Beyond Competency: Educating for Capability

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Note: This lecture is taken directly from a four part series on complexity science from British Journal of Medicine. See References on last slide.
True or False

Across all disciplines, at all levels, and throughout the world, health care is becoming more complex.
True or False

Big problems can be broken into smaller ones, analyzed, and solved by rational deduction.
Complexity Science
Certainty-Agreement Diagram

Low
Agreement
High
High
Simple
Complex
Chaotic
Low
Certainty
Complex Adaptive Systems (CAS)

- Definitions - collection of individual agents with freedom to act in ways that:
  - are not always totally predictable
  - whose actions are interconnected
  - one’s actions change the context for other agents

- Examples
  - immune system
  - a colony of termites
  - the financial market
  - any collection of humans
Complex Adaptive Systems

- Can interact with its environment, can adapt to a changing environment and has an element of choice.
- Characterized by the potential for self-organization.
- Evolve by random mutation, natural selection, and self-organization.

– http://www.commonsensemedicine.org/
CAS Characteristics

- Fuzzy, rather than rigid, boundaries
- Agent’s actions based on internalized rules that drive action
- Agents and the system are adaptive
- Systems are embedded within other systems and co-evolve
- Tension and paradox are natural phenomena, not necessarily to be resolved
CAS Characteristics

- Interaction leads to continually emerging, novel behavior *(feedback)*
- Inherent *non-linearity*
- Inherent unpredictability
- Inherent pattern
- *Attractor* behavior
- Inherent self organization through simple locally applied rules *(minimal structure/specifications)*
Certainty-Agreement Diagram

Agreement

Low

High

Certainty

Low

High

Simple

Complex

Chaotic
Zone of Simplicity

- High certainty and High Agreement
- Agents act in mechanistic manner
- Agents relinquish autonomy in order to accomplish a common undisputed goal
- Little emergent behavior
- Job done efficiently
- Example - Surgical team in a routine procedure
Certainty-Agreement Diagram

- **Simple**
- **Complex**
- **Chaotic**

Agreement:
- **Low**
- **High**

Certainty:
- **High**
- **Low**
Zone of Complexity

- Insufficient agreement and certainty to make next step obvious
- Not so much disagreement that system is in chaos
- Instinct is to revert to reductionist thinking
- Multiple approaches
- Lots of emergent behavior
Zone of Complexity

• Examples
  – Development and application of clinical guidelines
  – Care of a patient with multiple clinical and social needs
  – Coordination of educational and development initiatives
Zone of Complexity

• Methods
  – Schon’s reflective practitioner
  – Kolb’s experimental learning modern
  – Plan-do-study-act cycle of quality improvement
• These all involve the same process of reflecting on behavior and using such feedback to learn and modify behavior
The Learning Cycle

1. Reflection
   - What do you notice?
   - What do you call it?

2. Interpretation
   - What are relationships & connections?
   - What do they mean or reflect?

3. Application
   - Prediction: What will happen next?
   - Experiment: What can we do differently?

4. Engagement
   - Do it!

Task Origin  Task Goal
Zone of Complexity

• Explore new possibilities through
  – Experimentation
  – Autonomy
  – Edge of knowledge and experience
Zone of Chaos

- Lowest degree of agreement and certainty
- Must continuously scan for patterns to orient yourself
Complexity and Clinical Care
Clinical Encounter

• Child with eczema
  Zone?
• Unresponsive to emollients
  Zone?
• Estranged parents have conflicting views on use of topical steroids and homeopathy
  • Zone?
Health Promotion

- Child with asthma
  Zone?
- Both Parents smoke
  Zone?
- Several pack a day history
  Zone?
- Common habit of their friends and co-workers
  Zone?
Human Health/Illness is a CAS
(complex adaptive system)

• Body composition/systems
• Behavior
• Relationships
• Social environment
• Dynamic and Fluid
• Small changes = Big Impact
• Not well modeled by simple cause-effect model
Complex Adaptive Systems

