(Making Sense of) Knowledge Synthesis for Complex Primary Care Systems

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Overview

1. Brief acknowledgement of characteristics of complex systems from perspective of synthesis to inform policy for complex primary care systems.
2. Overview of current approaches to knowledge synthesis in relation to complex systems: lessons from existing work & contrasting approaches to research synthesis
3. Sensemaking and knowledge synthesis about of complex systems – an emergent process
4. A practical question of primary care team composition in Ontario
Introduction

There is a growing need to inform primary care policy issues, such as workforce and team planning, systematically, using complex systems lens(es).

This seminar will discuss evidence synthesis approaches using the lens of complex adaptive systems that has been conducted in Ontario.

It will briefly consider current synthesis methodologies, their strengths and weaknesses, and an emerging sense-making for synthesis approaches.

Examples describe the application of developmental synthesis approaches to facilitate primary care.
EDUCATIONAL GOALS AND OBJECTIVES

Upon completion of this seminar, the participant should be able to:

• Describe some of the challenges of current synthesis approaches for research in complex systems
• Outline and critique some current approaches to synthesis and knowledge translation for policy
• Increase capacity to develop and inform primary care knowledge synthesis in complex systems in the future.
Acknowledgement of characteristics of complex systems from perspective of synthesis

Section 1
‘As we know, there are known knowns. There are things we know we know. We also know there are known unknowns. That is to say we know there are some things we do not know. But there are also unknown unknowns, the ones we don’t know we don’t know.’

- Donald Rumsfeld (2002)
Knowledge – many perspectives

- Knowledge, according to most thinkers, must follow three defining characteristics – it must be justified, true and believed. However, meeting these qualifications may be difficult or impossible.

- Practically, knowledge is information we are aware of and can be divided into knowing *what*— naming facts and relationships – and knowing *how*— explaining procedures.

- Knowledge can also be thought of as
  - explicit knowledge which can be codified and can be easily communicated
  - tacit knowledge which cannot be codified and therefore cannot be easily passed on to others.

Current approaches

- **Research - Science** (from Latin *scientia* meaning "knowledge") is, in its broadest sense, any **systematic knowledge-base or prescriptive practice** that is capable of resulting in a prediction or predictable type of outcome. **Science** may refer to a highly skilled technique or practice.\(^1\)

- In restricted contemporary sense, **science** refers to a system of acquiring **knowledge** based on the scientific method, and to the organized body of knowledge gained through such **research**.\(^2,3\)

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1. ^ "Online dictionary", Merriam-Webster. [http://www.m-w.com/dictionary/science](http://www.m-w.com/dictionary/science). Retrieved 2009-05-22. "a department of systematized knowledge as an object of study<the science of theology> . . . something (as a sport or technique) that may be studied or learned like systematized knowledge <have it down to a science> . . . a system or method reconciling practical ends with scientific laws <cooking is both a science and an art>"

2. ^ "Online dictionary", Merriam-Webster. [http://www.m-w.com/dictionary/science](http://www.m-w.com/dictionary/science). Retrieved 2009-05-22. "knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method . . . such knowledge or such a system of knowledge concerned with the physical world and its phenomena"

Complexity – in contrast

- “Requires a circle of ideas & methods that depart radically from those taken as axiomatic”
- Our current systems theory, including that is taken from physics or physical science, has focused on simple systems or mechanisms
- Complex and simple/complicated systems are disjoint categories

WHAT IS COMPLEXITY?

- Too many definitions, some conflicting often interchanged with “complicated”
- Has a real meaning but after the question is reframed. That meaning itself is complex
- (This is self-referential: how can we define “complex” using “complex”?)

Context dependence necessarily introduces circularity

- A process happens in a context
- The process usually changes that context
- If the context changes the process usually changes as a result.
- Living systems are replete with examples of this

Von Neuman thought that a **critical level** of “system size” would “trigger” the onset of “complexity” (really complicatedness)

- Complexity - more a function of system qualities rather than size
- Complexity results from bifurcations - not in dynamics, but **in description**!

