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Article

From Complexity Theory to Clinical Action: A Trans-Scalar Systems Framework for Multimorbidity in Primary Care

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Abstract

Background Multimorbidity affects approximately 25% of adults and 65% of those over 65, but clinical care remains organised around single-disease guidelines that generate fragmentation, polypharmacy, and therapeutic paralysis in complex patients. Complexity-based frameworks have established that multimorbidity represents systemic dysregulation — not an accumulation of discrete pathologies — but have not provided clinicians with an operative structure to translate that understanding into clinical action. **Objective** To present the Trans-Scalar Systems of Care (TSSC) framework as a clinically operative structure that translates the principles of complexity science into assessment priorities, intervention sequencing, and leverage point identification for patients with multimorbidity in primary care. **Methods** The TSSC integrates four theoretical pillars — complexity science, enactive cognition, ecosocial epidemiology, and life course theory — selected for their ontological breadth, trans-scalar explanatory capacity, processual orientation, and clinical applicability. The framework is illustrated through the analysis of three representative clinical cases, and its implications for practice, health systems, and research are derived. **Results** The TSSC reconceptualises health as dynamic multi-scalar regulatory coherence and multimorbidity as a rigid attractor — a state the system tends to return to despite repeated interventions — maintained by mutually reinforcing constraints across ecological, relational, narrative, and physiological scales. It organises clinical assessment around four questions about the trans-scalar coordination pattern, the location of regulatory disruption, the mechanism of systemic rigidity, and the identification of trans-scalar leverage points, and proposes that intervention sequencing matters. It incorporates a configurational grammar of the consultation that distinguishes between epistemic closing signals and configurational opening signals. The consultation is understood as transdisciplinary co-construction in which doctor and patient are specialists in different disciplines. Four falsifiable predictions define an empirical research agenda that distinguishes the TSSC from additive biopsychosocial models. **Conclusion** The TSSC offers a clinically operative bridge between complexity theory and primary care practice. Its differential contribution is not the vocabulary of complexity but the operationalisation of that vocabulary into instruments that change the geometry of clinical reasoning. Its predictions are testable, its limitations explicit, and its value will ultimately be determined by whether clinicians find it useful and whether its hypotheses are confirmed in rigorous comparative studies.

Keywords: multimorbidity; complex systems; primary care; trans-scalar regulation; leverage points; clinical framework; enactive cognition; ecosocial epidemiology; transdisciplinary co-construction; configurational grammar

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1. Introduction

Manuel is a 58-year-old man with COPD and a long history of failed smoking cessation attempts. His family doctor has seen him repeatedly over the years, with each visit following a familiar arc: spirometry results, reinforced advice, a new referral to a cessation programme, and another relapse. The implicit question organising each encounter has been: why does this patient keep failing to adhere?

In one consultation, something shifts. The doctor asks not about tobacco but about daily life since Manuel's wife died two years ago. What emerges transforms the case entirely: the only moment of the day when Manuel feels genuine social connection is smoking at the bar with former workmates. The doctor did not know the cigarette was functioning as relational support. Manuel had never formulated: if I stop smoking, I will be completely alone.

The consultation stops revolving around smoking cessation and begins revolving around grief, isolation, and belonging. No treatment plan is negotiated. The explanatory model of the problem is transformed.

This is not a story about a more empathetic doctor. It is a story about a different clinical ontology. In the conventional model, context modulates disease. In the configurational model this article proposes, the vital configuration is the clinical phenomenon. Manuel's COPD, his smoking, his social isolation, and his bereavement are not parallel problems requiring parallel interventions. They are expressions of a dysregulated system that the consultation, approached differently, can begin to make intelligible.

Manuel's situation is not exceptional. Multimorbidity — the coexistence of two or more chronic conditions — affects approximately 25% of adults and 65% of those over 65, generating 50% of healthcare expenditure and a mortality two to three times higher than patients with a single disease [1–3]. Yet the dominant model of clinical care remains organised around isolated diseases. Guidelines, essential for standardising care in acute and single-pathology contexts, become counterproductive when applied simultaneously to patients like Manuel: the result is polypharmacy, contradictory lifestyle recommendations, and therapeutic paralysis [4,5].