- Often characterized by the presence of an “attractor” which defines the context of its behavior within broad limits.
Core Body Temperature

- Number of mechanisms interact to keep temperature in normal range
- Actual temperature may vary regularly but within a narrow range
- Shifts far from equilibrium will allow an alternative attractor to define a new context for system (i.e. Pyrogens)
Placebo Effect

Patients’ own complex system of adjusting

- from old attractor (disease state)
- through the effect of a new attractor (remembering wellness)
- to the context of the body being fit
Certainty-Agreement Diagram

- **Complex**
  - Good enough planning - minimum specification, simple rules
  - Multiple actions
  - Experiment and tune system-plan-do-study-act
  - Listen to the shadow system
  - Use intuition, muddle through
  - Chunking
  - Metaphors
  - Wicked questions

- **Simple**
  - Plan and control
  - Regulate

- **Chaotic**
  - Scan for patterns
Decision Making in the Complex Zone

- Intuition and Muddle through - best but not always “right” decision based on experience, evidence, and knowledge of the patient’s story
- Experiment - plan-do-study-act cycle
- Minimum specifications - general goals, suggestions, and examples
Decision Making in the Complex Zone

- **Chunking** - only try solving one or two problems at a time, then reassess
- **Metaphors** - improved communication to create shared understanding
- **Provocative questions** - questions that might throw light on basic assumptions
Plan ➔ Do ➔ Study ➔ Act

PDSA Cycle

How can we test very specific ideas in our setting?

ACT

STUDY

DO

PLAN
Step 1: Gather ideas about what changes will lead to improvement
You need to understand some basic information about what are the existing challenges to improvement. What are your challenges? What does your team think you should work on? For example, are the challenges you are facing related to roles, care processes, parent education, lack of support tools or prompts? Consider who could offer insight into the particular area and ideas for improving it.

Step 2: Plan the PDSA Cycle (PLAN)
It is important to develop a detailed plan for your PDSA so that you know exactly what needs to occur in your DO phase (who will do it, which patients it will involve, and how you will track your progress). When planning ask yourself the following questions: What are we testing?...Who are we testing the change on?...When are we testing?...Where are we testing?...Who will implement the cycle?...What is our measurement plan?
Example:

**Goal:** Decrease appointment no shows for ADHD, which will result in fewer medication refill requests between visits.

**What is being tested:** Using phone reminders for planned visits for ADHD. This will result in fewer no shows and less need for patient calls for refills in-between visits and missed visits.

**When/Where/Who:** Front desk staff will call ADHD patients scheduled the following day for visits. They will confirm the visit and inform the family that if they miss the scheduled appointment they will not be given a refill of medication until a visit is rescheduled and completed.

**Measurement:** Tally the total number of scheduled visits for ADHD (denominator) and the total missed ADHD visits (numerator) to calculate the % no shows after phone calls.

**Prediction:** The % missed visits will decrease with phone reminders, making the need for phone refills of medications obsolete.
Step 3: Conduct the Cycle (DO)
Carry out the cycle, collect data and begin analysis. Don’t forget to seek opinions about changes tested in this cycle.

Step 4: Analyze the Results (STUDY)
Studying the results allows you to answer the questions:

- Was this change an improvement?
- If yes, do we need more information before implementing the change with others in the practice (e.g., Test again on different days with different staff)?
- If not, what have we learned from this test? What could we do differently next time to make it an improvement over the current system? What additional information do we need to achieve an improvement?
- Share your results: Plot data of key measures each week and display for others in the office to see. Seek input from everyone in your office.
Step 5: Decide What to Do Next (ACT)

Identify what changes are to be made in the current cycle, from this, identify your next cycle. “The science in PDSA is in the act of reflection, learning from what one did. Those who want improvement to occur need to reserve specific times to ask, ‘What did we learn, and how can we build on it?’”

Learning: Feasible strategy for practice, although not all families were reached.

