This Presentation was Originally Created in Apple's Keynote.

Any funny business results from its conversion to PowerPoint...

Please contact me if i can help.

Stefan Topolski   MD

There are many concepts and demonstrations in my live talk

which cannot be captured in an outline.

Please send any questions my way...

Stefan Topolski   MD

Chaos & Complexity in the Medical Home

Stefan Topolski

Fitchburg Family Practice Residency
U. Mass School of Medicine

Caring in Community
& CottageMed, Inc.

www.cottagemed.org

Chaos & Complexity in the Medical Home

What is the Medical Home ?

Chaos & Complexity in the Medical Home
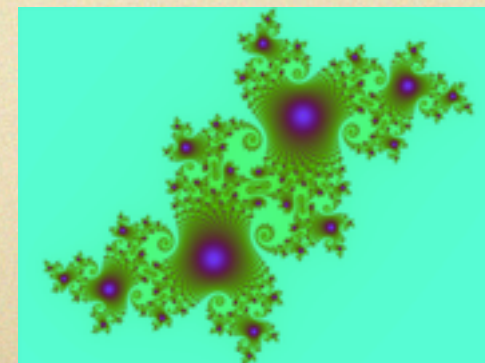
What is the Medical Home ?

Easy to talk...
Hard to walk...

Because YOU are a Complexity Specialist...

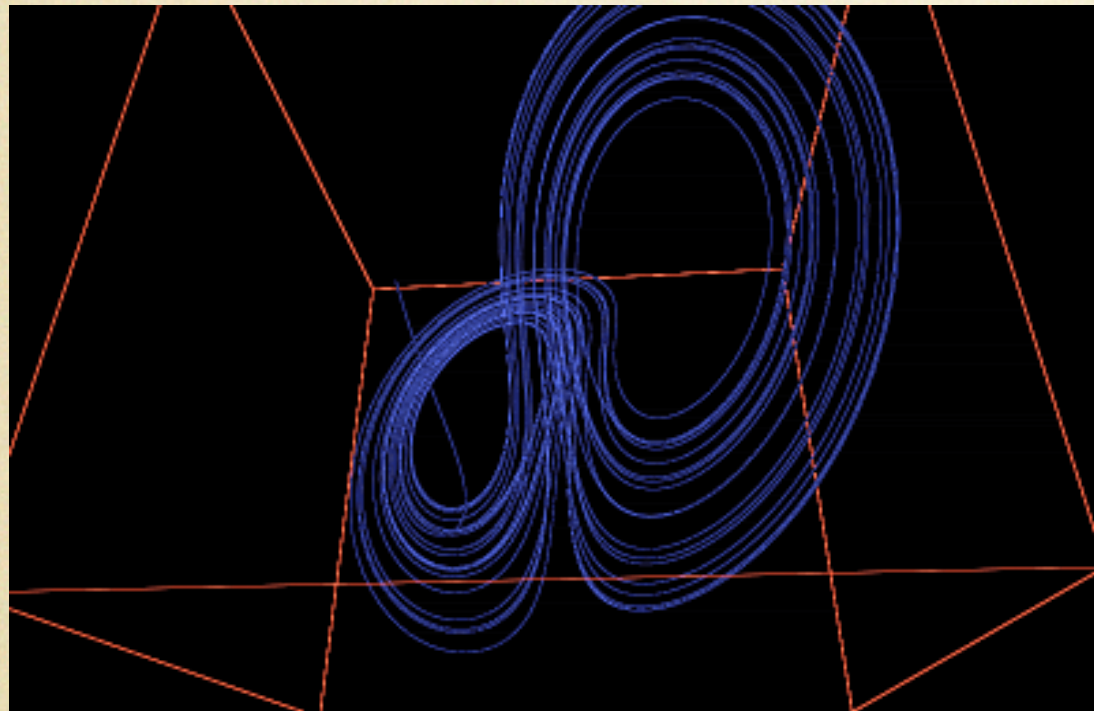What is Complexity ?

Is it Chaos ?

Chaos & Complexity in the Medical Home

Complex systems are ...

Patterned

Scaled

Connected with Feedback

Emergent

Flexible & Robust

Information Driven

Dynamic & Nonlinear

Counterintuitive

Irreversible

Whole

Chaos & Complexity in the Medical Home

Complex systems are …

Patterned
Scaled
Connected with Feedback
Emergent
Flexible & Robust
Information Driven
Dynamic & Nonlinear
Counterintuitive
Irreversible
Whole

Complexity on the
Edge of Chaos ⟶ Maximum function of
human systems

We need to understand Complexity in an Environment of
Chaos… i.e. our Medical "Non-System"

Chaos & Complexity in the Medical Home

Family Practice <u>Absorbs</u>
ALL Levels of Complexity

Individual
Family
Society
Connections between
all the above...

The <u>best</u> Family Doctors hold
the Broad View of the Forest
with an intimate knowledge
of the Trees...

Chaos & Complexity in the Medical Home

Family Practice <u>Absorbs</u>
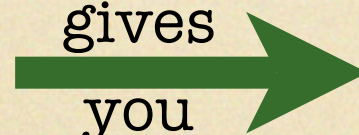**ALL** Levels of Complexity

Individual
Family
Society
Connections between
all the above...

The <u>best</u> Family Doctors hold
the Broad View of the Forest
with an intimate knowledge
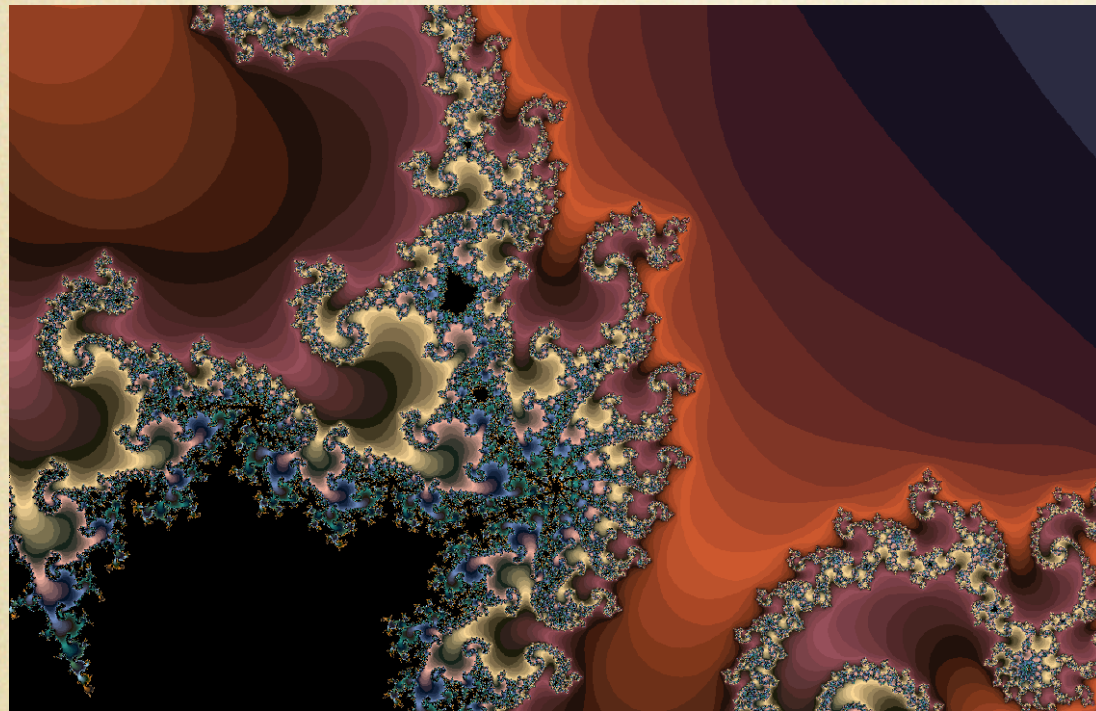of the Trees...

Complexity on the
Edge of Chaos

gives you → Maximum function of
human systems

We need to understand Complexity in an Environment of
Chaos... i.e. our Medical "Non-System"

Chaos & Complexity in the Medical Home

We are in Chaos; **HOW** do we build a Medical Home?

Z = Z² + C, Z is a complex number yi + x

Health is poorly known
In a Medical Non-System
with Improper Foundations
All connected together...

(medical context)

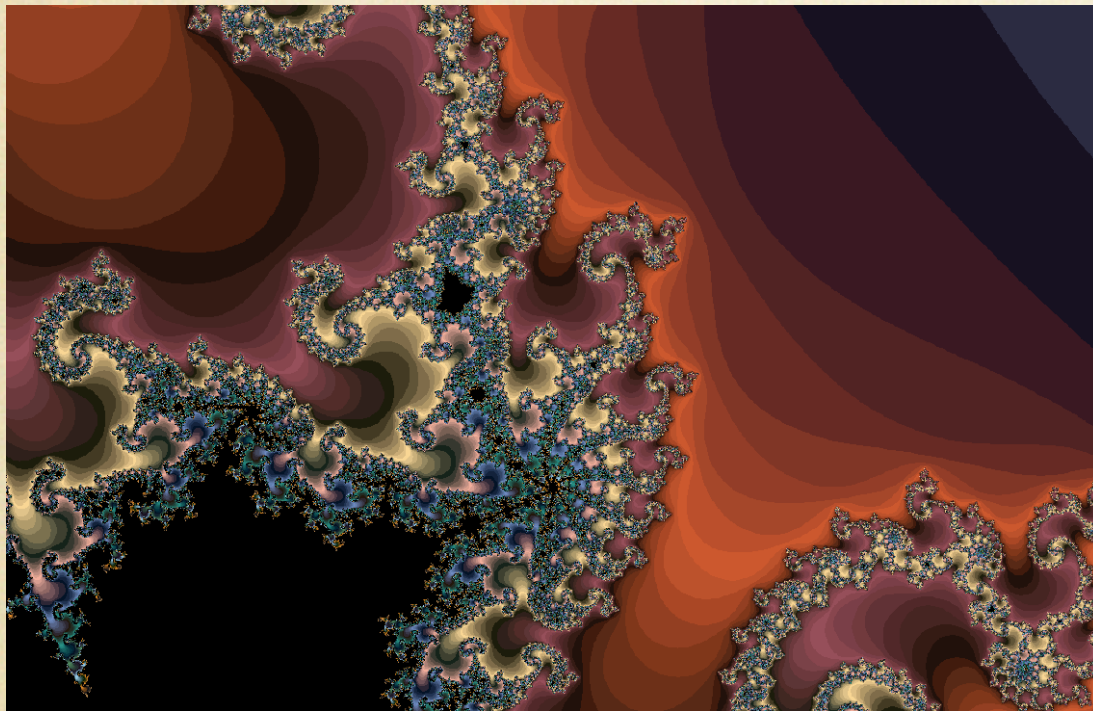(complexity terms)

Complexity
Emergence
Strange Attractors
Quality of Network
Scaled Interdependence

Chaos & Complexity in the Medical Home

We are in Chaos; **HOW** do we build a Medical Home?

Z = Z² + C, Z is a complex number yi + x

Health is poorly known
In a Medical Non-System
with Improper Foundations
All connected together...

