chaos and uncertainty

Dynamical instability or chaos refers to a special kind of behaviour in time found in certain physical systems and discovered around the year 1900, by the physicist Henri Poincaré. In complex systems with multiple interactions between different components, tiny variations in initial conditions produce vastly different outcomes that make accurate long-term predictions impossible. The discovery of chaos seems to imply that randomness and contingency lurk at the core of any deterministic model of the universe.

Uncertainty and doubt can be disturbing but they are also a source of freedom, akin to Keats' 'negative capability', giving us room to manoeuvre, to explore our possibilities and to be fully human. In medicine, the hope of both researchers and practitioners is to make the world a better place by easing suffering, but,

too often, hubris exaggerates the research achievement by extrapolating far beyond the findings and constructing an over-certain deterministic future. This concerns the old division between utilitarianism, which asserts that decisions should be judged by their consequences, and liberalism, which is focussed on rights and opportunities, on where people start rather than on where they end up. Utilitarianism, which today has a new underpinning in modern epidemiology, relies on the validity of deterministic prediction; liberalism makes more sense in a context of chaotic instability.

*'The human being, who appears to be thrilling and wonderful, may turn out at the same time to be monstrous in its ambition to simplify and control the world. Contingency, an object of terror and loathing, may turn out to be at the same time wonderful, constitutive of what makes a human life beautiful and thrilling.'*¹³

It is contingency, chance, fate, uncertainty, which makes life beautiful; the enduring truth that we can never know what will happen tomorrow whether or not we have taken our aspirin and our statin and declined to have butter on our bread, which makes life thrilling.

Resisting the urge to simplify

The processes of simplification by which the human mind interprets and makes sense of the world deny much of the complexity and detail of experience. The reductive nature

of biomedical science and the relatively crude generalisations which constitute our description of diseases are one such process. If we group people together according to these disease categories, we can extend our knowledge about the phenomenon they have in common – be it diabetes or epilepsy. As a direct result there has been enormous progress in clinical medicine – but the process of generalisation devalues individual experience and has no place for 'the inner life of fear, love and hope'.¹⁴

Philip Roth argues that the task of the writer is 'keeping the particular alive in a simplifying, generalizing world'.¹⁵ The writers of great novels evoke the detail of individual thought and the precise words of dialogue and invest each life with dignity and value. This dedication of the novelist to the complexity and authenticity of his or her characters has the same quality as that of the general practitioner to the ongoing care of his or her patients. Ian McWhinney has described this as commitment to a person whatever may befall them.¹⁶ Both novelist and practitioner are committed to keeping the particular alive, resisting simplification and embracing the complex reality of lived experience.

Through the lens of complexity, insights from the humanities and from science become complementary rather than oppositional and the discipline of general practice becomes coherent.

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