Potential Next Cycles:
- Monitor these patients to assess if coming in for visit did actually result in fewer med refill requests.
- Test calling families 2 days prior to visit (then repeat call one day prior if unable to reach them on first call) to increase response.
- Test a strategy of simply informing patients of new office practice for no refills between visits, and measure if no shows decreased without reminders.
Complexity and Health Care
Health System Performance Measures/Practice Guidelines

• Neonatal fever/ fever & neutropenia
• Asthma exacerbation
• Hemophilia with bleed
• RSV and Premies
• Immunizations
• Obesity
Complex Adaptive Systems

Often show inherent self organization through simple locally applied rules (minimal structure/specifications)
Minimal Specifications

- Direction pointing
- Boundaries
- Resources
- Permissions
Bleeding Hemophiliac

• Administration of factor within 30 minutes of onset of bleed (direction pointing)
• Administration can occur in any safe environment and may be done by any properly trained person (direction pointing, boundaries, permissions)
• Any group can access pooled budget, but (resources)
Bleeding Hemophiliac

- Proposal must reflect active participation of at least three members of the stake holder groups (direction pointing)
- All proposals, expenditures, and results of pilots will be shared openly to stimulate comment and assessment (resources)
Understanding Attractors

• Best practices are often frustratingly slow to spread in health systems
• Commonly thought of as resistance to change
• Assumed fix is installing strong leaders to overcome resistance and install best practices
• Alternative view is that behavior follows natural attractor patterns in the system
Example of Understanding Attractors in Complex System

• Perceived problem
  – Practice group will not use a new guidelines on immunization recommendations

• Common management approach
  – Label the practice as “resistant to change” and devise a strategy of sanctions or strict budget controls to force change
Example of Understanding Attractors in Complex System

• Understanding attractors approach
  – Ask: what changes and innovative practices have they previously adopted, or even pioneered?
  – Ask: what is their understanding of immunization recommendations and how does it differ from guideline?
  – Ask: what effect will the guideline have on the practice?

• New Insight and potential next steps
## Simple Rules for Health Care

<table>
<thead>
<tr>
<th>Traditional Approach</th>
<th>New Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Care is based on visits</td>
<td>Based on continuous healing relationship (direction pointing)</td>
</tr>
<tr>
<td>Professional autonomy drives variability</td>
<td>Customized according to patient’s needs and values (permission)</td>
</tr>
<tr>
<td>Professionals control care</td>
<td>Patient is source of control (boundaries)</td>
</tr>
<tr>
<td>Information is a record</td>
<td>Knowledge shared and information flows freely (boundaries, permission)</td>
</tr>
<tr>
<td>Decision making based on training and experience</td>
<td>Evidence based decisions (resources)</td>
</tr>
<tr>
<td>Do no harm is individual responsibility</td>
<td>Safety is a system property (direction, pointing, boundaries)</td>
</tr>
<tr>
<td>Secrecy is necessary</td>
<td>Transparency is necessary (direction pointing)</td>
</tr>
<tr>
<td>System react to needs</td>
<td>Needs are anticipated (resources)</td>
</tr>
<tr>
<td>Cost reduction is sought</td>
<td>Waste is continually decreased (direction pointing, resources)</td>
</tr>
<tr>
<td>Preference given to professional roles over system</td>
<td>Cooperation among clinicians is a priority (direction pointing)</td>
</tr>
</tbody>
</table>
Complexity and Education
True or False

Successful health services in the 21st century must aim not merely for change, improvement, and response, but for change-ability, improvability, and responsiveness.

