THE INTERNATIONAL JOURNAL OF CLINICAL PRACTICE

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| Journal: | *International Journal of Clinical Practice* |
| Manuscript ID: | IJCP-02-10-0113 |
| Manuscript Type: | Perspective |
| Date Submitted by the Author: | 16-Feb-2010 |
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| Specialty area: | |
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# The edge of chaos: reductionism in healthcare and health professional training

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The human body is a complex adaptive system that by definition is made up of a collection of individual agents with freedom to act in ways that are not always totally predictable, and whose actions are interconnected so that one agent's actions changes the context for other agents[1]. This definition can also be applied to a single primary healthcare team or indeed an entire healthcare system which throughout the world are becoming increasingly complex. Business and industry has responded to this process by adopting many of the ideas of complexity theory which emphasizes the need to accept some uncertainty, adopt multiple approaches and progress according to what is working best at a local level which reads very much like a mission statement for primary care. However, healthcare generally has been much slower to respond, and indeed remains dominated by a reductionist approach which seeks to divide healthcare into small measurable units whether pathological in terms of disease description and career specialization or financial in terms of quality and outcomes framework (QOF) or hospital episode statistics (HES) data. The inherent weakness of such approaches is the underlying assumption that the "whole is the sum of all the parts" while we already know from complexity theory and indeed from clinical experience that the sum of all the parts may be much more or indeed much less than the whole once all these individual parts start to interact often in unpredictable ways. This is not to say that the collection of QOF data is not necessary and useful but it must not come to dominate the process of clinical practice and research such that it distracts the clinician/researcher from the complex adaptive system before them, that is, the patient.

The care of a patient with multimorbidity, the development and application of clinical guidelines or the education of health professionals are all issues that lie in the zone of complexity. Our learnt instincts with such issues, based on reductionist thinking, are to break down the ambiguity, resolve any paradox, achieve more certainty and agreement, and move into the "simple system zone" where certainty about what to do and agreement between stakeholders on how to proceed are both high.[1] This is illustrated in Figure 1, the "certainty-agreement diagram" taken from Stacey[2] where the middle zone has insufficient agreement and certainty to make the choice of the next step obvious (as it is in the simple system zone), but not so much disagreement and uncertainty that the system is thrown into chaos.[2] Thus, the set of circumstances that call for such adaptive behaviors in a complex system have been aptly termed "the edge of chaos".[3]

As a case in point, we now know that multimorbidity – the simultaneous coexistence in single patients of more than one disease state - is the rule rather than the exception in primary care.[4] However, the absence of national or indeed international guidelines for the management of patients with multimorbidity highlights the gulf which exists between the complexity of disease and the reductionism inherent in the disease-specific approach. This probably goes some way to explain why guidelines are so often not followed in clinical practice.[5] This reductionist approach also dominates the research agenda. Multimorbidity has a prevalence of 60% among people aged 55 to 74 which is much higher than that of asthma (6.5%), hypertension (29.6%), and diabetes (8.7%) however for each article on multimorbidity, there are 74 on asthma, 94 on hypertension, and 38 on diabetes.[6] We would argue it is ethically questionable to continue to exclude patients with significant multimorbidity from clinical trials and the scientific community should not accept the lack of reporting of multimorbidity data on patients enrolled in such trials.[7] This only contributes to a lack of evidence with regard to appropriate interventions in this group while the identification of trial participants through secondary care settings further limits the applicability of some research findings to the heterogeneous and multimorbid primary care population. We must begin to see our patients without the blinkers of reductionism and our research must come to reflect this approach. In order for this to take place funders must demand higher ethical and reporting standards and prioritise those studies that include real people and populations.

Another area of particular concern, due to its potential to effect generations of future doctors and therefore the patients they will treat, lies within the realm of postgraduate medical training. With the recent advent of "Modernising Medical Careers"[8], and the subsequent "stream-lining" of training, junior doctors are expected to choose a specialty just eighteen months after graduation. This approach to medical training in the UK, attempts to minimize general training years (and the subsequent general experience that yields) and produce "competent" specialists is as short a time as possible. Due to considerable criticism, a formal inquiry by way of the Tooke report was commissioned which concluded that early selection to specialty training was "premature and constraining".[9] It was further commented that this new process "denied the value of experience", and concluded that one needs a "very good reason to depart from the fundamentals of professional practice which have guided medicine