**Thus** complex systems require that they be encoded into more than one formal system in order to be more completely understood

# Complex Systems vs Simple Mechanisms

(Mikulecky and Rosen)

<table>
<thead>
<tr>
<th><strong>Complex</strong></th>
<th><strong>Simple/Complicated</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>No largest model</td>
<td>Largest model</td>
</tr>
<tr>
<td>Whole &gt; than sum of parts</td>
<td>Whole is sum of parts</td>
</tr>
<tr>
<td>Causal relations rich and intertwined</td>
<td>Causal relations distinct</td>
</tr>
<tr>
<td>Generic</td>
<td>Non-generic</td>
</tr>
<tr>
<td>Analytic ≠ synthetic</td>
<td>Analytic = synthetic</td>
</tr>
<tr>
<td>Non-fragmentable</td>
<td>Fragmentable</td>
</tr>
<tr>
<td>Non-computable</td>
<td>Computable</td>
</tr>
<tr>
<td>Real world</td>
<td>Formal system</td>
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</table>
What are some of the things that make “complexity theory” necessary? (What has “traditional science” failed to explain?)

- Why is the whole more or less than the some of the parts?
- Self-reference and circularity
- The life/organism problem
- The mind/body problem

Morin, E. Restricted Complexity, General Complexity
http://www.worldscibooks.com/etextbook/6372/6372_chap01.pdf (accessed 18/01/10)
Synthesis vs analysis

- Not all problems can be or should be solved by deduction from mathematical and scientific principles. Synthesis is provisional and qualitative, a way of thinking different from the definitive, quantitative thinking of analysis. Its technique and tools reflect this difference.

WHY IS “OBJECTIVITY” A MYTH? (OR: WHY IS SCIENCE A BELIEF STRUCTURE)

- The formal system does not and can not tell us how to encode and decode. \textit{(Modeling is an art!)}
- The formal system does not and can not tell us when the model works, that is a judgment call even if other formalisms are enlisted to help (for example: statistics)
- Models exist in a context: a frame

Syntax vs Semantics

- The map is not the territory
- An equation is just an equation without interpretation
- This means we use formalisms in a context
- This context dependence also exists in nature
- This is one reason why there can never be a largest model

WHAT IS “FRAMING THE QUESTION”? 

- Based on the work of George Lakoff
- Cognitive Linguistics
- Frames are the mental structures that shape the way we see the world
- Facts, data, models, etc. only have meaning in a context
- Leads us to a scientific application of framing: Rosen’s theory of complexity


THE MODELING RELATION: THE ESSENCE OF SCIENCE??

- Allows us to assign meaning to the world around us
- Stands for our thinking process
- Causality in the natural system is dealt with by implication in a formal system
- Encoding of the natural system into the formal system & a decoding back
- When it all hangs together we have a model

THE MODELING RELATION: A MODEL OF HOW WE MAKE MODELS, A SCIENCE OF FRAMING

WE HAVE A USEFUL MODEL WHEN ARE SATISFACTORY WAYS OF “UNDERSTANDING” THE CHANGE IN THE WORLD “OUT THERE”

ROSEN’S CONCEPT FOR COMPLEXITY: A NEW FRAME

Complexity is the property of a real world system that is manifest in the inability of any one formalism being adequate to capture all its properties. It requires that we find distinctly different ways of interacting with systems. Distinctly different in the sense that when we make successful models, the formal systems needed to describe each distinct aspect are NOT derivable from each other.

Approaches to synthesis for complex primary care systems

Section 2
Systems of interest in Primary Care Research

Multi-level Human Complex systems changing and adapting in order to

• improve health, prevent health deterioration or ameliorate pain and suffering

• deliver care to meet stated goals at a particular first contact layer in the wider health system

• address political economy of health care delivery
JP Sturmberg and Carmel Martin, 2006
Primary Care Systems

A System is an instrumentality that combines interrelated interacting artifacts designed to work as a coherent entity. Simple / Complicated domain (assumes stable predictable)

- Evidence/systems or processes are related to discrete predictable, activities, linear actions.

Complex/chaotic (inevitable but unpredictable domain)

- Encompass both complicated and simple subsidiary problems or evidence subsets. Have special requirements, including understanding unique local conditions.
- Evidence based on pattern recognition and understanding unpredictable outcomes of non-linear relationships activities. Not generalizable yet informs future possibility.
Domains of a PC complex system?

**COMPLEX** Cause and effect via nonlinear patterns, coherent retrospectively not repeated – can be *understood*, *modelled & planned for*

**KNOWABLE** Cause and effect separated over time and space. Complicated but linear - *guidelines*

**CHAOS** No cause and effect, relationships – *perceivable only in retrospect*

**KNOWN** Cause and effect relations are repeatable, perceivable predictable – *best practice*

*JP Sturmberg and Carmel Martin, 2008 Knowing in Medicine, JECP14(5), 767-770*

Complex adaptive system (CAS)

- **Individuality**: CASs are often multilevel but are usually driven by decentralized, local interaction of constituent parts. Each level is composed of autonomous actors who adapt their behavior individually. Actors can be people but also larger social units such as firms and governments, and smaller biological units such as cells and genes.