(medical context)

(complexity terms)

Complexity
Emergence
Strange Attractors
Quality of Network
Scaled Interdependence

Chaos Theory and Complexity Science → Practical, Informed Advice

We need to understand Complexity in an Environment of Chaos... i.e. our Medical "Non-System"

Chaos & Complexity in the Medical Home

Principles of a Healthy Medical Home

Better Define Health

Identify Profession's Attractors

Set Appropriate Boundaries

Establish Feedback &

Balance Your Scale

(medical context)

(complexity terms)

Complexity

Emergence

Strange Attractors

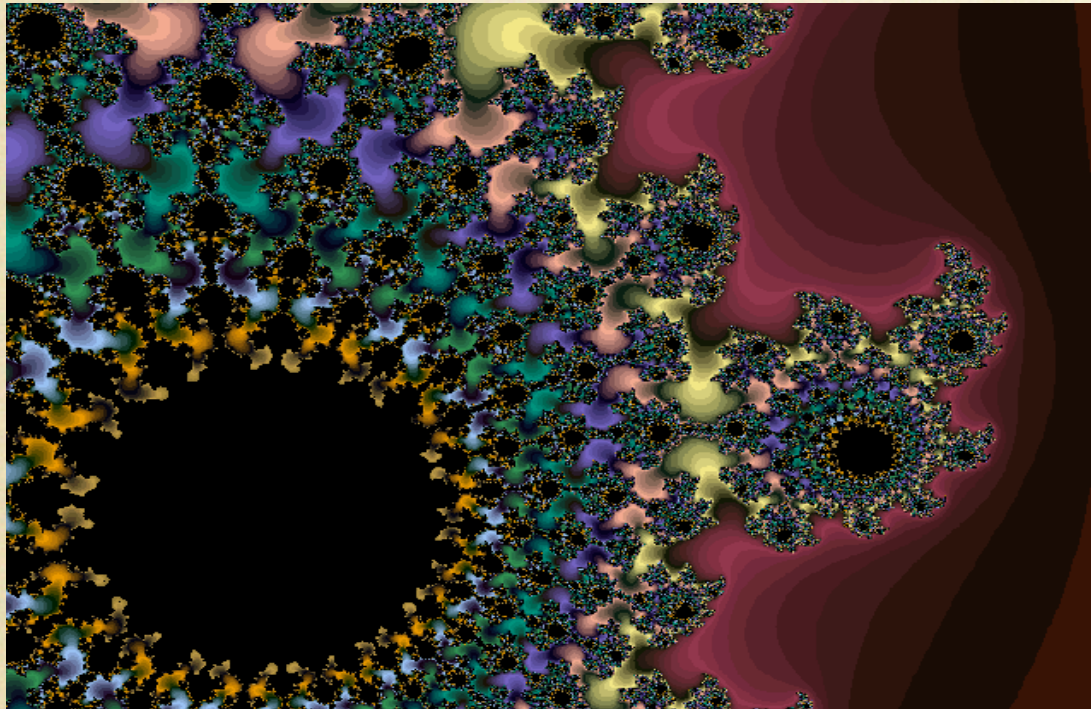Quality of Network

Scaled Interdependence

Chaos & Complexity in the Medical Home

Principles of a Healthy Medical Home

Better Define Health
Identify Profession's Attractors
Set Appropriate Boundaries
Establish Feedback &
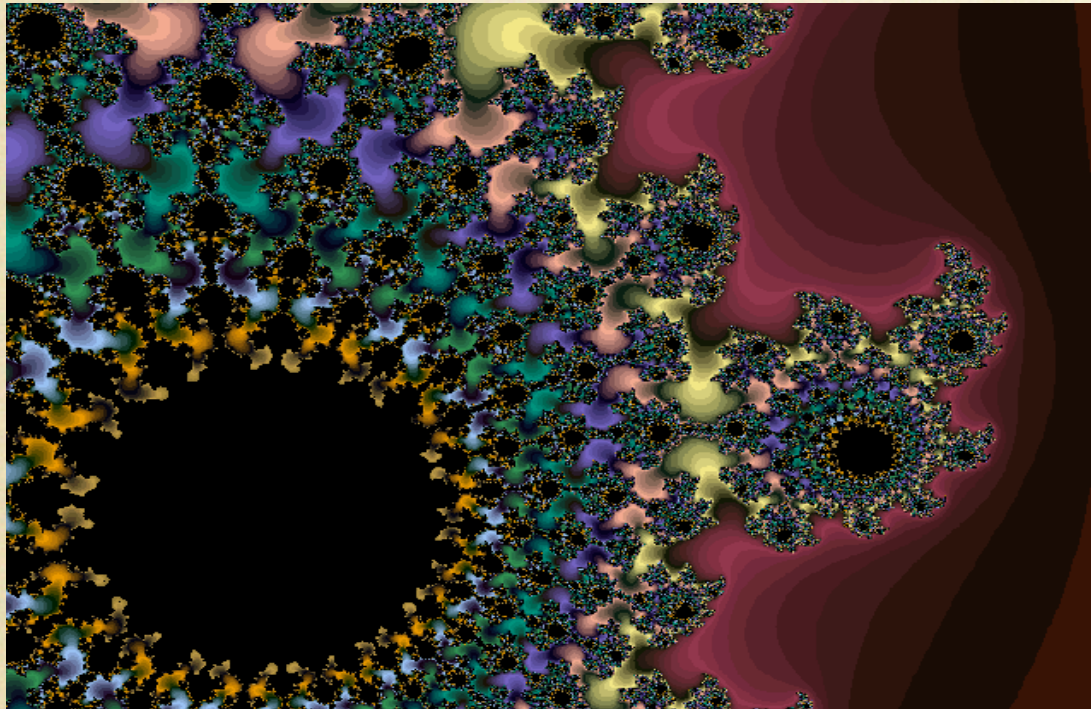**Balance Your Scale**

(medical context)

(complexity terms)

Complexity
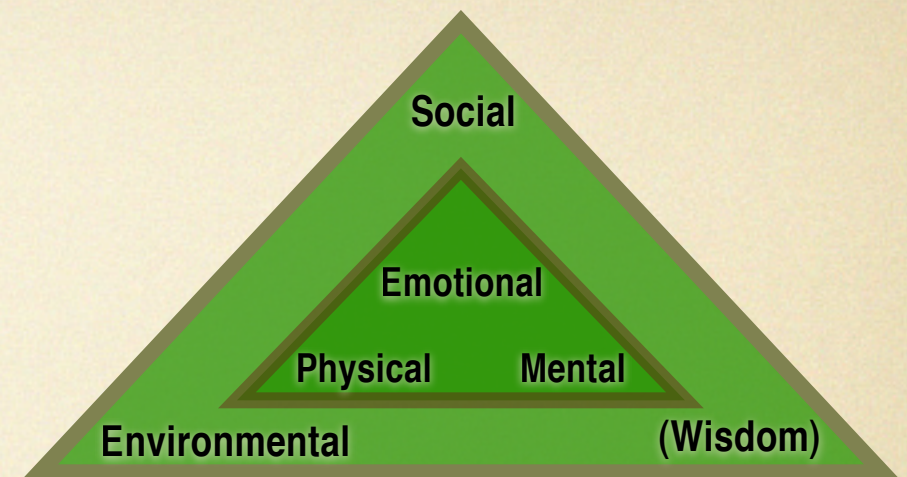Emergence
Strange Attractors
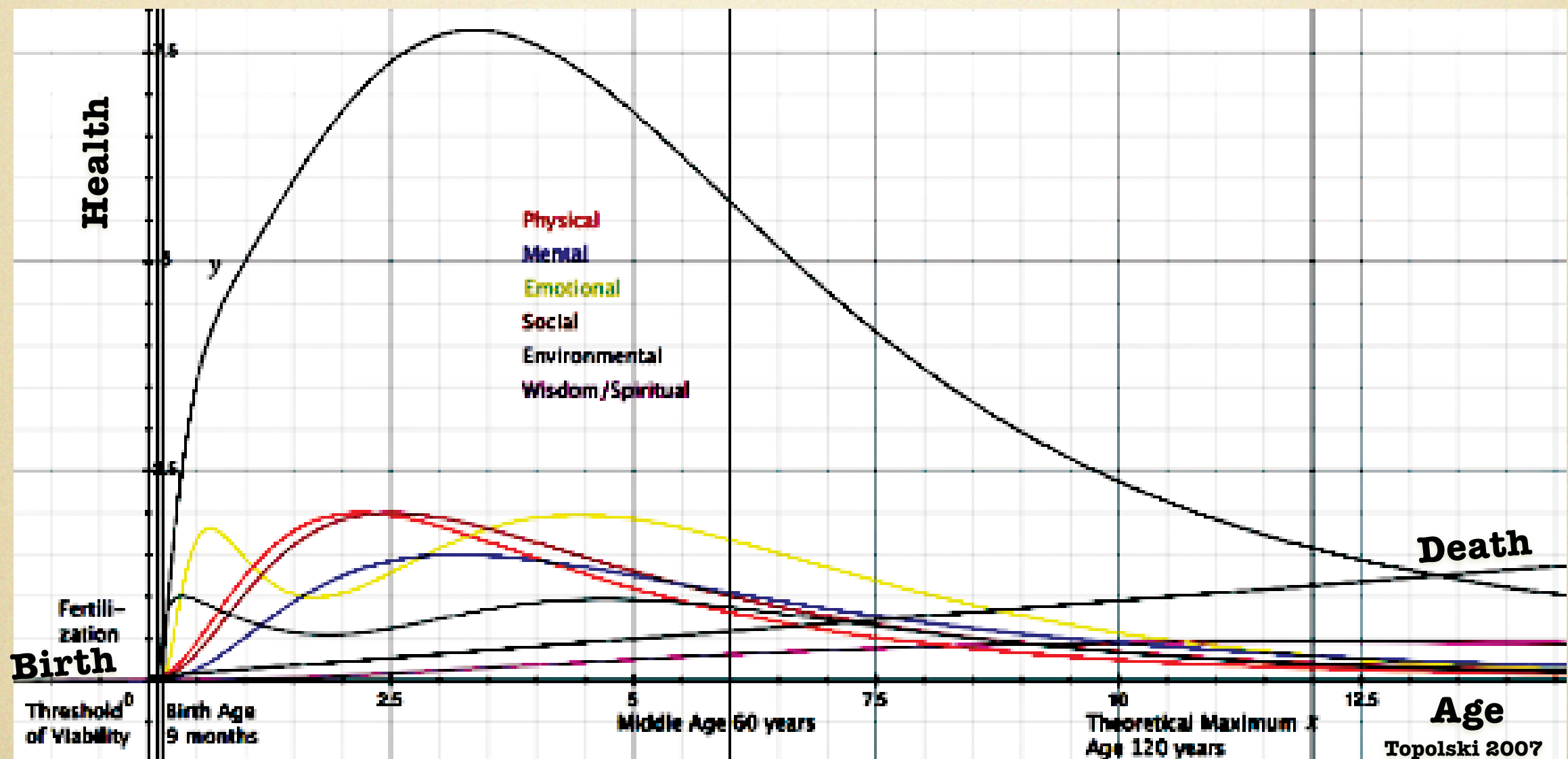Quality of Network
Scaled Interdependence

Let's get on to the details...

Chaos & Complexity in the Medical Home

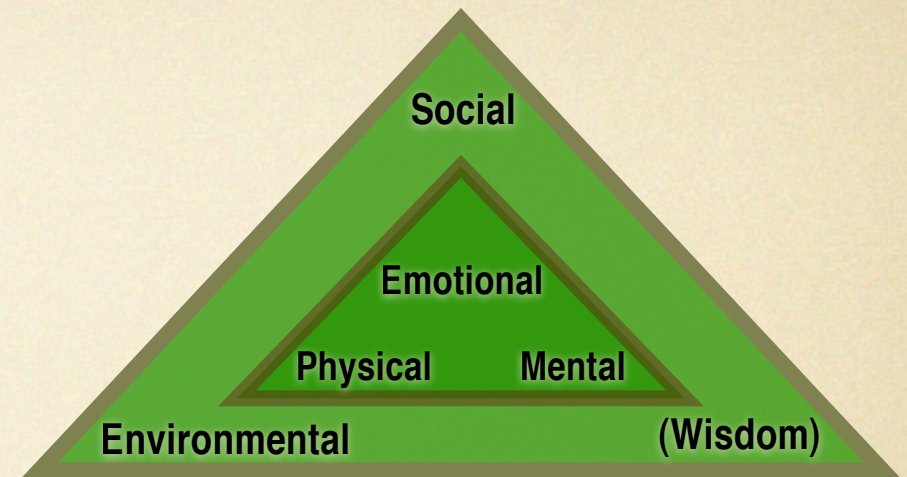**Complexity better defines Health**

Health Potentials

X - Y axes

Chaos & Complexity in the Medical Home

Complexity better defines Health

Social

Emotional

Physical   Mental

Environmental   (Wisdom)

Complexity Curves

Good   Maximum Performance

PERFORMANCE

Poor   Poor Performance   Poor Performance

Low   Moderate   High
(Underaroused)   (Optimally aroused)   (Overaroused)

EMOTIONAL AROUSAL
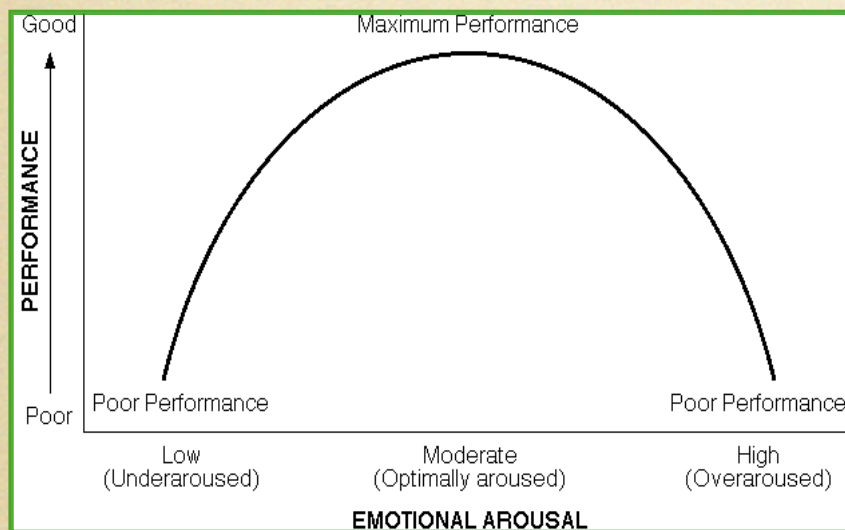
*Williams, J.M., Landers, D.M., Boutcher, S.H., (1993). Arousal-Performance Relationships, Applied Sport Psychology; Personal Growth to Peak Performance, pgs 170-184, **2***