for millennia". A similar reductionist approach to medical training has existed in the US for decades. Existing approaches to medical training do need to be reinterpreted for the modern era, however, this endemic allegiance to reductionism, across many sphere's within biomedicine, may be over zealous at best, and potentially catastrophic at worst. Medical education must deliver not just competency but also capability (the ability to adapt to change, generate new knowledge and continuously improve performance[10]) which will require a shift in structure and methods which has not taken place to date. It is vital that a place exists in postgraduate medical training that facilitates the gaining of general experience by physicians without causing disadvantage to career progression. Furthermore, medical training should not be reduced to a simple conveyor belt of "competent" specialists who may be unable to meet the wide-ranging and diverse needs of most of the developing world populations as well as marginalized and vulnerable communities of the developed world such as the Roma travelling community or the aboriginal community of the Australian outback.

With reductionism in training, and in health care delivery, how are we going to serve these marginalized and vulnerable communities? With the current training agenda, where are we going to find the next generation of true general surgeons and physicians? It is well recognized by rural doctors that reductionism in training and health care delivery spells the death of high quality remote care, and far from improving the standard of care for remote patients, has led to falling satisfaction, a significant increase in the number of transferred patients, and an unsatisfactory position where services are constantly being refined, with morale amongst health care professionals falling.[11] Reductionist theory, as adopted by the anaesthetic specialty from the aviation industry certainly helps minimise complications[12] - but have we gone too far in terms of medical training? Certainly, by limiting our general training, we become more proficient at a particular set of tasks – but does it leave us deficient in the broader skills of medicine, that are historically developed during general training and by extended experience. Recently, a colleague described how his father, a gynaecologist, during a routine procedure, discovered an inflamed appendix and was able to remove it. His son, a basic surgical trainee, asked his father where he gained such skills, and more importantly, the confidence, to act so decisively. Like many of his generation, he explained, he had extensive training in general surgery before embarking on a career in obstetrics and gynaecology. The current system of streamlined training, may produce proficient

practitioners and technicians in a certain organ system, but will fail to develop well rounded, experienced and confident doctors such as the one described above.

It is has been long established that patients are biopsychosocial beings whose health and illness are played out in complex and influential socio-cultural contexts.[13] Why does biomedicine and its allegiance to reductionist models of health persist in the face of such evidence? It is perhaps 'simpler' and probably more naturally intuitive to focus on specifics, in the sense that clinicians can focus their concentration on the specific body part or pathology. However, one has to ask the question how relevant this is when viewed on a population basis? Such a question has consequences for not only primary, but also secondary care. With the "greying" of populations worldwide, a proportional increase in multimorbidity is inevitable. Single organ doctors frequently struggle with such patients, and we feel our future training policy and research agenda should reflect this emerging trend. We can all think of examples where an expert general opinion was sought for a complex multimorbid patient. The irony is that with continued allegiance to reductionism in research and training in secondary care, there may be no generalists left to call upon, and no evidence base to guide our clinical decisions.

The limitations and inherent dangers of reductionist thinking are well recognised yet healthcare delivery and research continues to be dogged by the disease-specific approach. The emerging shift in healthcare funding towards an increased emphasis on primary care healthcare delivery and research in certain countries[14] is welcome and perhaps holds the key to future "health". However, it remains worrying that the key gate-keeping role of primary care seen in countries such as the UK, Ireland and the Netherlands is absent in many other countries such as the US and France whose per capita spend on healthcare is as a result significantly higher.[15]

Reductionism aims, by definition, to explain every complex phenomenon, by analyzing the simplest, most basic physical mechanisms that are in operation during that phenomenon.[16] We appreciate this approach and its importance in science, and particularly in the provision of organ specific therapies. However, medicine is becoming an increasingly complex interplay between different pathologies, treated in a multidisciplinary way, within the context of diverse socio-cultural backgrounds. The temptation to focus on manageable "bite-size" portions, in an increasingly accountable and litigious society, is an understandable one.