The limitations of this approach are well recognised. The biopsychosocial model represented a crucial advance in recognising that biological, psychological, and social dimensions jointly contribute to health and disease [6]. However, achieving genuine integration of these dimensions in clinical practice has proved consistently difficult [7]. They tend to be addressed through parallel interventions rather than as coupled regulatory systems whose interactions produce emergent phenomena that cannot be predicted by examining any level in isolation. The model describes what to consider; it does not guide what to do first, or why.

More recently, complexity science has offered a richer conceptual vocabulary for understanding multimorbidity. Sturmberg and collaborators, publishing in this journal, have argued compellingly that multimorbidity is not the sum of discrete pathologies but the manifestation of disturbances in interconnected physiological, social, and environmental networks [8,9]. This work has been foundational in establishing that linear disease-centred models are structurally inadequate for complex patients.

What remains missing, however, is the translation of those theoretical insights into a clinically operative structure: one that guides the practitioner not only to understand why Manuel's system is failing, but to identify where and how to intervene. The doctor attending Manuel in a fifteen-minute consultation needs more than a reconceptualisation; they need a framework that converts the principles of complexity into clinical questions, assessment priorities, and actionable leverage points.

This article proposes the Trans-Scalar Systems of Care (TSSC) framework as that bridge. Drawing on complexity science, enactive cognition, ecosocial epidemiology, and life course theory, the TSSC does not replace existing knowledge about Manuel's conditions — it recontextualises them within a multi-scalar understanding of how biological, psychological, relational, and ecological processes co-regulate health trajectories. We illustrate its application through the analysis of three representative clinical cases, derive testable predictions that distinguish the TSSC from additive

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biopsychosocial models, and outline implications for clinical practice, health system design, and research.

2. The TSSC Framework: A Structure for the Consultation

The Trans-Scalar Systems of Care framework proposes that health is not the absence of discrete pathologies but a dynamic pattern of coordination across nested biological, psychological, relational, and ecological scales. These scales are not parallel dimensions to be evaluated separately — they are interdependent regulatory processes whose interactions produce emergent properties that cannot be predicted by examining any level in isolation [10,11].

This has a direct clinical implication. When a patient's system loses coherence across scales — as occurs with Manuel — the result is not simply the sum of several diseases. It is a self-reinforcing pattern of dysregulation in which each scale constrains the others, creating what complexity science calls a rigid attractor — a state the system tends to return to despite repeated interventions directed at individual components [12,13].

The TSSC organises this understanding into four clinical questions that can guide assessment and intervention in the consultation. Unlike conventional assessment instruments, these are not questions the doctor asks about the patient: they are questions that doctor and patient explore together, each from their own area of expertise. The doctor contributes clinical and systemic knowledge; the patient contributes knowledge of their own lived experience, history, and health-illness model. What emerges from that shared exploration was not present in either of them before the consultation.

What is the pattern of coordination across this patient's scales? Rather than asking only 'what diseases does this patient have?', the consultation asks how the patient's biological, psychological, relational, and ecological processes are functioning together — and where coordination is breaking down. In Manuel's case, the question is not 'why doesn't he stop smoking?' but 'what holds this system together and what happens if one of its elements is disrupted?'

Where has regulatory coherence been disrupted? The doctor and patient map together the scales where dysregulation is most prominent. Is the principal disturbance physiological? Relational — as in Manuel's case, where grief and isolation are the dominant restriction? Ecological? Or narrative, expressed in a self-narrative left unupdated after the loss?

Why is the system stuck in this pattern? Multimorbidity is understood in this framework as a rigid attractor maintained by mutually reinforcing constraints across scales [12,14]. The clinical question is not 'why does this patient have several diagnoses?' but 'what keeps this system locked in dysregulation despite treatment?' In Manuel's case, escalating smoking cessation advice on a system under severe relational isolation is unlikely to produce lasting change [21,22].