- **Heterogeneity**: Substantial diversity among actors at each level — in goals, rules, adaptive repertoire, and constraints — can shape dynamics of a CAS in important ways.

- **Interdependence**: CASs usually contain many interdependent interacting pieces, connected across different levels. System dynamics are often characterized by feedback and substantial nonlinearity.

- **Emergence**: CASs are often characterized by emergent, unexpected phenomena — patterns of collective behavior that form in the system are difficult to predict from separate understanding of each individual element.

- **Tipping**: CASs are also often characterized by "tipping." Nonlinearity means that the impacts caused by small changes can seem hugely out of proportion. The system may spend long periods in a state of relative stability, yet be easily "tipped" to another state by a disturbance that pushes it across a threshold.

Some theories underpinning knowledge synthesis

- **Subjective idealism**: no single shared reality independent of multiple alternative human constructions (social constructionist)
- **Objective idealism**: there is a world of collectively shared understandings (grounded theory)
- **Critical realism**: knowledge of reality is mediated by our perceptions and beliefs (realist synthesis)
- **Scientific realism**: it is possible for knowledge to approximate closely an external ‘reality’ (systematic analytic and meta-analysis)

Review and Synthesis

• **Review** - the process of bringing together a body of evidence from different sources

• **Synthesis** - stage of a review or *process* in which evidence extracted from different sources is *juxtaposed* to identify patterns & direction in the findings, or *integrated* to produce an overarching, new explanation/theory which attempts to account for the range of findings (adapted from Mays 2005)

Reviews

- **Systematic review**: a review which tries to adhere to a set of ‘scientific’ methods to limit error (bias) mainly by attempting to locate, appraise and synthesize (attempt to reconcile) all relevant evidence (from research or more widely) to answer a particular question(s)

- **Narrative review and synthesis** – a process of synthesising primary studies to explore heterogeneity descriptively rather than statistically

Scientific Synthesis

• *Meta-analysis* – uses statistical techniques to synthesize results of trials or similar studies into a single quantitative estimate of effect


Qualitative Synthesis

- *Metanarrative* - A metanarrative is a grand overarching account of the progress of knowledge in a particular research discipline about a subject or question. Researchers in different traditions conceptualise, explain and investigate questions differently and use different criteria for judging the quality of empirical work. A synthesis of metanarratives is used to give order to the knowledge pertaining to a particular question.

Objectivist approaches

Realist synthesis

- A method for studying complex interventions in response to perceived limitations of traditional systematic review methodology which follows highly specified and intentionally inflexible methodology, with the aim of assuring high reliability. A realist review follows a heterogeneous and iterative process, less amenable to prescription but equally rigorous. An audit trail of the review needs demonstrate how decisions were made, evidence sought, sifted, assessed, and findings synthesized.

Complex Systems’ synthesis

In synthesizing the system's initial concept, three qualitative techniques are fundamental:

- heuristics,
- metaphors, and
- models.

Systems’ synthesis cont

Heuristics are brief statements of understandings, transposing lessons learned in the past & applicable to the present situation.

Explicit Knowledge based on synthesis of linear, non-linear qualitative research

Metaphors transpose the implicit behavior of a system to a more familiar context, e.g. is the desktop metaphor for personal computer operating systems.

Models to present different perspectives/initial synthesis of a proposed system to multiple stakeholders so that all have a common frame of reference.
Progressive modeling emphasizes continuing refinement of models during system development with feedback systems incorporating heuristics, explicit and tacit knowledge and metaphors.

Making Explicit: ongoing Assumptions and Approaches

- Underlying theoretical perspectives
- Boundary and system constraints
- Nature of modeling relationship to reality continually being tested
- Sense making informing future possibilities
Examples of approaches to PC systems

- **Meta-analysis** — Leykum, L et al. (2007). Organizational interventions employing principles of complexity science have improved outcomes for patients with Type II diabetes. Implementation Science, 2(1), 28


Sensemaking and knowledge synthesis about complex systems – an emergent process

Section 3
Making sense of Synthesis

Assumptions Underlying Methods of Synthesis

Simple/Complicated
‘Facts’

Meta-analysis
Systematic review

Complex/Chaotic
Sense making, patterns

Mixed methods
Meta-evaluation
Meta-ethno, etc

Realist synthesis
Meta-narrative review
Making sense of synthesis

Initial Conditions - ongoing conditions - predictability and unpredictability; stability and instability; bifurcations; self organization and feedback, circularity and context dependence; time dependence

http://suijaijohnmak.wordpress.com/
SELF-REFERENCE AND CIRCULARITY

- The “laws” of nature that traditional science teaches are artifacts of a limited model.
- The real “rules of the game” are context dependent and ever changing - they make the context and the context makes them (self-reference).
Making sense of synthesis