However, we feel that in order to provide excellent patient care, we need to realign ourselves as a profession with the reality of the society we live in and the communities we serve. This should be reflected in medical training, research and education if we are to remain a profession that strives for excellence and delivers high quality care to our patients. If the current trend continues will it result in health professionals who know more and more about less and less and researchers who instead of searching for the whole truth in real populations, continue to seek to examine smaller, more easily defined and separable phenomena. [17]

Those in medicine who have effected the greatest change have been those who have had a comprehensive vision involving not just pathology but also social medicine, politics and anthropology, which enabled them to be great advocates and architects of change particularly with regard to the most vulnerable in society. This was true in the 19th century with visionaries such as Rudolph Virchow[18], who not only was the father of modern pathology but one of the first to recognise the importance of social medicine and public health. This remains true today with people such as the renowned anthropologist and physician Paul Farmer, who through his organisation, "Partners in Health" attempts to deliver healthcare to the world's poorest people.[19] People such as Virchow and Farmer are surely much less likely to emerge if our reductionist approach to healthcare and healthcare training continue. With respect to the future, we need to regard seriously once more Ivan Illich's[13] prophetic and polemic words that "the major threat to health in the world is modern medicine" and fundamentally re-think our approach to modern healthcare and healthcare training before it is too late.

## Conflict of interest statement

I declare no conflict of interest

**Contributors** LG (guarantor) had the original idea for the article and RS contributed to development and structure. LG and RS drafted the article and both authors revised the article and granted final approval to the version submitted for publication.

## References


1. Plsek PE, Greenhalgh T. Complexity science: The challenge of complexity in health care. *BMJ* 2001;323(7313):625-28.
2. Stacey RD, editor. *Strategic management and organizational dynamics.* . London: Pitmann Publishing, 1996.
3. Langton CG, editor. *Artificial life. Proceedings of the Santa Fe Institute. Studies in the sciences of complexity.* Redwood City, CA: Addison-Wesley, 1989.
4. Fortin M, Bravo G, Hudon C, Vanasse A, Lapointe L. Prevalence of Multimorbidity Among Adults Seen in Family Practice. *Ann Fam Med* 2005;3(3):223-28.
5. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud P-AC, et al. Why Don't Physicians Follow Clinical Practice Guidelines?: A Framework for Improvement 10.1001/jama.282.15.1458. *JAMA* 1999;282(15):1458-65.
6. Fortin M, Hudon C, Lapointe L, Vanasse A. Multimorbidity is common to family practice: Is it commonly researched? *Canadian Family Physician* 2005;51:244 - 45.
7. Fortin M, Dionne J, Pinho G, Gignac J, Almirall J, Lapointe L. Randomized Controlled Trials: Do They Have External Validity for Patients With Multiple Comorbidities? 10.1370/afm.516. *Ann Fam Med* 2006;4(2):104-08.
8. Department of Health UK. Modernising Medical Careers - The next steps. The future shape of Foundation, Specialist, and General Practice Training Programmes. . London, 2004.
9. Professor Sir John Tooke. Aspiring to Excellence. Independent Inquiry into Modernising Medical Careers. , 2008.
10. Fraser SW, Greenhalgh T. Complexity science: Coping with complexity: educating for capability. *BMJ* 2001;323(7316):799-803.
11. McCormick J, Walls, A. Personal perspectives on remote and rural medicine in Scotland. - Evolution of remote and rural acute services in Stranraer, Scotland. *Royal College of Physicians of Edinburgh* 2005.
12. Guande A, 2003. Complications : A Surgeons notes on an imperfect science. . London: Picador, 2003.
13. Illich I. *Limits to Medicine. Medical Nemesis: The Expropriation of Health*. London: Marion Boyars, 1995.
14. Department of Health and Children. Quality and fairness: a health system for you. Dublin: Department of Health and Children, 2001.
15. Starfield B. Is primary care essential? *Lancet* 1994;344(8930):1129-33.
16. Merriam Webster Dictionary. http://www.merriam-webster.com/.
17. Wyngaarden JB, Smith, L.H., editor. *Cecil Textbook of Medicine 17th ed.* USA: W.B. Saunders Co., 1985.
18. Ackerknecht EH. Rudolph Virchow : Doctor, Statesman, Anthropologist. . University of Wisconsin: Madison, 1953.
19. Kidder T, editor. *Mountains Beyond Mountains: The Quest of Dr. Paul Farmer, A Man Who Would Cure the World.* . New York.: Random House Trade Inc., 2004.

**Figure 1. The certainty-agreement diagram**