How do we incorporate this kind of flexibility into our students?
Complexity Concepts Applicable to Education

• Neither the system nor its external environment are, or will ever be constant
• Individuals within a system are independent and creative decision makers
• Uncertainty and paradox are inherent within the system
• Problems that cannot be solved can nevertheless be moved forward
• Effective Solutions can emerge from minimum specifications
• Small changes have big effects
• Behavior exhibits patterns (termed attractors)
• Change is more easily adopted when it taps into attractor patterns
Competence vs. Capability

- Competence - what individuals know or are able to do in terms of knowledge, skills, attitude
- Capability - extent to which individual can adapt to change, generate new knowledge, and continue to improve their performance
Capability

- Learning takes place in the Zone of Complexity
- Learning which builds capability takes place when individuals engage with uncertain and unfamiliar context in a meaningful way
- Capability enables one to work effectively in unfamiliar contexts
Developing Capability

- Transformational learning - learning evolves in response to local feedback about the impact of actions
- Relational learning - learning how things are interconnected allowing application in unique context
- Non-linear learning - learners embrace a situation in all its holistic complexity
Developing Capability

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What about Content?

- Content Learning
- Non-linear learning

Process   Techniques
Process Oriented Learning Methods

- Informal and unplanned learning
- Self directed learning
- Non-linear learning
Informal and unplanned learning

- Experimental learning
- Networking
- Learning activities
- Buzz groups
- Facilitated email list servers
- Teach back opportunities
- Feedback
Self directed learning

- Mentoring
- Peer supported learning groups
- Personal learning log
- Appraisal
- Flexible course planning
- Modular courses
Non-linear learning

- Case based discussions
- Simulations
- Role Play
- Small group, problem based learning
- Teambuilding exercises
## Higher Education in 21st Century

<table>
<thead>
<tr>
<th>Area</th>
<th>Traditional</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Static, finite, linear, private</td>
<td>Dynamic, open ended, multidimensional, public</td>
</tr>
<tr>
<td>Learning</td>
<td>Instructivist model</td>
<td>Constructivist model</td>
</tr>
<tr>
<td>University</td>
<td>Bureacracy – greatest resource stock of high status knowledge</td>
<td>Greatest resource are staff and networks maintained</td>
</tr>
<tr>
<td>Teacher</td>
<td>Sage on stage</td>
<td>Guide on side</td>
</tr>
<tr>
<td>Student population</td>
<td>Homogeneous</td>
<td>Heterogeneous and shifting</td>
</tr>
<tr>
<td>Student experience</td>
<td>Generally precedes definitive career choice and personal relationships</td>
<td>Lifelong learning converging with work, family, and personal development</td>
</tr>
<tr>
<td>Assessment</td>
<td>Based on reproduction of facts</td>
<td>Based on analysis, synthesis, and problem solving</td>
</tr>
<tr>
<td>Course Time Table</td>
<td>Teacher-centered</td>
<td>Learner centered</td>
</tr>
<tr>
<td>Course development</td>
<td>Historical model</td>
<td>Outcomes model</td>
</tr>
<tr>
<td>Time and Space Utilization</td>
<td>Synchronous, mass, single location</td>
<td>Asynchronous, individualized, networked</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>Paper work exercise</td>
<td>Ongoing process of learning owned by staff</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Teacher focused</td>
<td>Learner focused</td>
</tr>
<tr>
<td>Research and teaching</td>
<td>Discrete, hierarchical separation</td>
<td>Integrated model</td>
</tr>
<tr>
<td>Funding</td>
<td>Block grants</td>
<td>Diffuse decentralized resources</td>
</tr>
</tbody>
</table>
References

The end

- Proceed to the post test
- Print the post test
- Complete the post test
- Return the post test to Dr. S. Oliver
- 407i TAMUII
Post Test Question One

1. Across all disciplines, at all levels, and throughout the world, health care is becoming more complex.

A. True
B. False
Post Test Question Two

2. Schon’s reflective practitioner, Kolb’s experimental learning model, Plan-do-study-act cycle of quality improvement and all involved in the same process of ________________
Complex Adaptive Systems are a collection of individual agents with freedom to act in ways that:

A. are always totally predictable
B. whose actions are interconnected
C. one’s actions does not change the context for other agents
Post Test Four

Which of the following reflects traditional care?

A. Patient is the source of control
B. Transparency is necessary
C. Waste is continually decreased
D. Care is based on visits