Where can a small intervention unlock systemic reorganisation? The TSSC introduces the concept of trans-scalar leverage points: interventions that are modest in themselves but, by acting on a regulatory junction between scales, produce disproportionate effects across the entire system [14]. These points are not identified by the doctor alone: they emerge from the co-constructed understanding between doctor and patient. In Manuel's case, the leverage point is not smoking cessation — it is reconstructing a network of belonging that makes cessation viable.

These four questions are made possible by integrating four theoretical pillars. Complexity science provides the ontological foundation: health as emergent, dynamic, and multilevel [10]. Enactive cognition — whose central contribution is that knowing is acting, that the clinical case does not pre-exist the consultation but emerges within it — explains how the construction of meaning and agency are themselves regulatory processes, not psychological add-ons [15,16,43,44]. This understanding of the patient as a dynamic process — analogous to what thermodynamics calls a dissipative structure, a pattern maintained through flow without needing an executive centre to direct it — and its implications for clinical practice are developed in depth in a companion article addressed to family physicians [50]. Ecosocial epidemiology locates health trajectories within the structural constraints of power, resources, and political economy [17,18]. Life course theory captures

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how current physiological states are partly the biological embodiment of accumulated exposures [19,20].

The technical rationale for selecting these four pillars is provided in Supplementary Material S1.

Table 1 summarises the configurational grammar of the consultation: a set of operators that allow the clinician to recognise when they are shifting modes of clinical reasoning. This table is not intended as a protocol — it is intended as a grammar capable of making visible the difference between confirming what is already known and co-producing new understanding.

Table 1. Configurational grammar of the consultation: from epistemic closing to trans-scalar opening.

Clinical proposition	Usual closing signal	Opening question	Microcase	Leverage point type
Transdisciplinary co-construction	'We need to improve adherence'	What function does this behaviour serve in this patient's life?	Manuel smokes to avoid isolation after his wife's death	Relational
Always knowing the patient for the first time	'Same as always'	What has changed in this system since the last consultation?	'High-utiliser' patient who has started caring for a spouse with dementia	Relational-temporal
Multidetermination as epistemic relaxation	'They don't look after themselves'	What attractors sustain this behaviour?	Diabetic who eats at night because it is the only time without family demands	Temporal-identity
Inversion of the epistemic arrow	'Guidelines indicate anticoagulation'	What place does this evidence occupy in this specific life?	Frail elderly woman with terror of haemorrhage after her husband's traumatic death	Narrative-biomedical
Bias as hypothesis	'It's anxiety'	What doesn't fit my current hypothesis?	Dyspnoea labelled as anxiety that concealed early heart failure	Biomedical

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CME as knowledge ecosystem	'I need to update my guidelines'	What ecosystem produced this recommendation?	New diagnostic entity with expanded thresholds and majority-conflicted panel	Epistemic
AI as enactive co-producer	'I search AI for the correct answer'	What emerges from coupling with AI that neither of us had beforehand?	Doctor consulting about a 'difficult' patient and discovering she rejects being exclusively 'ill'	Identity-narrative
Trans-scalar leverage points	'We need to increase the dose'	What small intervention could reorganise configurations at multiple scales?	Man with chronic pain who returns to playing guitar after forced retirement	Identity-temporal

Table 2 summarises the conceptual evolution from the biomedical model, through the biopsychosocial model, to the TSSC, illustrating what each adds and what it leaves unresolved.

Table 2. Conceptual evolution: from the biomedical model to the TSSC.