Maximum Complexity / Health

y

4

3.2

Illness

Increasing Health

Recovery

Self-Similar curves construct a fractal macro curve

0.8

Constant Themes of Tension & Rebound

-0.8   0   0.8   1.6   2.4   3.2   4   4.8   5.6   6.4   7.2   8   8.8

Enthalpy / Disorder   ← **Increasing Energy** ←   **Entropy / Order**   Topolski 2007
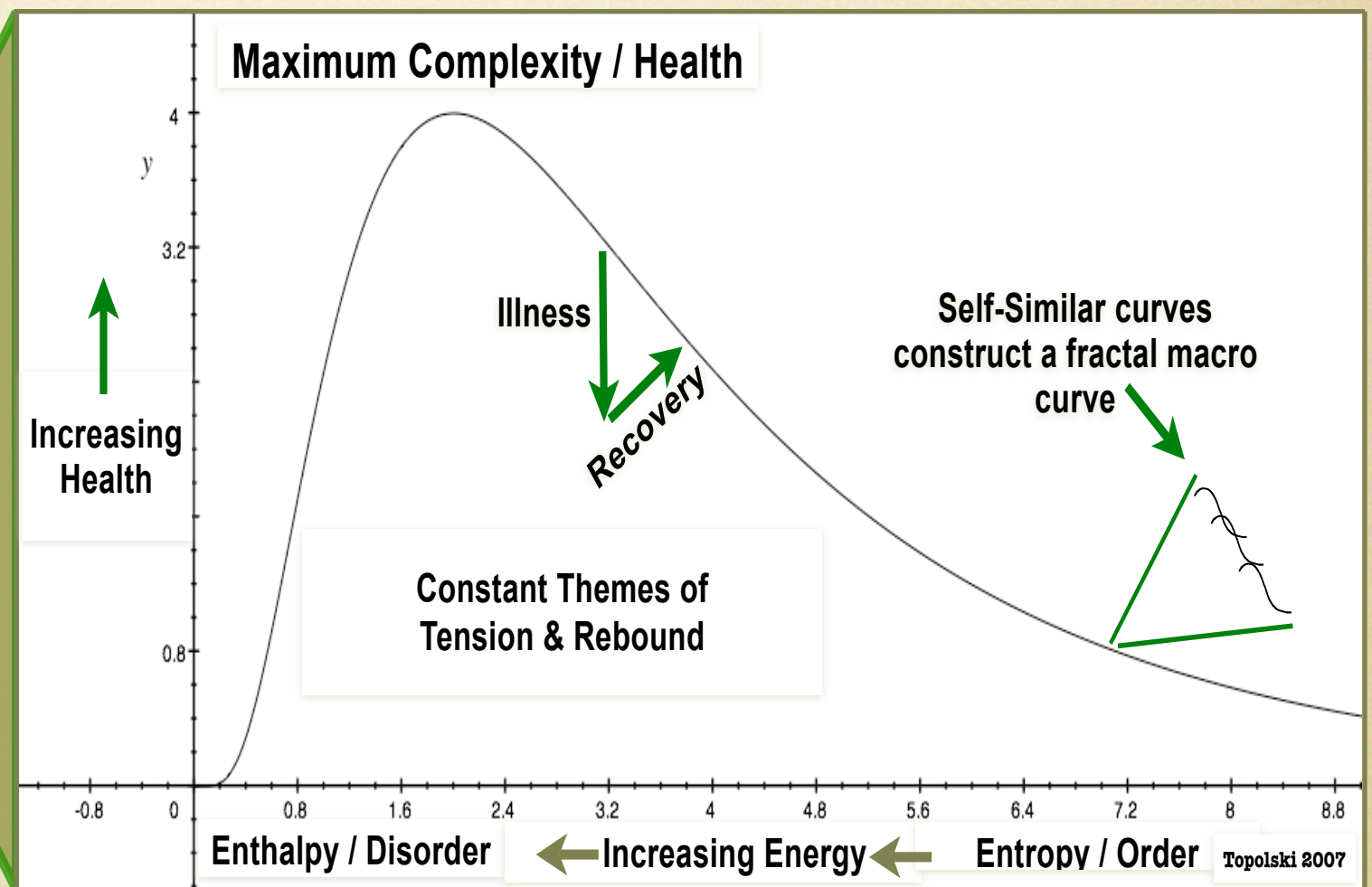
Z axis

Chaos & Complexity in the Medical Home

Factor Analysis Identifies Profession's Strange Attractors

Health Trajectory

Health Basin of Attraction

Chaos & Complexity in the Medical Home

Factor Analysis Identifies Profession's Strange Attractors

Triangle diagram (top right): Social / Emotional / Physical — Mental / Environmental — (Wisdom)

Traditional Linear Model

Medical Education model...*

The Ideal is *Virtue*

The Reality is Corporate business culture
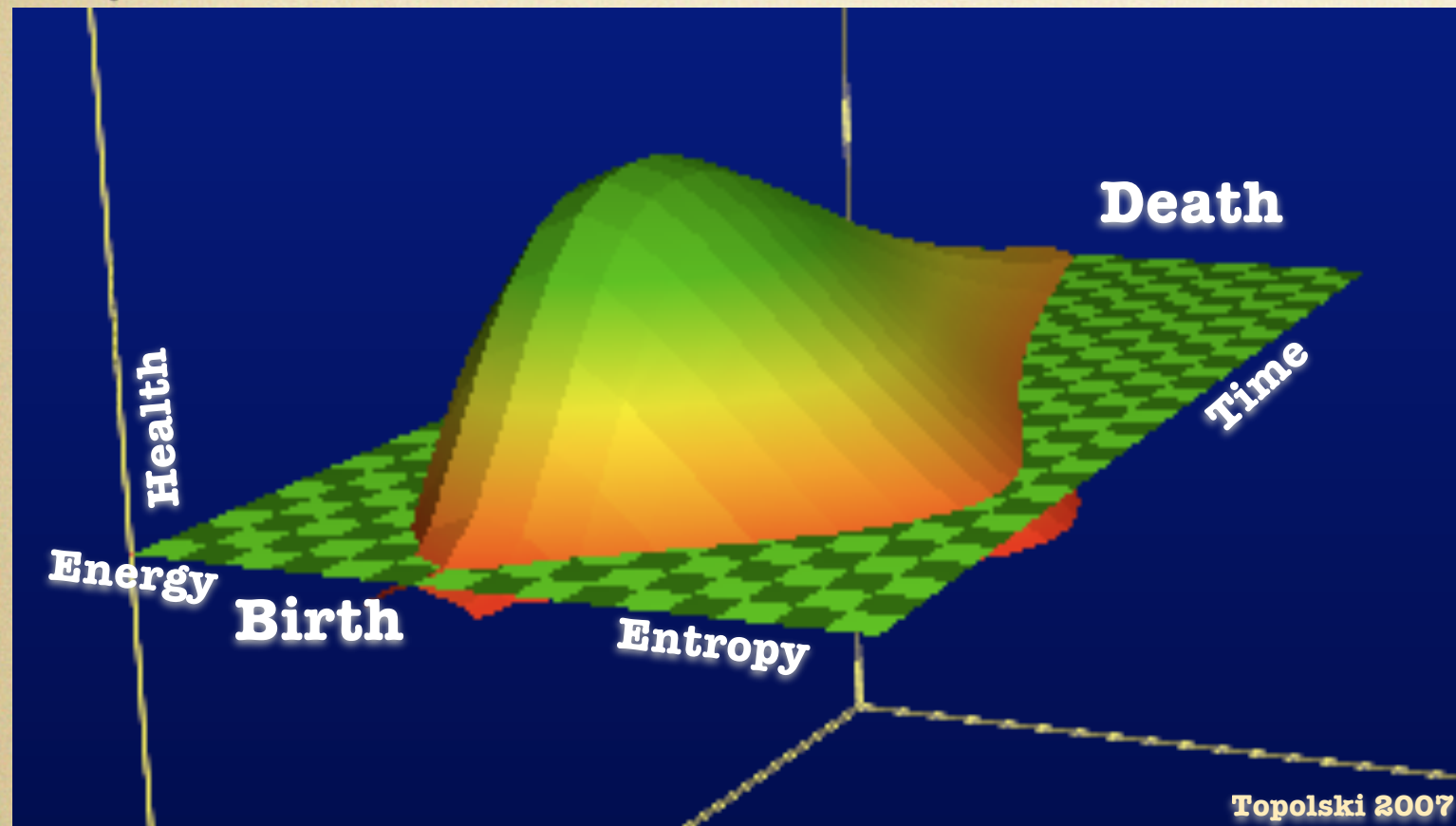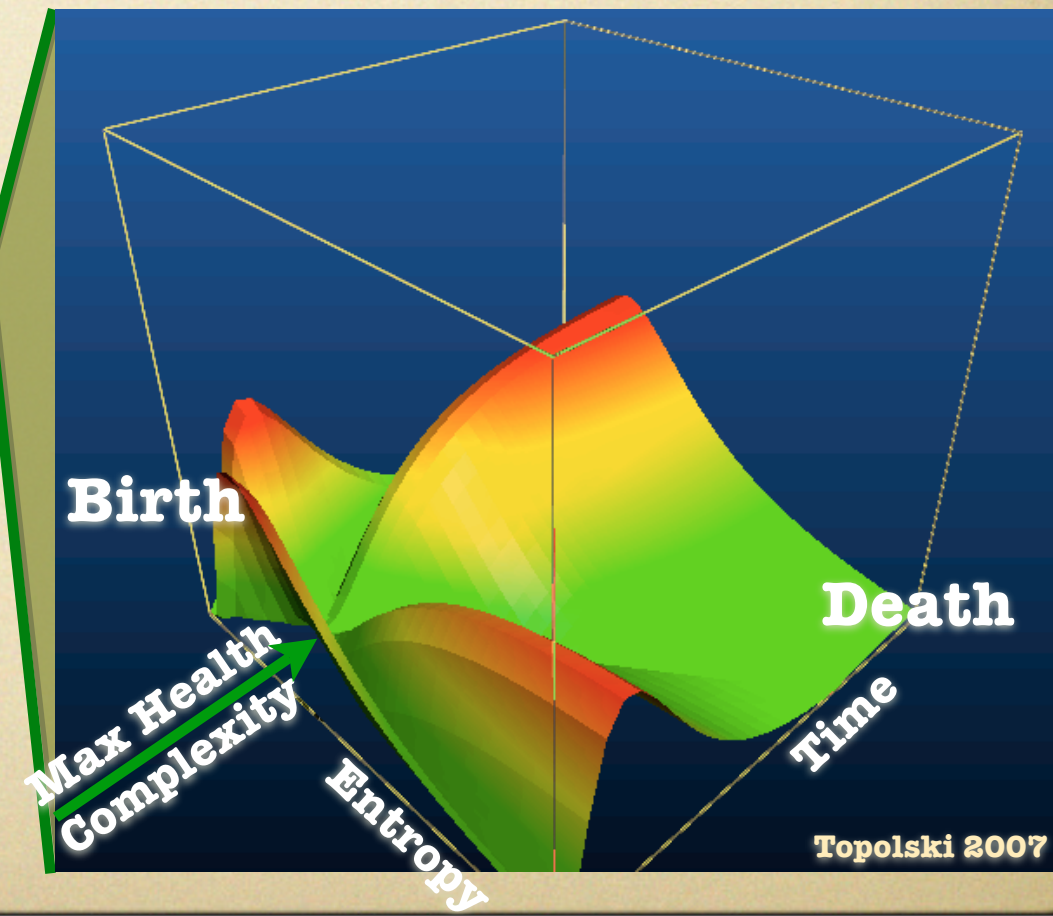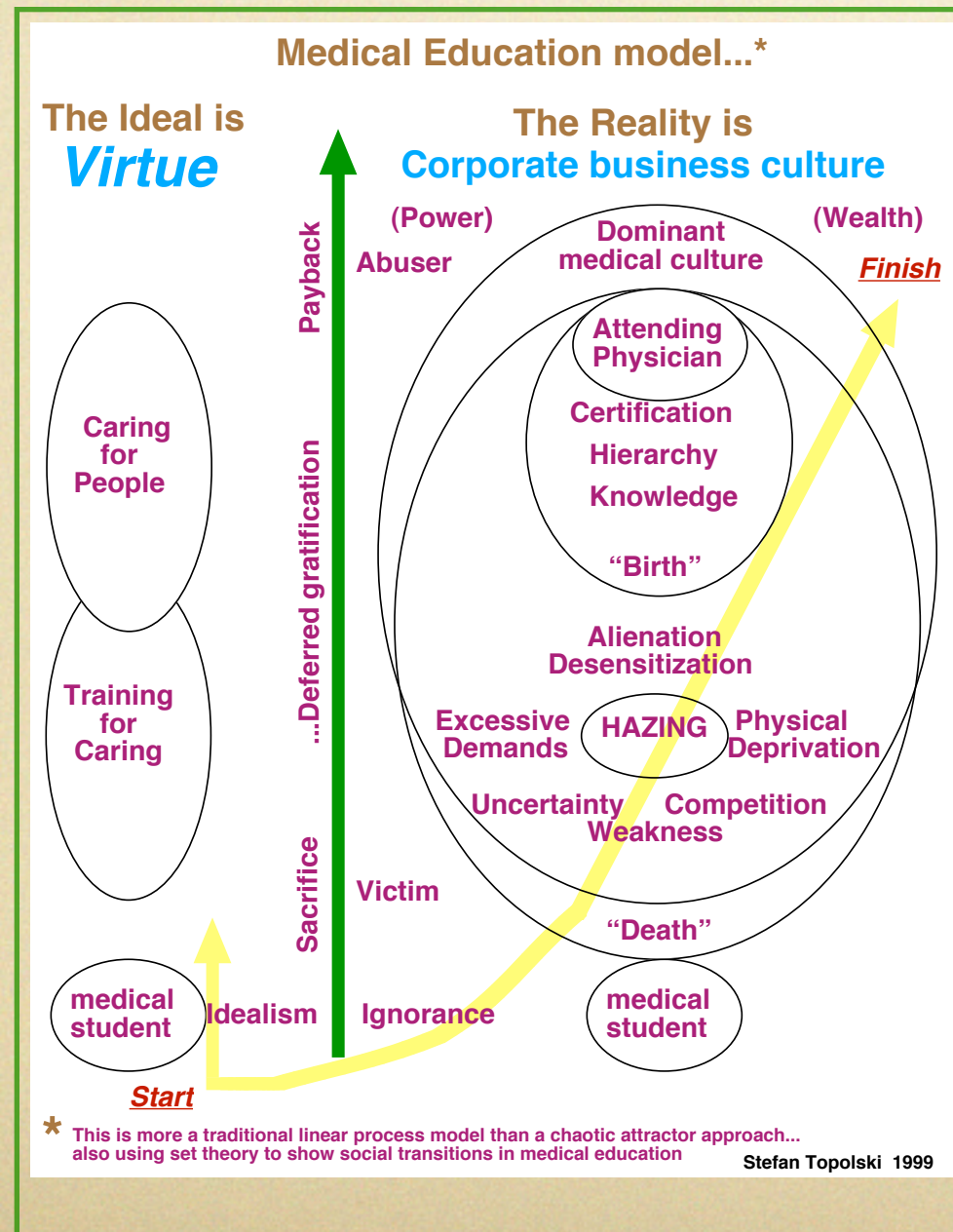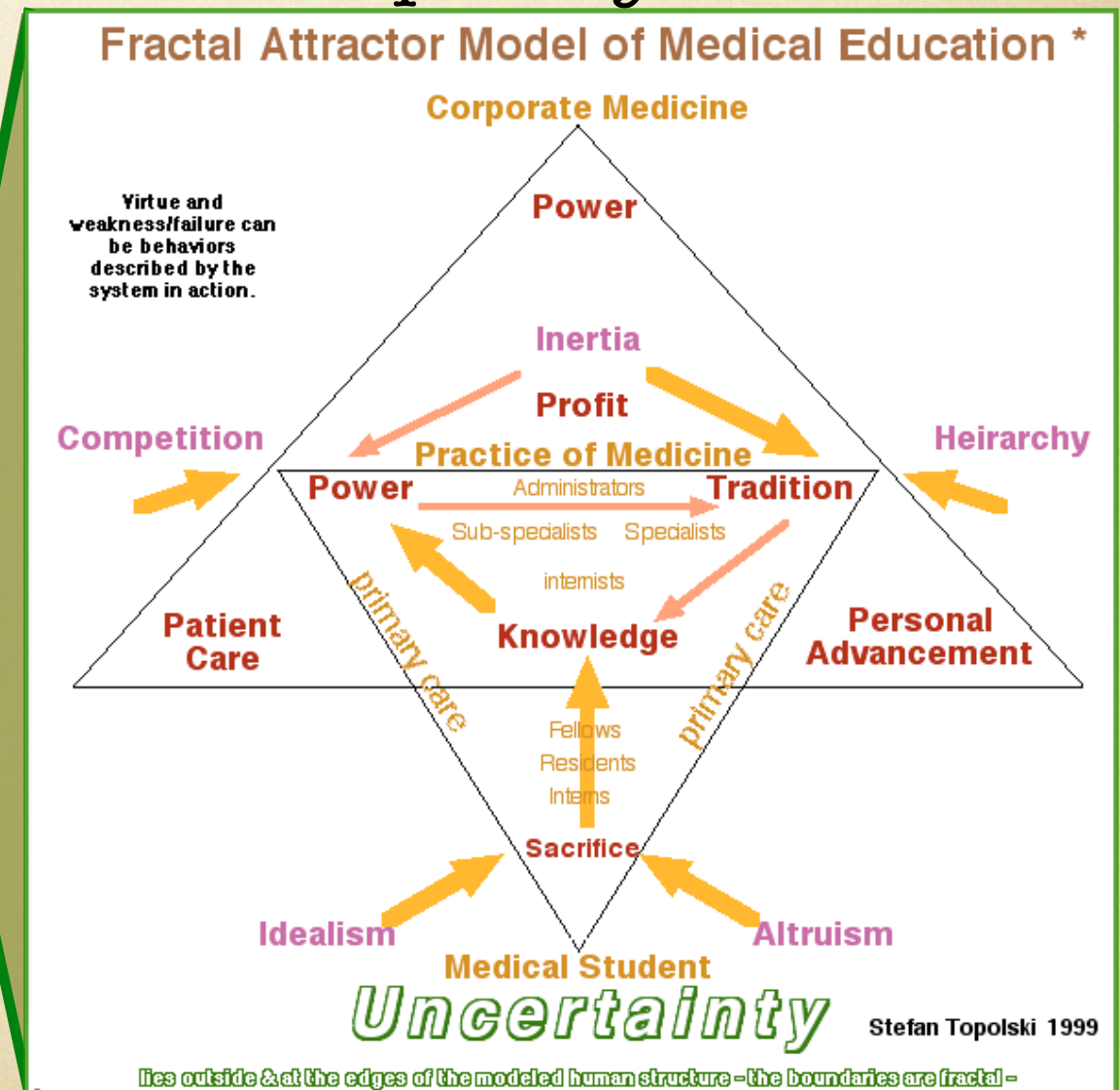
(Power) — (Wealth)
Abuser — Dominant medical culture — *Finish*

