

A theoretical framework for multimorbidity:

from complicated to chaotic

BACKGROUND

Multimorbidity is the coexistence of two or more long-term conditions. Patients with multiple conditions are common and have poor outcomes, including decreased quality of life, longer hospital stays, and higher costs of care.^{1,2} Models have been proposed to support clinical intervention in multimorbidity,³⁻⁵ but they are limited in scope and practical application. This paper offers a broader theoretical framework within which multimorbidity can be explored, from three perspectives:

- the clinical encounter — the consultation between practitioner and patient;
- service delivery — with increasing demands on limited healthcare resources, there is a need to deliver services more effectively and efficiently; and
- clinical governance — measures of clinical quality are becoming increasingly relevant.

CONSTRUCTS OF THE MODEL

The model takes as its starting point the

systems approach of Kurtz and Snowden.⁶ Three domains are proposed:

- ordered (simple or complicated), where there is a simple relationship between cause and effect that can be understood by analysis of its component parts;
- transitional, with features of both ordered and unordered systems; and
- unordered (complex or chaotic), in which there is no simple relationship between cause and effect. The system cannot be understood by a reduction into its parts, although patterns emerge from the underlying interactions, and causality may be inferred retrospectively. Chaotic is used in the sense of unstructured randomness with no relationship between cause and effect, rather than the mathematical chaos, which is deterministic.

The structure of each domain has implications for clinical decision making and health service delivery, illustrated by a case study of morbidity (Table 1).

The ordered domain

Simple ordered. There is a single-ordered clinical problem and a predictable and linear relationship between cause and effect. Small inputs give rise to small outputs and vice versa. Outcomes are well defined and the process that relates system inputs to outputs is known or knowable.

Complicated ordered. There are a number of simple problems that do not interact with each other, although the system can be analysed by a reduction into its simple-ordered component parts. Knowledge can be captured by techniques within a hierarchy of evidence-based approaches. The system is 'knowable', providing adequate investigative resources are available, but where uncertainty does exist, it can be quantified using statistical methods. The clinical approach is to categorise the system and act according to predefined pathways or guidelines. Ordered problems can be addressed by practitioners with lower levels of training by following clinical protocols such as nurse-led care for asthma or hypertension. Managed systems operating

Table 1. Evolution of multimorbidity in a patient over time across three domains

Domain	Age, years	Clinical picture
1a. ORDERED Simple system <ul style="list-style-type: none"> • System characteristics: there is a simple, known, or knowable relationship between cause and effect. • System approach:⁶ sense, categorise, respond. 	30	<ul style="list-style-type: none"> • Patient develops dyspepsia. Treated with antacids
1b. ORDERED Complicated system <ul style="list-style-type: none"> • System characteristics: the system can be considered as a number of simple systems that do not interact. • System approach:⁶ sense, categorise, respond. 	40	<ul style="list-style-type: none"> • Worsening dyspepsia treated with proton pump inhibitors • Develops gout. Started on allopurinol • Found to have essential hypertension, controlled with an angiotensin-converting enzyme (ACE) inhibitor
2. TRANSITIONAL <ul style="list-style-type: none"> • System characteristics: although exact causal relationships cannot be known, the direction in which variables drive the system can reasonably be assumed. • System approach:⁶ sense, analyse, respond. 	50	<ul style="list-style-type: none"> • Due to stress at work, restarts smoking • Develops ischaemic heart disease against a background of a positive family history • Lack of exercise leads to increased weight • Increased weight and smoking exacerbates dyspepsia • Develops peripheral vascular disease
3a. UNORDERED Complex system <ul style="list-style-type: none"> • System characteristics: causal relations not clear but patterns emerge that can be identified in retrospect. • System approach:⁶ probe, sense, respond. 	55	<ul style="list-style-type: none"> • Poor sleep exacerbated by obstructed sleep apnoea against background of obesity • Becomes depressed • Starts drinking 40 units of alcohol a week • Loses job and family splits up
3b. UNORDERED Chaotic system <ul style="list-style-type: none"> • System characteristics: unstructured randomness. • System approach:⁶ sense, stabilise. 	60	<ul style="list-style-type: none"> • Loses home • Drinking increases • Non-compliant with medication • Self-harm attempt