Dimension	Biomedical model	Biopsychosocial model	TSSC
Unit of analysis	Disease as discrete entity	Three parallel domains (bio-psycho-social)	Multi-scalar dynamic system
Causality	Linear: pathology → symptom	Additive: sum of factors	Emergent: scale interactions produce unpredictable phenomena
Clinical objective	Eliminate or control disease	Treat the three domains in parallel	Facilitate systemic reorganisation towards greater regulatory coherence
Intervention logic	Apply correct treatment to diagnosis	Add interventions in each domain	Identify leverage points and sequence them

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Patient role	Passive treatment recipient	Informed and adherent	Co-constructor of the plan; specialist in their own experience
Role of guidelines	Prescriptive: determine action	Orientative: adapt to context	Tool invoked from understanding of the patient's system
CME	Disciplinary update	Biopsychosocial integration	Understanding the knowledge production ecosystem

3. Ana Revisited: The TSSC in Action

Ana is a 54-year-old hospital cleaner with hypertension, type 2 diabetes mellitus, chronic low back pain, generalised anxiety, and moderate depression. She takes seven medications prescribed by three specialists. She describes herself as 'overwhelmed' and 'stuck in survival mode'. Her HbA1c remains elevated despite increasing doses of metformin; her blood pressure remains poorly controlled despite triple therapy.

Before applying the TSSC, it is worth naming what the conventional consultation would probably do with Ana. The epistemic closing signals would be recognisable: diagnostic crystallisation around 'poor metabolic control due to low adherence'; conversion of Ana's narrative — 'stuck in survival mode' — into quantifiable variables; defensive reinterpretation of narrative anomalies as contextual factors that 'influence' but do not constitute the central clinical problem. The doctor senses that 'something deeper is failing', but without a framework to articulate it, the consultation returns to its habitual geometry: dose adjustment, educational reinforcement, referral.

The question the TSSC proposes is not 'how do I improve Ana's adherence?' but 'what vital configuration makes this persistent dysregulation pattern intelligible?' That question cannot be answered by the doctor alone. Ana is the only specialist in her own lived experience. The TSSC-oriented consultation does not extract information from Ana: it co-produces with her an understanding that neither of them had beforehand.

Scale-by-Scale Analysis

Ecological scale. Ana's rotating shifts, physical demands, chemical exposures, and long commutes impose persistent circadian and physiological stress, continuously disrupting the regulatory rhythms on which metabolic and immune function depend [23,24]. Her work is not a background contextual factor — it is an active dysregulator operating daily on her biological systems. When Ana says 'I can't sleep well', she is not describing a symptom: she is describing the physiological signature of a structural restriction that the doctor cannot change from the consultation but must know in order to contextualise any intervention.

Relational scale. Caregiving responsibilities for parents and grandchildren, combined with her partner's job insecurity and progressive social isolation, exhaust the sources of co-regulation and emotional support that normally buffer physiological stress responses [25,26]. Ana's relational network, which was a resource, has become an additional demand on an already overburdened system. This is probably the most powerful restriction on treatment response — more than medication dosing.

Narrative and meaning scale. Ana's self-description as 'expendable' and 'stuck in survival mode' is not merely a psychological symptom — it reflects a loss of narrative coherence and agency that actively constrains adaptive coping and future orientation [27,28]. Within the TSSC, meaning construction is a regulatory process: the narrative a patient inhabits shapes physiological state as

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effectively as medication. Adding self-care demands to a system that already experiences itself as without agency does not produce adherence — it produces further evidence of the patient's own incapacity.

Physiological scale. These higher-order constraints manifest biologically as low-grade inflammation, autonomic rigidity, metabolic dysregulation, and fragmented sleep [29–31]. They are not the causes of Ana's multimorbidity; they are its current biological signature. Adjusting Ana's metformin dose in a system subjected to chronic circadian disruption, relational exhaustion, and narrative entrapment is unlikely to produce lasting change [21,22].

A life course perspective adds an additional dimension. These constraints are not simply present stressors — they are the crystallisation of decades of accumulated restriction [19,20,32]. Ana's current physiology is partly the biological embodiment of that history. This matters clinically: it establishes realistic expectations about the pace of change and the depth of intervention required.