Payback

...Deferred gratification

Attending Physician
Certification
Hierarchy
Knowledge
"Birth"

Caring for People

Training for Caring

Alienation Desensitization
Excessive Demands — HAZING — Physical Deprivation
Uncertainty Weakness — Competition Weakness

Sacrifice

Victim

"Death"

medical student — Idealism — Ignorance — medical student

Start

* This is more a traditional linear process model than a chaotic attractor approach...
also using set theory to show social transitions in medical education

Stefan Topolski 1999

Complexity Model

Fractal Attractor Model of Medical Education *

Corporate Medicine

Virtue and weakness/failure can be behaviors described by the system in action.

Power

Inertia
Profit
Practice of Medicine

Competition — Power — Administrators — Tradition — Heirarchy
Sub-specialists — Specialists
internists

Patient Care — Knowledge — Personal Advancement

primary care — primary care

Fellows Residents Interns

Sacrifice

Idealism — Altruism

Medical Student
Uncertainty

lies outside & at the edges of the modeled human structure – the boundaries are fractal –
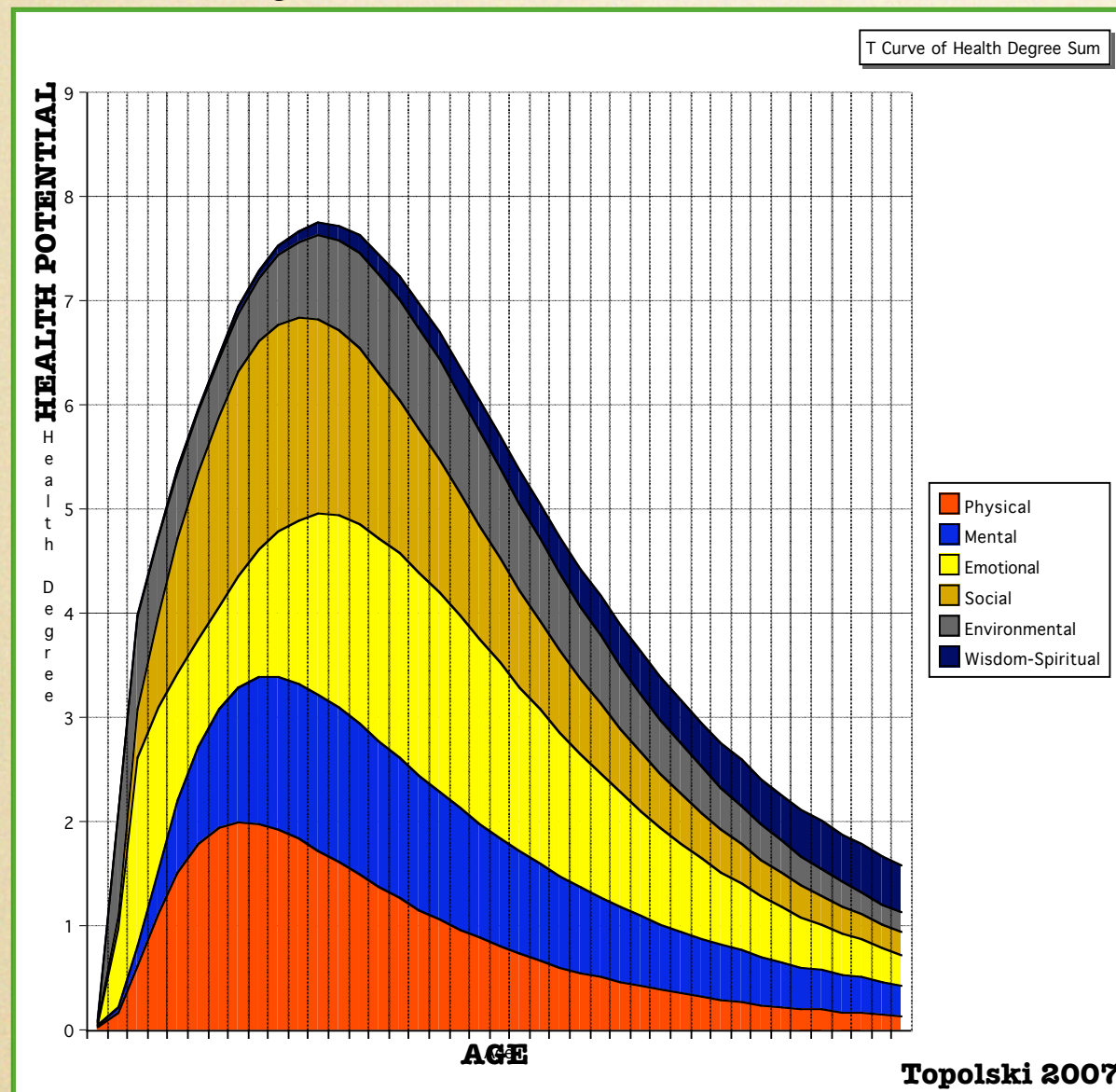
Stefan Topolski 1999