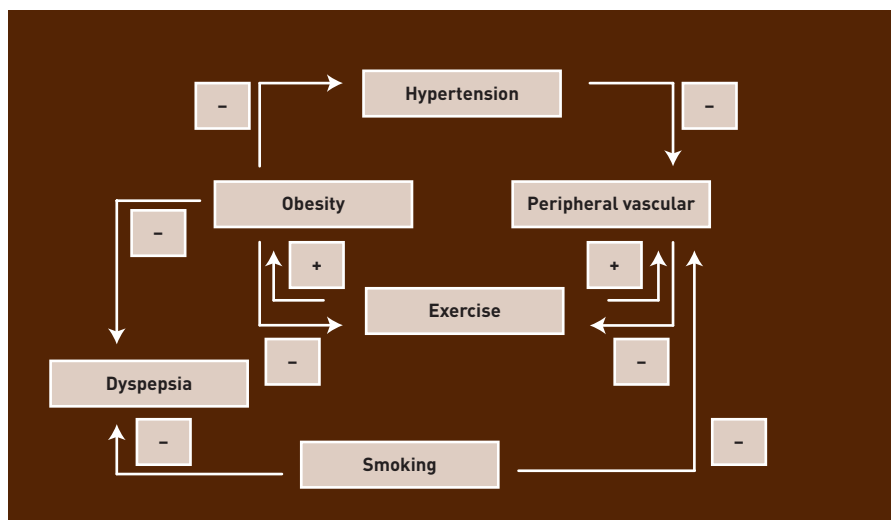


Figure 1. Influence diagram for transitional domain. -- = negative system influence; + = beneficial system influence.

within bureaucratic frameworks or market-based approaches based on competition between providers have been adopted to deliver effective and efficient patterns of service delivery.⁷ Measures of quality can be readily defined and measured, as in the NHS Quality and Outcomes Framework.

The transitional domain

In this domain, there is a transition from order to disorder. Interaction between system elements prevents each clinical entity being completely understood in isolation. Although exact causal relationships cannot be known, the direction in which variables drive the system can reasonably be assumed. Here, a 'bounded rationality' recognises the limits to decision making and courses of action that are good enough.⁸ An approach known as qualitative system dynamics⁹ assumes that we may not know the precise results of any action but we may know enough to be able to identify sensible actions. Inference diagrams can offer a way of describing potential interactions between multiple variables acting in interacting loops, and identify opportunities for movement in a required direction (Figure 1). However, as the system becomes less ordered, these opportunities become more ambiguous.

Protocol-driven care may still be relevant but with a wider acknowledgement of the potential impact of other factors. A broader team approach emphasises management and coordination across teams. The focus is on a closer integration between mental health, public health, and primary care, supported by information sharing and case management.¹⁰

As the transitional domain becomes

more unordered, management guidelines and strategies may themselves create a growing burden for patients. A 'minimally disruptive approach'¹¹ recognises that the complex interactions of comorbidity are excluded from most practice guidelines and that the treatment burden can become problematic for the patient.

In the transitional domain, realistic evaluation offers an exploratory framework that seeks to understand the ways in which mechanisms interact with contextual factors to bring about unique outputs.¹² The focus shifts from 'what works?' to 'what works for whom in what circumstances?'. Normalisation process theory¹³ identifies factors that promote or inhibit the routine incorporation of interventions into practice and how they become embedded into routine practice. However, similarity of conditions, although important, is insufficient to ensure knowledge transfer to complex domains. The development of pattern-recognition capabilities that lead to heuristic-guided decisions under conditions of uncertainty and incomplete information is also important.¹⁴

From a governance perspective, a broader range of quality indicators becomes relevant but the difficulties of developing indicators in this domain are recognised.¹⁵ The focus shifts from checking to trusting (the expectation that others will behave in predictable and desirable ways even in the absence of incentives or scrutiny¹⁶), an attribute that is associated with a range of benefits that include reduced transaction and verification costs, improved communication, enhanced teamwork, increased job satisfaction, and innovation.^{17,18}

The unordered domain

Complex unordered. Here, patterns emerge through the interactions of multiple physical, psychological, and social inputs that may only be perceived in retrospect and not predicted with any degree of certainty. The clinical approach is to probe the system in order to make patterns or potential patterns more visible before taking action. Patterns that are found to be desirable are stabilised and those that are not are destabilised.

A complex system is defined as a network of elements that exchange information in such a way that change in the context of one element changes the context for all others.¹⁹ Recursive feedback at a local level gives rise to non-linearity (there is no simple relationship between cause and effect — small inputs can cause large system outputs and vice versa.) Although the system is inherently unstable and unpredictable, due to the presence of multiple feedback loops the system is capable of self-organisation, and ordered and stable patterns emerge that could not have been predicted from the study of individual elements. The emphasis moves away from prediction and control to an appreciation of the configuration of relationships among a system's components and an understanding of what creates patterns of order and behaviour among them. Some important features of complex systems are shown in Box 1.

Where high levels of uncertainty exist, alternative approaches to the agent-principal problem are required. Here the patient-practitioner unit is the focus of analysis rather than the single units of agent and principal. Often practitioners know more than they can say and reveal a capacity for reflection on intuitive knowledge in the midst of action, and use this tacit capacity to cope with the unique uncertain and conflicting situations of practice.²⁰ The emphasis is on the exchange of knowledge and negotiating of meaning in a relationship that is held together by commitment and 'holding relationships'²¹ — ongoing support without expectation of cure.

Practical approaches to working in complex clinical domains have been described.²²⁻²⁴ Patient narrative techniques reflect the interpretive aspect of practice where patients' experiences and priorities are integrated with the practitioner's knowledge of pathology,²⁵ but the danger of reducing them to a level of a technical description is recognised.