Identifying Leverage Points

The TSSC does not generate a parallel plan alongside the guidelines. It generates a different order of priorities, based on where in the system a modest intervention can unlock reorganisation across scales. These points are not prescribed by the doctor: they emerge from joint exploration of what Ana values, what she feels she has room to change, and what the doctor can offer within the real constraints of the consultation.

Circadian stabilisation — establishing consistent sleep-wake cycles — operates at the intersection of the ecological and physiological scales. Evidence supports that sleep stabilisation in patients with multimorbidity produces coupled improvements in glycaemic control and affective symptoms [33,34]. This intervention is modest, low-cost, and actionable from primary care. And crucially: it is an intervention that Ana can understand as her own, not as an external prescription.

Relational repair — identifying and strengthening a key support relationship — operates at the intersection of the relational and physiological scales. Co-regulation through secure attachment reduces autonomic rigidity and inflammatory burden, creating physiological conditions more receptive to pharmacological intervention [25,35]. In Ana's system, relational exhaustion may be a more powerful restriction on treatment response than medication dosing.

Narrative reframing — co-constructing with Ana a narrative that shifts entrapment towards a manageable process — operates at the intersection of the meaning and physiological scales. The TSSC hypothesises that coherent narrative agency may act as a facilitating precondition for systemic reorganisation — not as an outcome but as a possible precondition — within the enactive framework [15,27]. This reframing is not a communicative technique: it is the recognition that Ana is co-author of any possible change, not a recipient of a treatment plan.

The clinical implication is both of sequence and content: stabilise circadian rhythms before escalating metformin; address relational exhaustion before adjusting anxiolytics; build narrative agency before adding self-care demands. Sequence matters because lower-level regulatory disruptions actively constrain the efficacy of higher-level interventions.

Table 3 contrasts the guideline-based and TSSC approaches to Ana's management across each scale, including the epistemic closing signals the conventional model would activate and the leverage points the TSSC identifies.

Table 3. Contrast between guideline-based and TSSC approaches in Ana's case.

Scale	Closing signal (conventional model)	Guideline-based approach	TSSC approach	Predicted outcomes (testable hypotheses)
Ecological	'Rotating shifts are a	Refer to occupational	Identify circadian restriction as an	Coupled improvement in

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	modifiable risk factor'	medicine; sleep hygiene advice	active dysregulator; prioritise sleep stabilisation before escalating metformin	HbA1c and affective symptoms if sleep-wake rhythms are stabilised [33,34]
Relational	'Insufficient social support; refer to social work'	Assess social work intervention; support group	Identify relational exhaustion as the primary restriction on treatment response; strengthen one key support relationship	Reduction of autonomic rigidity and low-grade inflammation with improvement of relational coupling [25,35]
Narrative	'Negative attitude; low self-efficacy'	Motivational interviewing techniques to increase self-efficacy	Co-construct a narrative that shifts 'I am expendable' towards recoverable agency; the TSSC hypothesises that narrative agency may act as a facilitating precondition	Improvement of narrative coherence as a facilitating condition for systemic reorganisation [15,27]
Physiological	'Poor metabolic control due to low adherence'	Escalate metformin; add second antidiabetic; reinforce adherence	Address higher scales before optimising pharmacologically; lower-level disruptions limit upper-level efficacy	Lower need for pharmacological escalation once higher-order regulatory restrictions are addressed [21,22]

4. Implications for Practice, Systems, and Research

For Clinical Practice

The TSSC does not require a new consultation format or additional time — it requires a different orientation within the consultation that already exists. The shift is from 'what diseases does this patient have and what do the guidelines recommend?' to 'how is this patient's system regulating across scales, and where is the most tractable entry point for change?'

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In practical terms, this reorientation affects three aspects of clinical work.

Assessment. A trans-scalar assessment complements the standard clinical history with four additional lines of inquiry: the patient's daily rhythms and sleep patterns; the quality and availability of close relationships; the dominant self-narrative and sense of agency; and the structural constraints — occupational, economic, environmental — that establish the limits of what is possible. It is not an extensive additional assessment; it is a reframing of questions that the skilled clinician already asks, now organised within an explicit regulatory architecture.