Chaos & Complexity in the Medical Home

Set Appropriate Boundaries

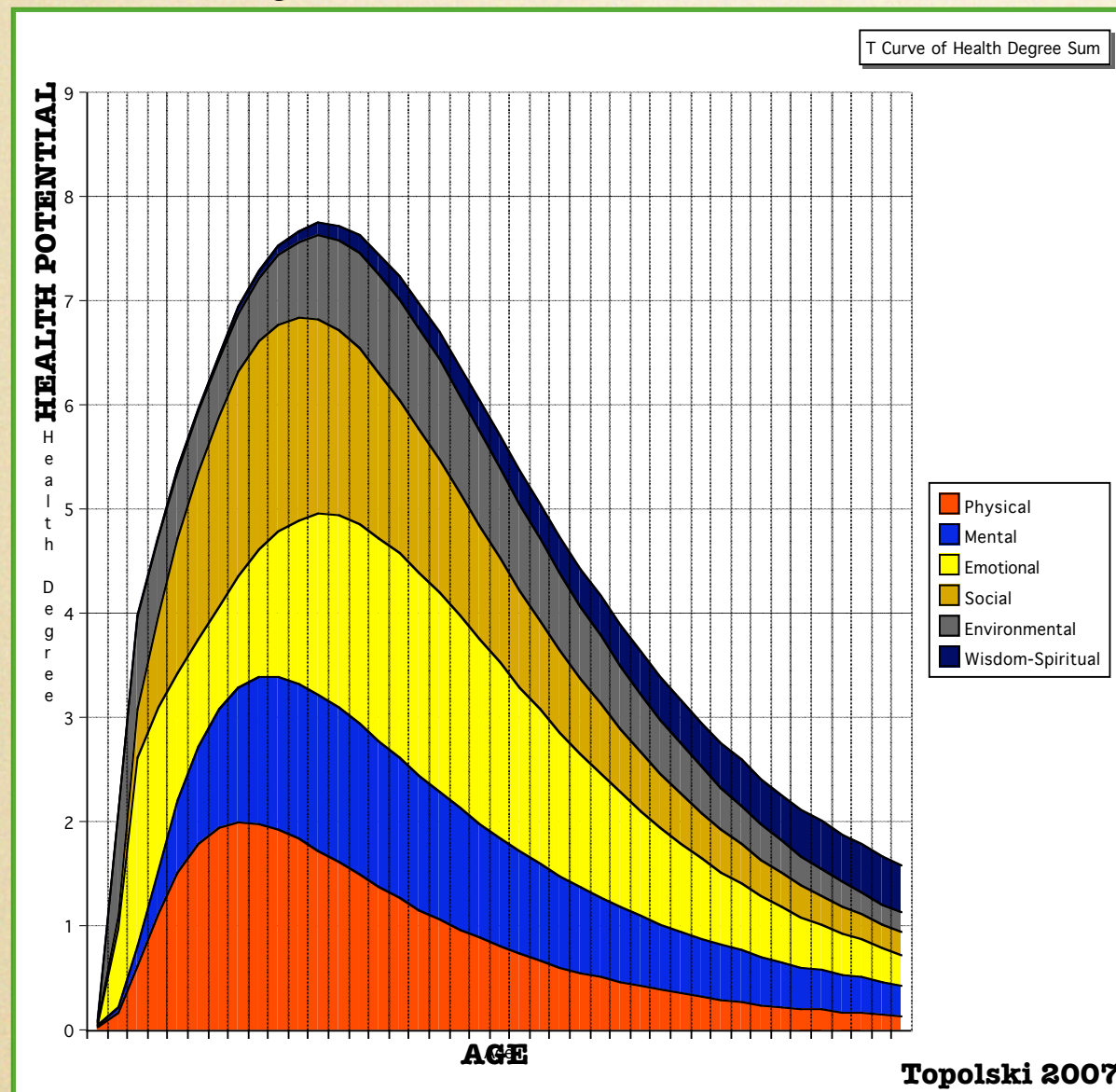### Identify Boundaries of Impact

Boundaries also Maximize Diversity, Complexity, and Potential Function
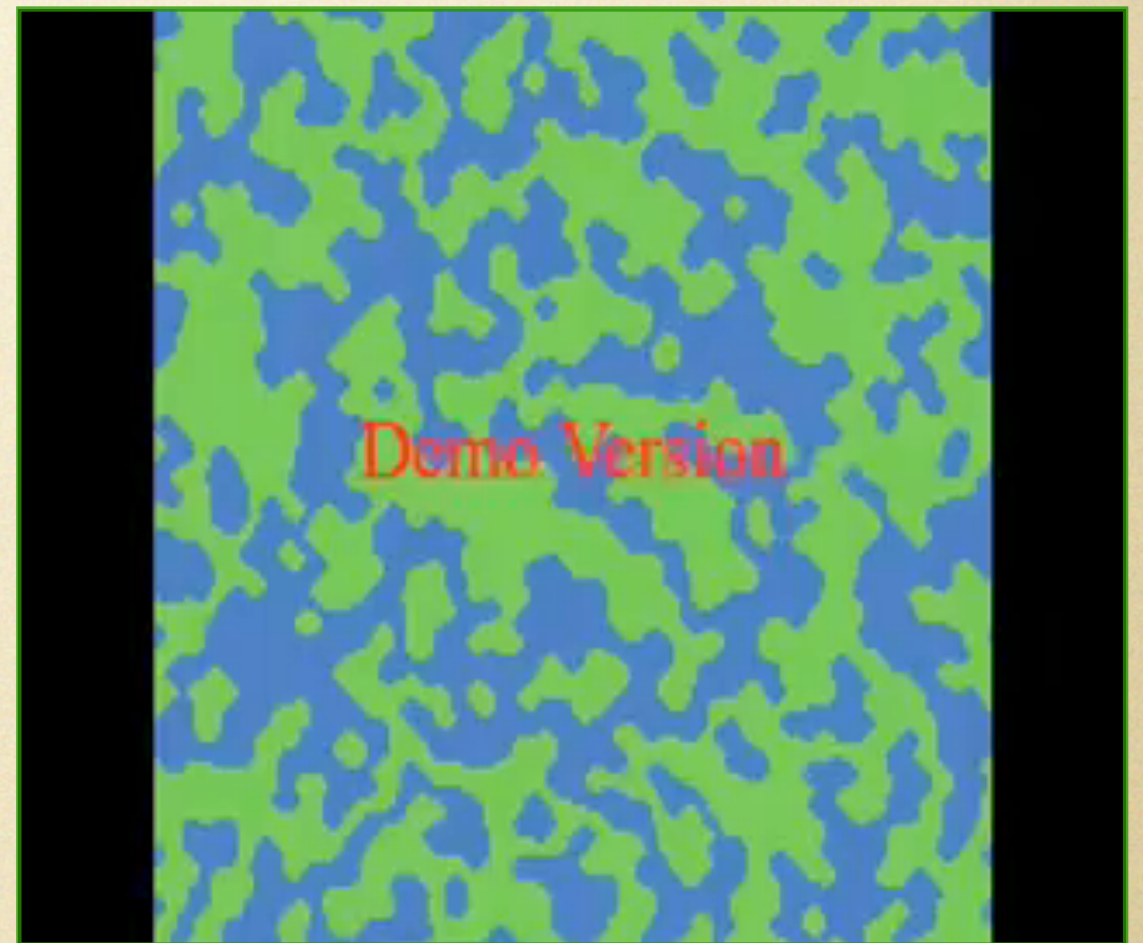
Chaos & Complexity in the Medical Home

Set Appropriate Boundaries

Identify Boundaries of Impact

Boundaries also Maximize Diversity, Complexity, and Potential Function
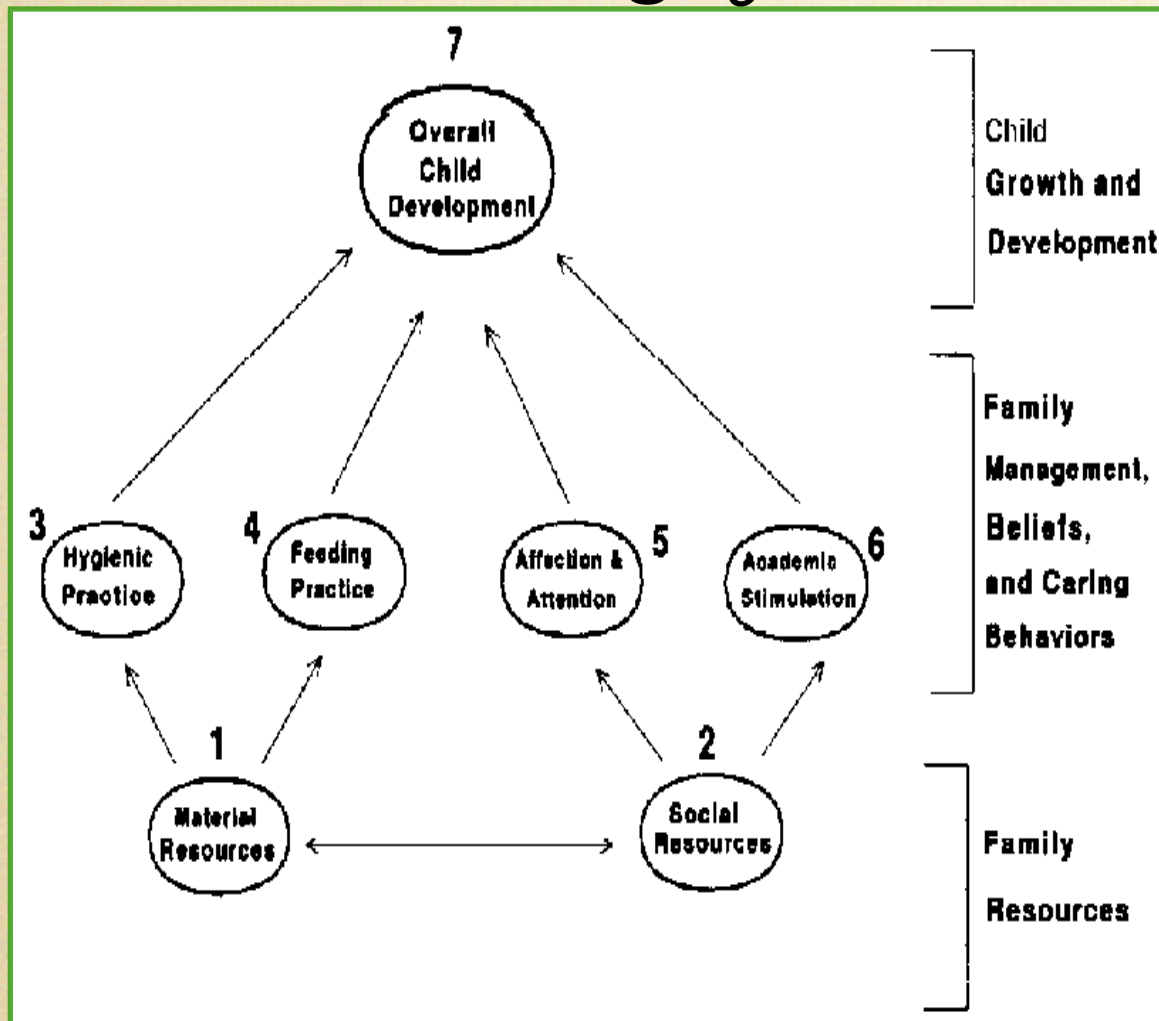

A Medical Home- <u>cannot</u> be built in our biomedical non-system... -neither a for-profit **nor** a national health care system that is <u>consolidating</u> and <u>homogenizing</u>.

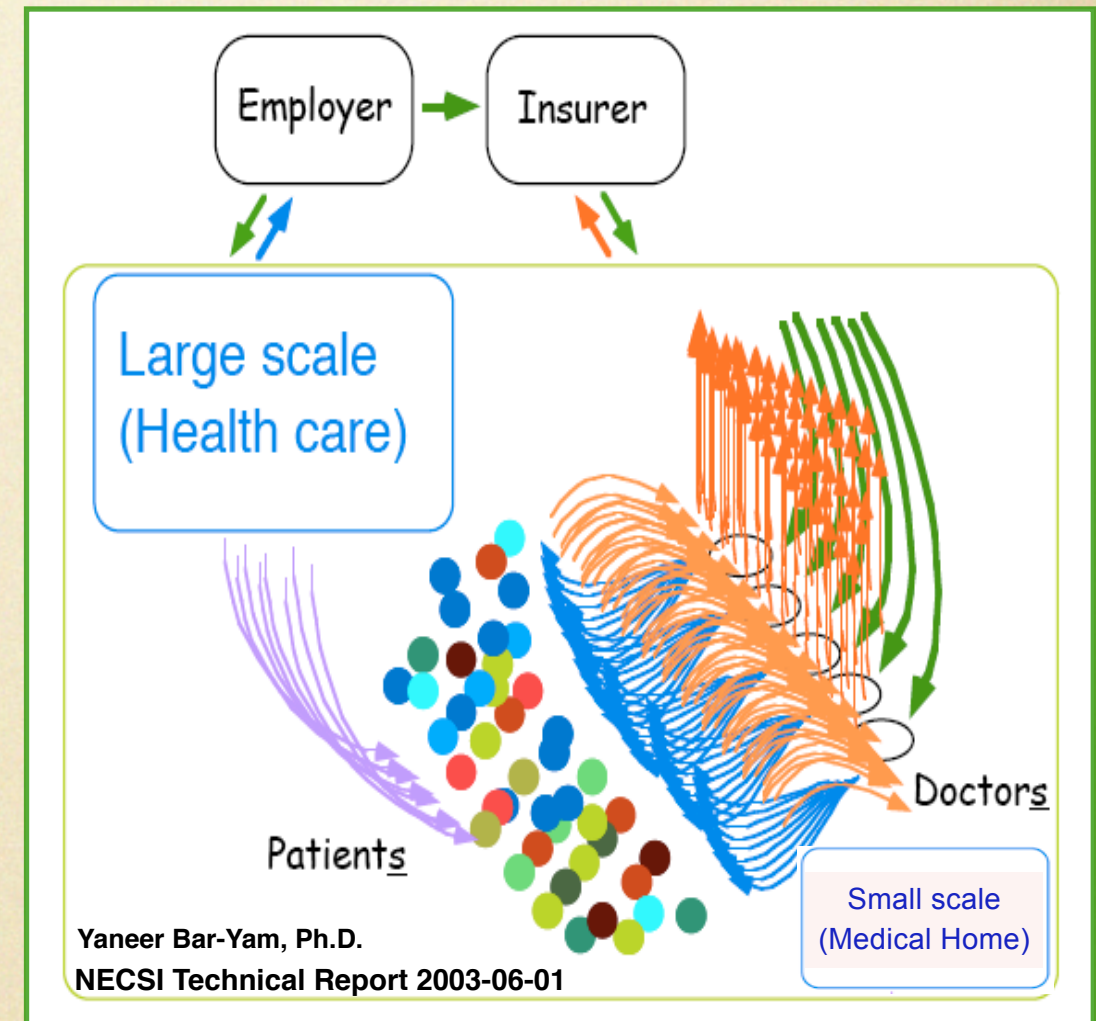# Chaos & Complexity in the Medical Home

Establish Feedback & Balance Your Scale

Feedback is ESSENTIAL to successful living systems...