Stacey expands the focus, recognising

Box 1. Some important features of complex systems

- Complex systems have a large number of components that are rich and diverse.
- Positive and negative feedback loops in the systems give rise to non-linear behaviour (small changes can have large effects and vice versa) but give stability.
- Because of non-linearity, the future state of the system cannot be predicted with certainty or the system manipulated to desired ends.
- Any observer is co-evolving with the system and cannot stand outside of it.
- The behaviour of complex systems emerges from the interaction of elements at a local level.
- An important but contested concept is that complex behaviour emerges from the reiteration of a small number of guiding principles or simple rules. These may be implicit or explicit. Underpinned by these simple rules, the system invariably feeds back on itself rather than feeding back with reference to external set points — the source of standards of the system is the previous history of the system itself.

the importance of free-flowing conversation allowing the space of possibilities to be explored and the expression of novelty and creativity.²⁶ This theory of 'complex responsive processes of relating' acknowledges the ability to work with uncertainty and to display a 'good enough holding of anxiety'. Unlike the ordered domain, where the focus is on the reduction of risk and uncertainty, the focus is on the exploration of probability and the accommodation of risk. The skill required is for the practitioner to enable free-flowing conversation but to remain sensitive to potential opportunities for change in the system trajectory.

As this domain becomes increasingly unordered, the practitioner's 'resources of complexity' are best suited to the expression of complex problems. The faculties of mind and the resources of language become increasingly relevant to the expression of complex problems.²⁷ The experienced practitioner has a unique capacity for contextual understanding of meaning and the processing of non-literal aspects of language and emotional expression that include metaphor, irony, and humour and can hold ambiguous possibilities in suspension without closure on one outcome.²⁸ This clinical approach has been called 'perceptual capacity' — an intellectual grasp of the situation that also embraces the use of imagination and an appropriate degree of emotional engagement.²⁹

From a service-delivery perspective, the focus is on a generalist practitioner 'who integrates biotechnical and biographical care that is continuous and not disease centred and where health is seen as a resource for living'.³⁰ A key feature is a high level of interpersonal trust and recognition of a much broader range of incentives. The medical humanities, an interdisciplinary field that includes the humanities, social sciences, and the arts, can provide important insights into the skills that are essential in this domain.

In the unordered domain, the research focus shifts to research undertaken as a dialogue within a socially constructed framework rather than an expert activity.³¹ Techniques such as action research³² and knowledge utilisation³³ emphasise collective sense-making, through which knowledge is negotiated and constructed by stakeholders. Other, more practical approaches to research in complex health systems have been proposed.^{34,35}

In the example of Table 1, the practitioner explores the patient's family relationships and the reason for his heavy drinking. The practitioner reflects upon his own experiences of alcohol abuse and draws upon metaphor that resonates with the patient's experience to describe his predicament, interjecting with appropriate irony and humour. They agree on some short-term goals and frequent review.

Chaotic unordered. Here there are no perceivable relationships between elements of the system. The system is highly turbulent and system characteristics are likely to change very rapidly and dramatically. The aim is to act quickly and decisively to reduce danger and return to a complex domain.

The focus will be on crisis management with the aim of stabilisation and focused interventions, often from an authoritarian perspective. For example, in the case study in Table 1, the patient is sectioned under the mental health act and, through a system of sheltered accommodation, brought to a less unordered domain.

CONCLUSION

A model has been proposed as a starting point to order our knowledge and explore multimorbidity. It could be argued that all clinical presentations are complex, but the purpose of models is to simplify reality in order to generate greater descriptive and prescriptive power.

The proposed model highlights the importance of matching the domain of the patient with the correct analytical and interventional approach from clinical, service-

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delivery, and governance perspectives. A central problem is that there may be disagreement between stakeholders on the nature of a situation and a danger that the nature of the domain is interpreted on the basis of preference for action. There is also a danger that organisational arrangements and incentive structures are created that lead to conditions favouring the predictions made in theory, thus reinforcing inappropriate modes of service delivery.

The framework described does not suggest that simple presentations may not be addressed by drawing on the insights from more complex domains. Reflection, imagination, emotion, and narrative can benefit outcomes in the simplest of domains. But dysfunctional consequences may arise if analytical frames are used inappropriately. For example, confronted with inappropriate service-delivery structures, 'street level bureaucrats' will modify their roles and adopt coping strategies that may not be in the best interests of the system.³⁶

The majority of multimorbidity presentations are likely to reside in the transitional domain. Here, as systems become increasingly disordered, entrained patterns are at their most dangerous — a simple error in assumption can lead to a false conclusion that is difficult to isolate and may not be seen.

Confronting the challenges of multimorbidity will need an understanding of and sensitivity to different analytical perspectives and a diversity of healthcare delivery frameworks that are appropriate for the particular nature of the system domain.

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Provenance

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