Prioritisation. The TSSC suggests that when multiple scales are simultaneously dysregulated, the sequence of intervention matters. Addressing narrative agency before physiological stability is established, or adding self-care demands before relational resources are available, will probably produce poor adherence — not because the patient fails to comply, but because the system lacks the regulatory capacity to sustain change in higher scales while lower-level disruptions persist [36,37]. The clinical skill the framework develops is identifying which regulatory disruption acts as the primary restriction on the others.

The therapeutic relationship as regulatory mechanism. The TSSC makes explicit what experienced clinicians have always intuited: the consultation itself is a regulatory intervention [38]. The safety, attunement, and narrative clarity within the clinical encounter provide conditions under which the patient's system can begin to reorganise. This is not a soft add-on to technical care — it is, within the enactive framework, a mechanism with physiological consequences.

This understanding of the consultation as a regulatory mechanism has an epistemological implication that the TSSC distinguishes explicitly from established communicative models such as motivational interviewing. In motivational interviewing the professional facilitates the patient's adoption of predetermined therapeutic objectives, reducing their ambivalence through communication techniques. The underlying structure remains asymmetric: there is a correct knowledge the professional possesses and that the patient must reach.

The TSSC proposes a different model: the consultation as transdisciplinary co-construction in which professional and patient are specialists in different disciplines — the professional in clinical and systemic knowledge, the patient in their lived experience, history, and own health-illness model — and in which the interaction produces an understanding that neither could have constructed alone. The objective is not for the patient to adopt the professional's model but for both interlocutors, maintaining sufficient openness regarding their own prior frameworks, to co-produce a model that changes with each interaction. The indicator of a successful trans-scalar consultation is not patient adherence to a treatment plan but their growing interest in participating with the professional in co-constructing that plan — a signal that the system has gained sufficient coherence to sustain shared agency.

A TSSC-oriented consultation can be recognised by specific signs that distinguish it from conventional clinical communication: the problem changes name during the conversation; questions appear that neither brought prepared; the patient formulates their own hypotheses; the doctor abandons an initial category; evidence is invoked after understanding the configuration, not before; an action emerges that was not in any protocol but does not contradict the biology; both leave with new understanding. When none of these signs appears, the consultation has probably been a confirmation of what was already known, not co-production.

This reorientation has implications beyond the individual consultation. Conventional health education shares with motivational interviewing an implicit premise: there is a set of correct behaviours the professional knows and that adequate communication can install in the patient. The TSSC proposes a different understanding: health behaviours — both those of the patient and of the professional — are multidetermined by attractors operating at scales that exceed individual will, available knowledge, and the scope of the consultation.

Recognising this multidetermination does not lead to inaction but to understanding: mapping the attractors that configure the behaviours of both interlocutors, rather than attributing them to deficits of motivation or information. One practical consequence of this reorientation is the reduction

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of the burden of indispensability on the professional — both the pride when the patient changes and the guilt when they do not. This relaxation is not resignation: it is the natural consequence of understanding that the system is larger than any of its actors, and it liberates cognitive and relational resources to sustain the transdisciplinary openness the model requires.

The clinical bias — the prior interpretive framework that makes perception possible — is not the problem: it is inevitable and necessary. What complexity questions is attachment to bias: the inability to let each interaction modify it. A doctor without prior frameworks does not see more; they see less. A doctor attached to their frameworks sees only what they already expected to find. Clinical practice informed by complex thinking operates in the space between both: it arrives with hypotheses, not premises, and sustains sufficient openness for the patient's system to confirm, refute, or transform them into something the prior framework did not contain.

A third implication concerns how the professional relates to accumulated knowledge about the patient. Complex thinking posits that systems are in continuous change: the configurations we observe are temporary, maintained by attractors that move with time. The patient arriving today is not identical to the one who came six months ago, although they share name, clinical history, and diagnoses. The doctor operating from a static model arrives with a stored representation of the patient and uses the interview to confirm it. The doctor operating from a dynamic model recognises that the system has moved since the last coupling — that they are always knowing the patient, not simply already knowing them — and uses the interview to detect that movement.