Health Care is Global; The Medical Home is Local...

Chaos & Complexity in the Medical Home

Establish Feedback   &   Balance Your Scale

Feedback is ESSENTIAL to successful living systems...

Health Care is Global; The Medical Home is Local...

Yaneer Bar-Yam, Ph.D.
NECSI Technical Report 2003-06-01
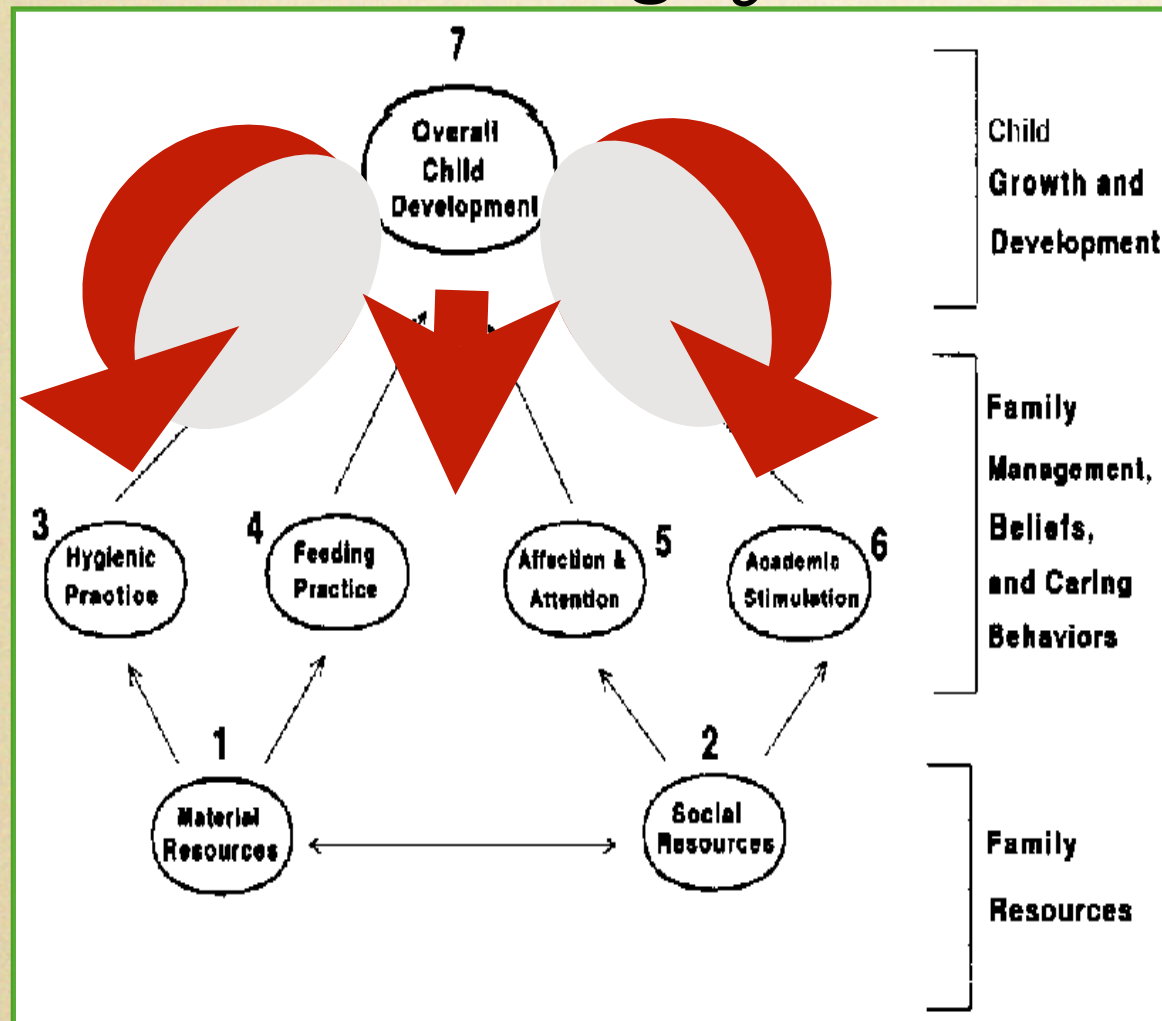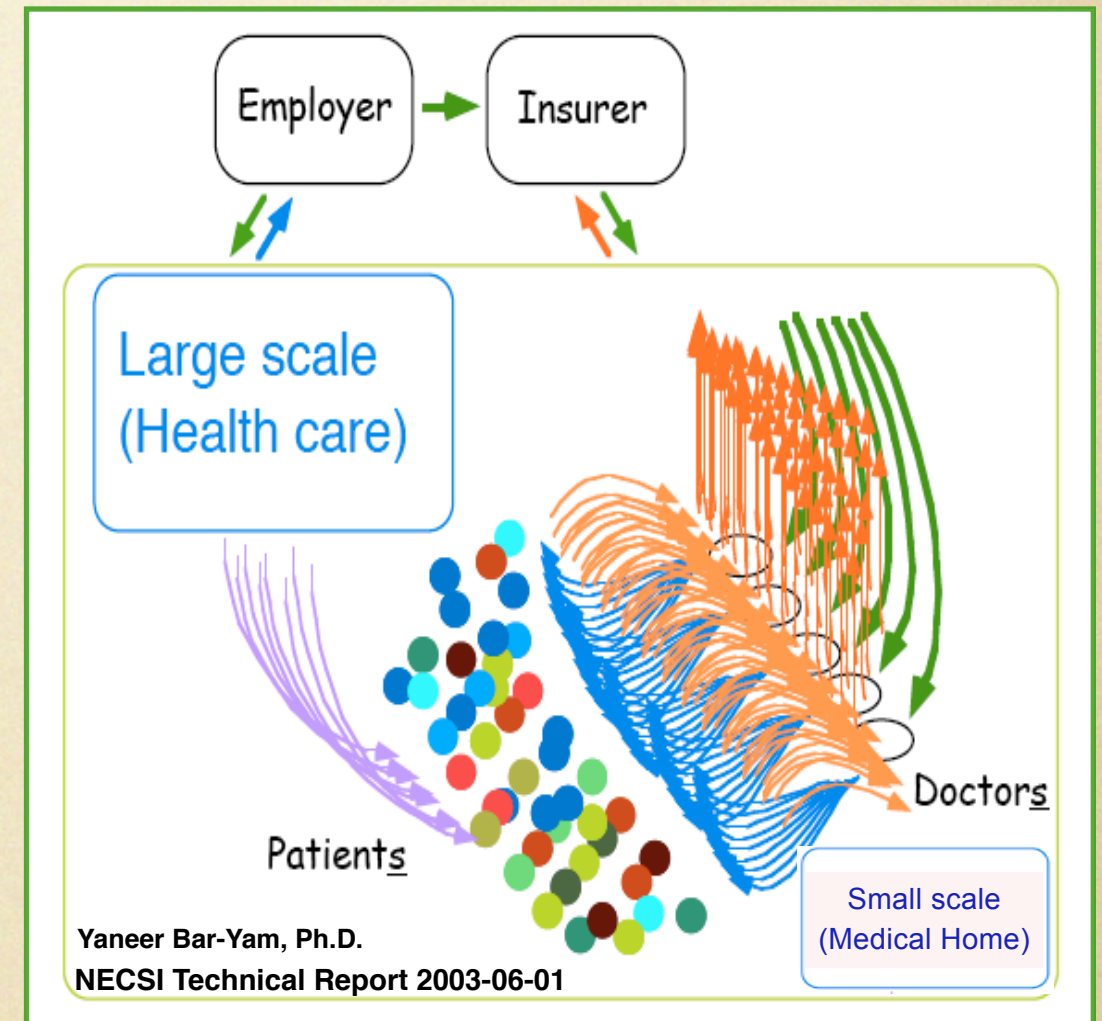
A Medical Home - <u>requires</u> direct and continuous feedback...
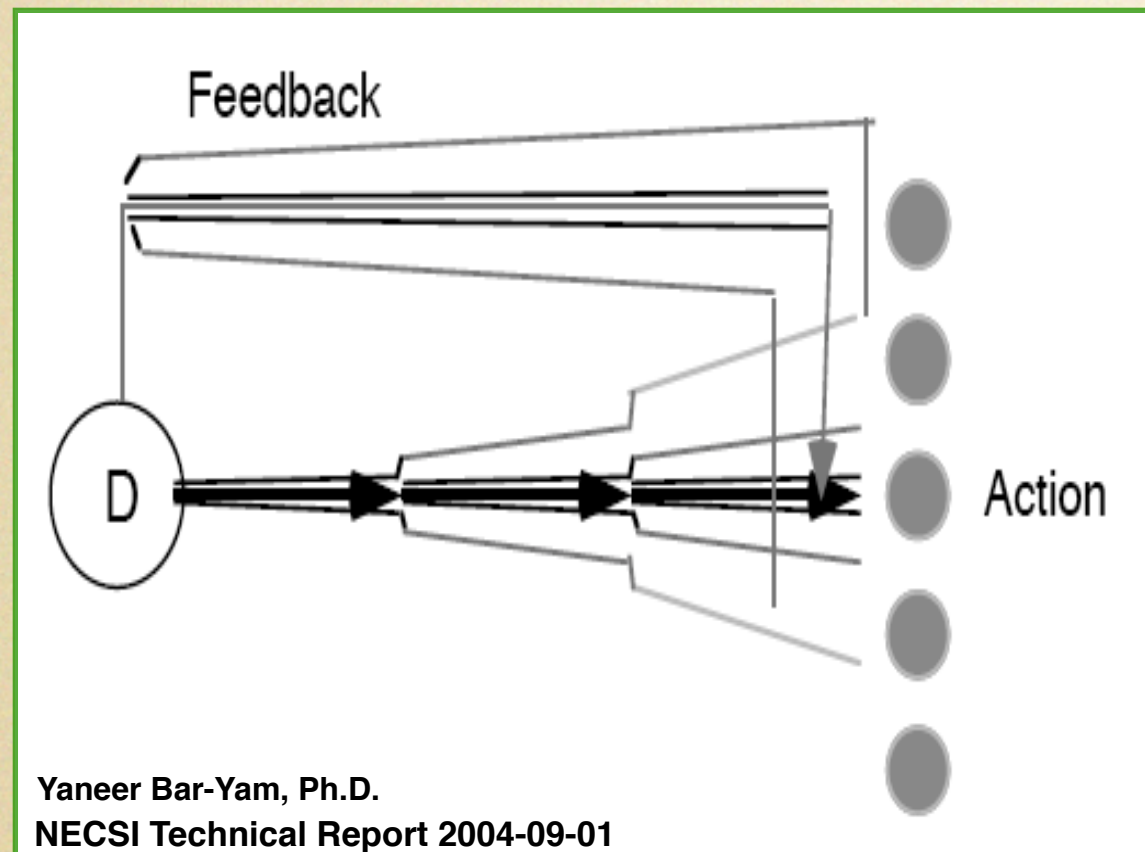- <u>cannot</u> be the swiss army knife of excellence at both the micro and macro scales...

Chaos & Complexity in the Medical Home

Establish Feedback   &   Balance Your Scale

Feedback is ESSENTIAL to successful **HealthCare** systems...

TURBULENCE in mismatched information flow is the CHAOS we feel...