Initial Conditions

Ongoing conditions
Virtual Office of Synthesis and Information - Primary Health Care
VOSI Team

- Carmel Martin, MD, PhD
- Margot Felix-Bortolotti, RN, PhD
- Sarah Strasser, MB BS
- Shelley Darling, BHSci, MHA
- Alanna Smith BA Hons (candidate)

Funding: Primary Health Care Transition Fund, 2004-2006, Ministry of Health and Long Term Care Ontario, Canada
Ministry & Stakeholder questions

1. How should the mix and number of providers on a multidisciplinary team reflect needs of community or practice population?
2. How do changes in the mix and number of providers on the PHC team impact on the responsiveness, quality and the cost-effectiveness of care?
3. What factors facilitate health care providers working together to provide comprehensive PHC (scope of practice, funding, education)?
1. Theoretical conceptual analytical frameworks
2. Scope/map key conceptual/synthesis papers
3. Scope and map PHCTF projects
4. Coding, categorizing and synthesis of scoping
5. Approaches to detailed synthesis in key areas
Phase 1. Conceptual and Theoretical Mapping

Phase 2. Draft Operational Framework

Phase 3. Review of Synthesis Methods

Phase 4. Framework Testing

Literature Scoping

Stage 1 — 400 Stage 2 — 294 Stage 3 & 4 — 100

Activities - Key Questions
1. ‘Problematisation’ of Key Questions using theoretical framework of complexity and political economy;
2. Location in theoretical and operational framework;
3. Testing and recommending PHC synthesis approaches.

PHC Expert Grup Consultations
Meetings and Follow-up Survey

Funding agent

Iterations

Stakeholders Providers, Local Ontario Experts, International Experts

International and Canadian Experts

PHC Synthesis Framework Options Recommendations
Connecting to Theoretical Work on Structure Process and Agency in a Comparative Perspective

CONCEPTS ASSOCIATED WITH PHC
- Value & Goals - Based
- Structures Processes Agencies - Based
- Complex Systems Theories
- Political Economy

Evidence
- Research Evaluation Synthesis
- Impact on Methodologies and Practice
- Variations Over Time & Space
Patterns in a complex PC system?

Self-organization 'values'

- Historicity
- Interdependence
- Emergence
- Connectivity
- Space for possibilities
- Time dependent
Evidence - Patterns underpinning a PHC system
Central "priorities*"

* program ‘ideas’, financing & accountability, politics

"Local Needs"

Unique local PHC system customization - socially constructed meaning eg person and community centred care, local provider HHR, history, capacity and politics in context of equitable, comprehensive and interconnected health system

Local Determination and priorities with simple standardized implementation strategies outside of a context of equity and comprehensive needs assessment

‘Simple’ linear world view

Expert-lead non-contexted evidence about simple systems, reductionist research and implementation standardization

Complex world view

Expert-lead contexted mixed methods modeling of system needs – customization of broad system interventions to meet population

Local Needs
Maternity Providers, experts, representatives of 4 projects planned processes of consultation, field work, consensus and action.

**PLAN**
- Ongoing synthesis of findings.
- Feedback loops
- Consensus building
- Collaborative Strategy development
- Staged dissemination

**FIELD WORK**
- Literature review
- Expert consultation
- Field Work-Test interdisciplinary models;
- Surveys, Focus Groups
- Stakeholder narratives
- Consensus building

**CONSULTATION & CONSENSUS**
- Presentation of 4 projects key findings to Providers, experts, representatives.
- Stakeholder narratives
- Consensus building

**CONSSENSUS STRATEGY DISSEMINATE**
Surveys and focus groups of women’s needs and provider perspectives

**Qualitative synthesis**

‘Simple’ linear world view

**Quantitative scientific synthesis**
- Literature review, analysis, Meta-analysis
- Descriptive statistics
- Population projections

Modeling of system needs – customization of broad system interventions to meet population

*program ‘ideas’, financing & accountability, politics*

Real world – implementation of best knowledge available at the time with sufficient flexibility to allow self-organization with feedback within the constraints of PHC patient and service needs, and the political economy
Limitations

- VOSI - formative process development.
- Stakeholders
- Difficulties in sorting out policy based evidence or evidence based policy
- Delineation of research, evaluation and consultation