This principle has a concrete clinical correlate. Carlos is a 62-year-old man with chronic pain, sedentary behaviour, and mild depression. He has received multiple analgesic adjustments with marginal benefit. In several successive consultations something emerges that initially seemed irrelevant: he stopped playing guitar after a forced early retirement three years ago. The doctor understands, applying the four TSSC questions, that the loss of that activity simultaneously reorganised Carlos's social network, his daily rhythm, his sense of competence, his anticipatory pleasure, his physical movement, and his self-image. The initial intervention is not to increase medication: it is to explore with Carlos whether there are conditions to resume that system-organising activity. The accumulated clinical history is valuable as a record of the characteristic patterns of change of the system — its way of eddying — but not as a description of its current state.

A fourth implication concerns continuing medical education (CME). Conventional CME reproduces the fragmented logic the TSSC questions: it updates the professional in the disciplines that subdivide medicine, as if the patient were the sum of those disciplines and correct knowledge descended from academic centres to clinical practice through guidelines and protocols.

The TSSC proposes an epistemological inversion: the starting point is understanding the patient's system, and from there the knowledge that can illuminate aspects of that system is invoked. Evidence-based medicine is a powerful tool within its domain, but its domain is partial: it accounts for knowledge that can be formalised in controlled studies with measurable outcomes in defined populations. When it becomes the starting point of clinical reasoning, the patient becomes a case where evidence is applied. When it becomes a resource invoked from understanding the patient, evidence is one of the instruments consulted to understand this particular system. This distinction can be formulated as the difference between partial epistemic jurisdiction — what EBM can answer — and complete clinical architecture — the framework within which those answers make sense for a specific patient.

CME coherent with complex thinking is not a summary update in the disciplines that subdivide medicine. It is understanding the changing set of knowledge relevant to the profession — medical and non-medical — including the implicit theoretical frameworks in which that knowledge is produced, the broader social paradigms that determine which questions are asked and which are not, and the actors building that knowledge with what interests and under what conditions. In this context, artificial intelligence is not simply a consultation tool or a substitute for clinical judgement [46]: it is an extension of collective human enactive knowledge, one more node in the network of actors that co-produce medical knowledge. The doctor who couples with AI from configurational

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openness — prepared for the interaction to produce something neither had beforehand — obtains qualitatively different results from one who uses it to confirm what they already know.

For Health Systems

Current health systems are structurally organised around the same disease-centred logic that fails patients like Ana and Carlos. Specialist referral pathways, quality indicators linked to individual disease objectives, and consultation times calibrated for acute problems collectively create a system that fragments precisely what needs to be integrated.

The TSSC suggests three directions for system-level change. First, outcome measurement should evolve beyond disease-specific objectives to include indicators of systemic coherence: heart rate variability as a measure of physiological flexibility [30]; indicators of narrative coherence and agency [39]; and social connection indices as measures of relational regulatory capacity [25]. Second, care for patients with complex multimorbidity requires team structures capable of simultaneously addressing multi-scalar dynamics [40]. Third, the TSSC requires not so much substantial new resources as strategic reallocation of existing ones [41,42]. Cost-effectiveness studies comparing TSSC-guided care with conventional management are needed [47].

For Research: Testable Predictions

The TSSC generates specific and falsifiable predictions that distinguish it from additive biopsychosocial models and define an empirical research agenda.

Trans-scalar coupling hypothesis. Interventions directed at one scale should produce measurable changes in other scales through regulatory coupling mechanisms. The framework predicts that sleep-wake cycle stabilisation in patients with multimorbidity will produce coupled improvements in glycaemic control and affective symptoms — changes that occur together and not independently [33,34].

Leverage point hypothesis. Small interventions at identified trans-scalar leverage points should produce disproportionately large systemic effects compared with larger interventions at non-leverage points [14].