Feedback

D → Action

Yaneer Bar-Yam, Ph.D.
NECSI Technical Report 2004-09-01

Employer → Insurer

Large scale (Health care)

Patients

Doctors

Small scale (Medical Home)

Yaneer Bar-Yam, Ph.D.
NECSI Technical Report 2003-06-01

modified by Topolski 2008
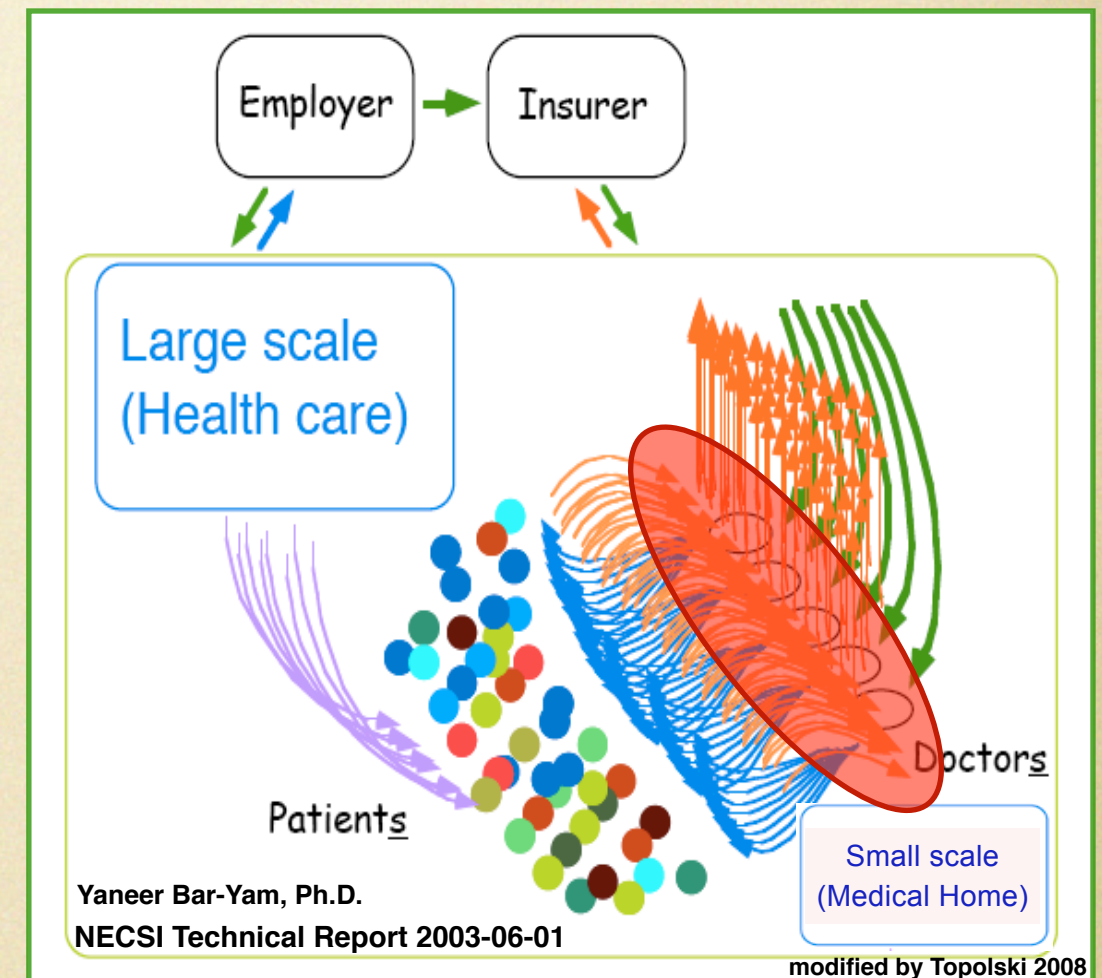
Chaos & Complexity in the Medical Home

Establish Feedback & Balance Your Scale

Feedback is ESSENTIAL to successful **HealthCare** systems...

TURBULENCE in mismatched information flow is the CHAOS we feel...

Feedback

D

Action

Yaneer Bar-Yam, Ph.D.
NECSI Technical Report 2004-09-01

Employer → Insurer

Large scale (Health care)

Patients

Doctors

Small scale (Medical Home)

Yaneer Bar-Yam, Ph.D.
NECSI Technical Report 2003-06-01

modified by Topolski 2008
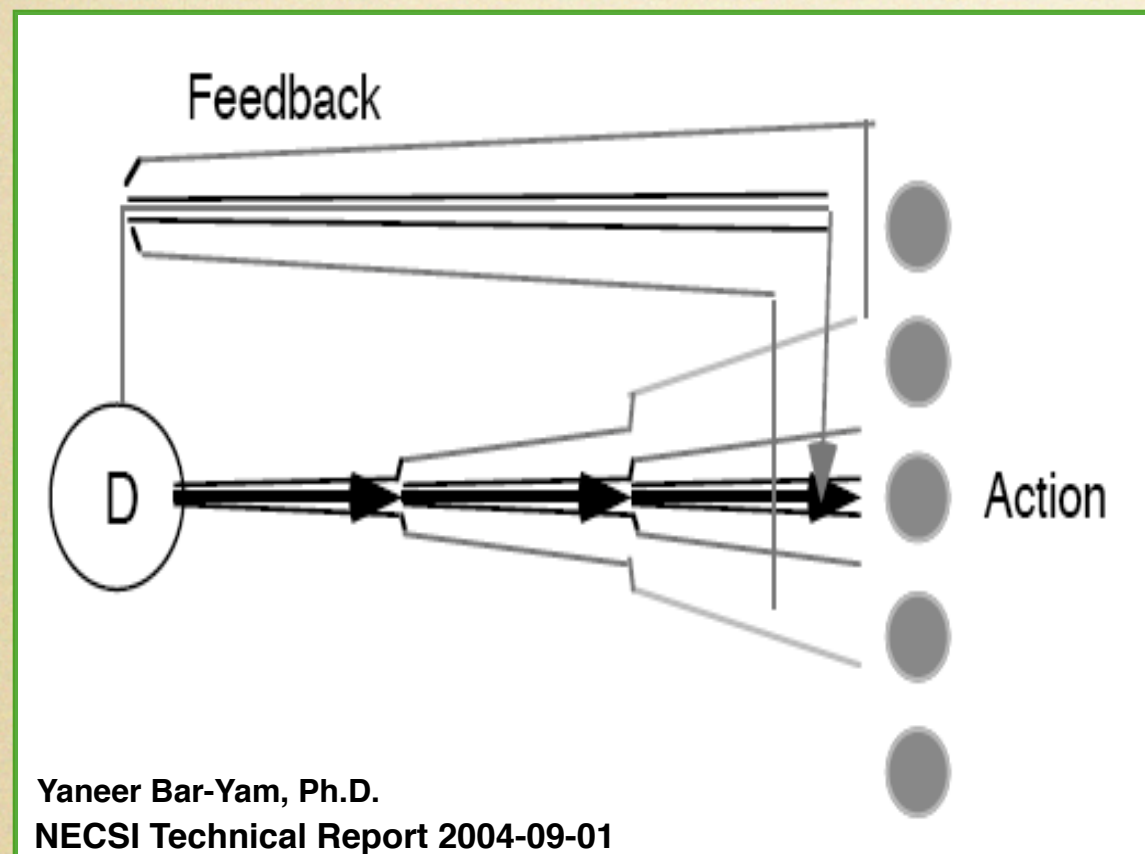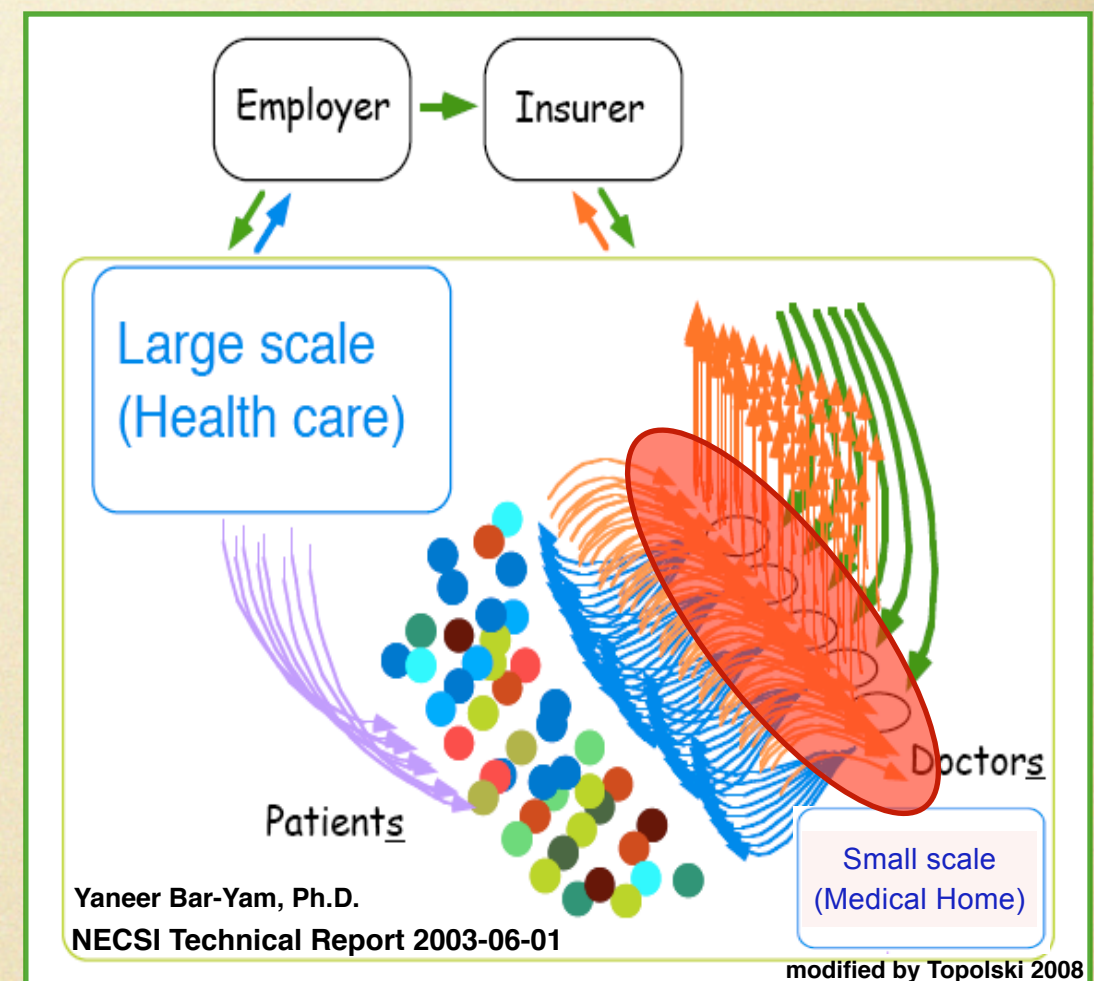
A Medical Home - <u>must</u> have patients providing feedback
- <u>must</u> be focused on individual's mind-boggling complex health and healing.

Chaos & Complexity in the Medical Home

Chaos in the health care system is **a sign of unhealthy structure**... but that's no surprise.

Complexity principles have been applied to improve systems, networks, organizations and management.

To reduce chaos and build a better medical home it may help to understand other Principles of Complexity...

Context
Composites
Robust Adaptation
Control Hierarchy
Scale-Free Structure
Pattern Formation
Time Series (not Taylorian)
Catastrophe Cusps
Emergence

Chaos & Complexity in the Medical Home

Chaos in the health care system is **a sign of unhealthy structure**... but that's no surprise.

Complexity principles have been applied to improve systems, networks, organizations and management.

To reduce chaos and build a better medical home it may help to understand other Principles of Complexity...

Context
Composites
Robust Adaptation
Control Hierarchy
Scale-Free Structure
Pattern Formation
Time Series (not Taylorian)
Catastrophe Cusps
Emergence

But for now, let's conclude...

How will the Medical Home Look?

Principles

Complexity

Emergence

Strange Attractors

Quality of Network

Scaled Interdependence

Problem

We claim to be creating the
Medical Home while
Health is poorly known
In a Medical Non-System
with Improper Foundations
All connected together in
Chaos...

Solutions

Better Define Health as

a complex tensor of qualitative factor curves that is wholistic, accurate, and measurable.

Identify Profession's Attractors as

monetary and social power before service to start removing obstacles to the medical home.

Set Appropriate Boundaries to

both practice shape and healing mission to preserve diversity and maximize return on healers' efforts.

Establish Feedback to

manage complex human social structures and improve responsiveness, flexibility, robustness, and overall quality.

Balance Your Scale so

that you appropriately match project to problem and don't continue using the wrong measures of health and quality.

The True Medical Home will be...

Better at Healing because

you understand that health is more than just removal of disease or HgbA1c levels - Rather it is a wonderful symphony of balance between body and environment, mind and society, instruction and empowerment.

Truly Noble because

we will reverse both the egregious overpayment of specialists and the insidious return of indentured servitude for medical students without means who can best serve those in need.

Grassroots and small scale because

the unique and infinitely complex contextual health needs of human beings suffer distortion, simplification, and violence with ever larger scales of health system intervention.

Supported by patients who

are the people most capable of measuring their health quality and the caring we provide. Our goal is health, not false equality.
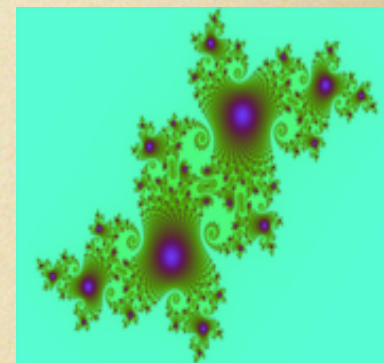
Focused on the patient and

not on inappropriate simplistic algorithmic public health average recommendations that seek a false equality without respect for patients or their innate, complex, and unique life stories.

Easy to talk...

Hard to walk...

Because

you ARE

the

Complexity

Specialist!

Chaos & Complexity in the Medical Home

Questions !

Stefan Topolski

Fitchburg Family Practice
Residency
U. Mass School of Medicine

Caring in Community
& CottageMed, Inc.

public@cottagemed.org

Addenda...