Non-linear transition hypothesis. Systemic coherence should exhibit threshold effects in which small increments produce disproportionate improvements in clinical outcomes [12,13]. This prediction is compatible with both classical bistability models and non-normal transition dynamics [45]; what distinguishes it from additive models is the prediction of non-linearity in treatment response, regardless of the specific underlying mechanism.

Sequence dependence hypothesis. The order in which scales are addressed should affect long-term outcomes. Interventions that stabilise fundamental regulatory scales before addressing higher-order scales should produce more durable results than the reverse sequence [36,37].

Operationalised measures, research designs, and primary outcome definitions for each hypothesis are detailed in Supplementary Material S2.

5. The TSSC in Relation to Existing Frameworks

Building on Sturmberg and Complexity-Based Approaches

The fundamental argument of this article — that multimorbidity is not an accumulation of discrete pathologies but a systemic phenomenon requiring a different clinical logic — rests on the work that Sturmberg, Martin, and collaborators have developed over more than a decade, including in this journal [8,9,38]. The TSSC accepts these premises in their entirety.

The TSSC builds on that foundation to propose a specific clinical architecture: four operative questions, an intervention sequencing logic, and the concept of trans-scalar leverage points as a prioritisation tool. It does not claim to be the only way to operationalise the principles of complexity — Sturmberg and collaborators' work includes practical orientations that this framework complements. What the TSSC specifically contributes is an assessment architecture structured around

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trans-scalar regulatory dynamics, and a sequence-based intervention logic, that can be used within the real time constraints and conditions of a primary care consultation.

However, there is a warning that merits honest formulation. The complexity-in-health literature has frequently produced what might be called decorative complexity: frameworks that use the vocabulary of emergence, non-linearity, and attractors but whose underlying practice remains linear [49]. The clinician who learns that 'the patient is a complex system' but continues asking 'what treatment does the guideline recommend for this diagnosis?' has adopted a language without changing the geometry of their reasoning. What distinguishes the TSSC from that risk is not theoretical sophistication but operationalisation: the four clinical questions, the table of closing and opening signals, and the sequencing logic are instruments that compel the clinician to reason configurationally, not merely speak configurationally. This operationalisation connects with Montori and collaborators' cumulative complexity model [48], which from a patient-centred perspective identifies illness work burden as a primary restriction on response capacity — a convergence that the TSSC extends towards a multi-scalar assessment architecture.

Relationship with the Biopsychosocial Model

The biopsychosocial model deserves recognition as the framework that first granted clinicians the conceptual permission to look beyond biology [6]. The TSSC does not reject this contribution. It proposes, however, that the architecture of the biopsychosocial model — three parallel domains that the clinician integrates through judgement — is insufficient for the regulatory complexity that multimorbidity represents. The limitation is not that the model identifies the wrong dimensions, but that it treats them as additive rather than as coupled regulatory systems whose interactions produce emergent phenomena [7].

What the TSSC Does Not Claim

The TSSC is a theoretical framework at an early stage of clinical development. Its predictions are falsifiable propositions, not validated outcomes. Its clinical illustration — the cases of Ana, Manuel, and Carlos — demonstrates internal coherence and clinical plausibility; it does not constitute empirical evidence of superiority over existing approaches. The cases were constructed to illustrate the TSSC's reasoning, not to test it.

The TSSC also does not resolve the tension between individual agency and structural constraint that runs through all complexity-based approaches to health. Identifying ecological constraints as regulatory forces does not tell the clinician what to do when those constraints are beyond clinical reach. The framework makes these constraints visible and clinically relevant; it does not make them tractable. This is an honest limitation, and one that defines a boundary between clinical intervention and the structural changes that health policy must address.

Finally, the TSSC does not claim to have solved the problem of operationalising complexity in health. It claims to have advanced in it. If the proposed instruments prove useful to clinicians and their predictions are confirmed in rigorous comparative studies, the framework will have demonstrated its value. If not, it will have indicated more precisely where the next approximation should be sought.

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