Chaos & Complexity in the Medical Home:

We have studied:

Core Concepts of Chaos and Complexity

Complexity's new definition of Health

How to improve Health in a Medical Home

So...

How do Chaos and Complexity shape the successful Medical Home ?

Chaos in the health care system is a sign of **unhealthy structure**... but that's no surprise.

Complexity principles have been applied to systems, networks, organizations and management.

To reduce chaos and build a better medical home you need to understand a few Principles of Complexity-

Context
Composites
Robust Adaptation
Control Heirarchy
Appropriate Scale
Scale-Free Structure
Feedback Loops
Pattern Formation
Catastrophe Cusps
Emergence

Health in the Medical Home:
What does complexity do for us ?

Physical
Emotional
Mental   Internal
Environmental
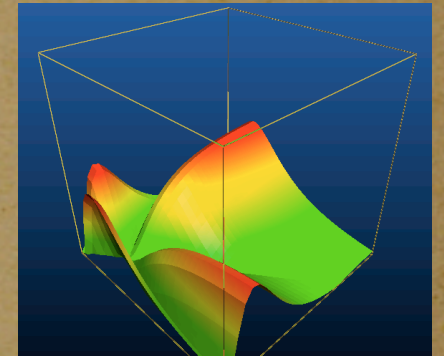Social
(Wisdom/
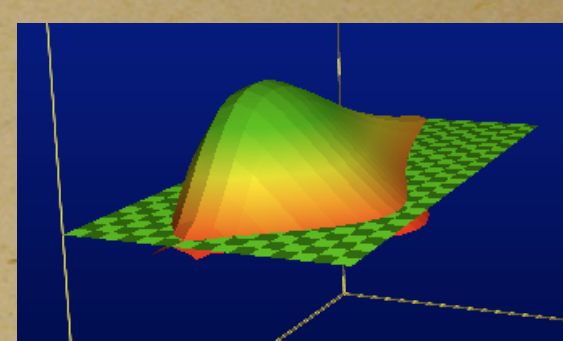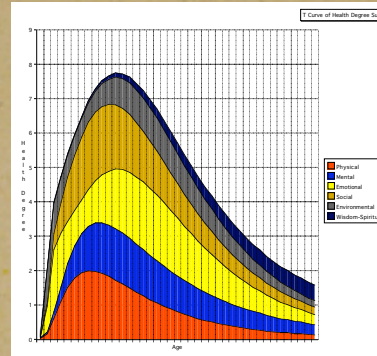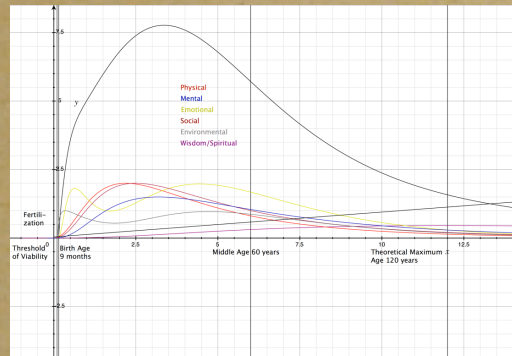Spiritual) External

Log Normals

Entropy/Energy

Curve Addition

Fractal Surface

Strange Attractor

The Inverted 'U'...

Novel Predictions:

Health is MORE complex than the biopsychosocial model describes.

Health has internal AND external factors.

Health at different ages is NOT equivalent -
Healthy infants and children are categorically LESS healthy than healthy teenagers and adults.

Chronic Illness comes in two Distinct and OPPOSITE forms - Excess Entropy (Underuse) or Excess Energy (Overuse) - which heal through fundamentally OPPOSITE processes.

Acute Illness is a THIRD form with a fundamentally DIFFERENT healing process from the 2 forms of Chronic Illness.

A new concept of VIABILITY THRESHOLD with slope changed by age, rare genetic or infectious illnesses.

Health and Illness can be defined by slope of surface, fractal texture of surface, total complexity of system, or total complexity of system minus viability threshold,

More clearly shows which health interventions have large yield or small yield.

The healthy human being may be a nearly infinite fractal image of human health, but we can still crudely picture changes in health over time by modeling with effective simplification.

"Folly, all is folly...
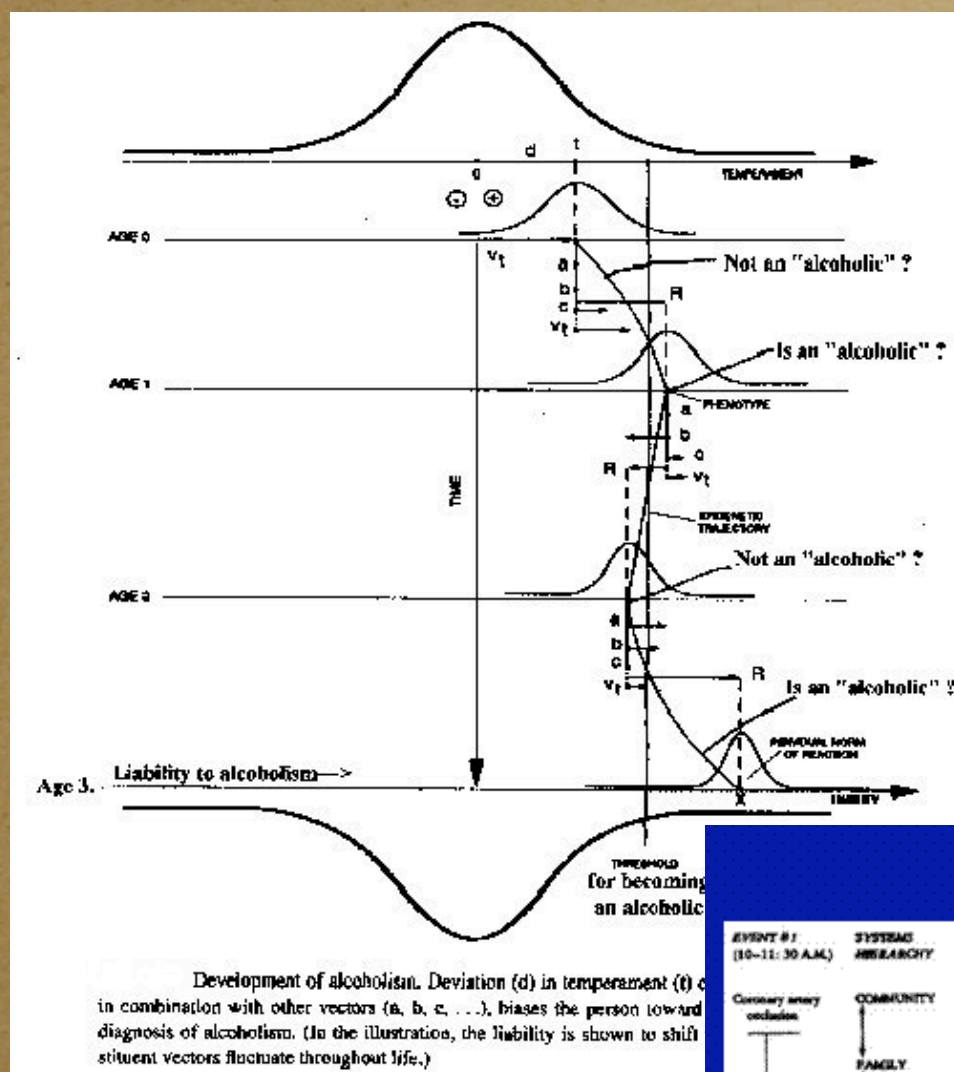   **for there is nothing new under the sun."**

Ecliasticus

"Physical   Fitness. Nutrition. Medical self-care. Control of substance abuse
  Emotional   Care for emotional crisis. Stress Management
  Intellectual   Educational. Achievement. Career development
  Spiritual   Love. Hope. Charity.
  Social   Communities. Families. Friends ...

Health promotion is the science and art of helping people change their lifestyle to move toward a state of optimal health. Optimal health is defined as a balance of physical, emotional, social, spiritual, and intellectual health. Lifestyle change can be facilitated through a combination of efforts to enhance awareness, change behavior and create environments that support good health practices. Of the three, supportive environments will probably have the greatest impact in producing lasting change. "[1]
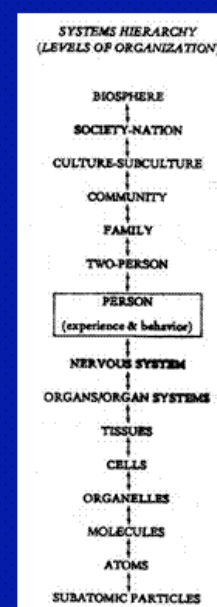
[1] American Journal of Health Promotion, 1989,3,3,5

"Blessed be the Peacemakers, not the HgbA1c checkers..."

Development of alcoholism. Deviation (d) in temperament (t) ... in combination with other vectors (a, b, c, ...), biases the person toward ... diagnosis of alcoholism. (In the illustration, the liability is shown to shift ... stituent vectors fluctuate throughout life.)
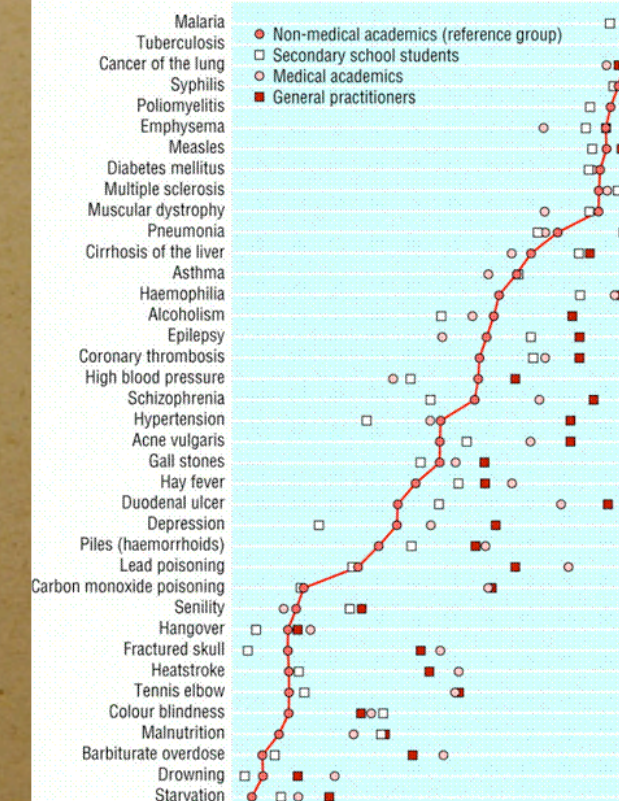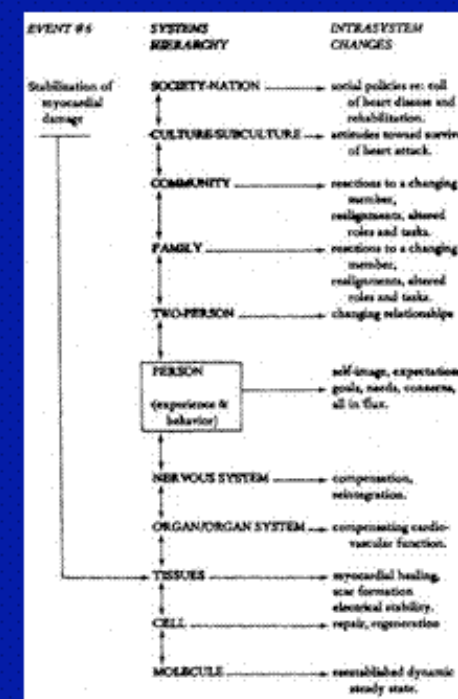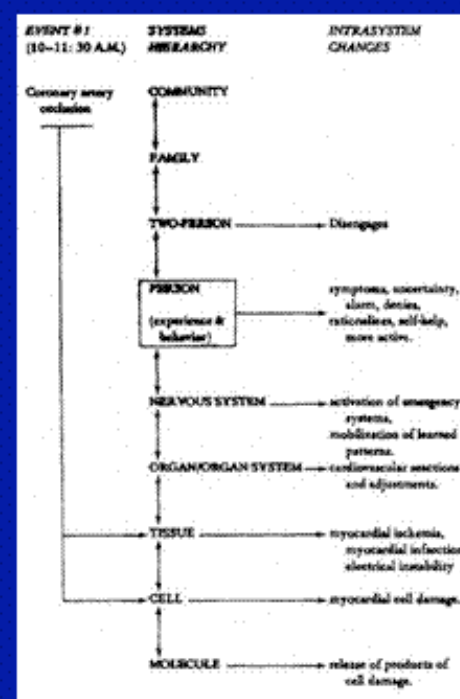

The Biopsychosocial model

Theoretical basis
(Engel, 1981)

The Biopsychosocial model
(Applied)
(Engel, 1981)

Which is a disease and why?

Maximum Complexity / Health

Increasing Health

Illness

Recovery

Constant Themes of Tension & Rebound

Self-Similar curves construct a fractal macro curve

Enthalpy / Disorder — Increasing Energy — Entropy / Order

Topolski 2007