



Richard C. Vari, PhD Lecture
Teaching Excellence Academy for Collaborative Healthcare

27 October 2022

Assessment and evaluation in medical education

What does physiology teach us ?

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Uniformed Services University of the Health Sciences

Virginia Tech Carillon School of Medicine

“to develop physician thought leaders through inquiry, research and discovery, using an innovative curriculum based on adult learning methods in a patient centered context.”





Unified theory of practice,
competence, readiness and
evaluation in the clinical setting.

**Embrace complexity,
act with simplicity.**

Defining curricular Success and Failure

**A beginning intern from my medical school
sees a patient with thyrotoxicosis who needs medication**

Simple program evaluation

- I would be happy if....

They could describe iodine metabolism and how methimazole worked.

Simple program evaluation

If not knowing
these basic
mechanisms,
they did not fill
this “gap”...

I would drop dead with
embarrassment .

Faculty create Independence, Capability
= ability to fill the gap

- What has to be internalized in the student?
- What is the role of faculty?



Independently learning from experience

An idea of success, a comparison

essential

desirable

Disclaimer and Disclosure

- The opinions and assertions expressed herein are mine and do not necessarily reflect the official policy or position of the Uniformed Services University or the Department of Defense.
- Harvard Macy Course in “Systems of Assessment in Medical Education” (honorarium).
- ACP book, *Leadership Careers in Med Ed* (royalty)

Terms as I will use them

- Learner, studentresident, fellow
- Readiness = “competence” = capable of advancement towards independence

MS1

Reporter ~~→~~ Interpreter

- “Assessment” = observing
- “Evaluation” = interpretation in context

PGY2

Understanding → Action

“Assessment” = observing

“Evaluation” = interpretation in context

“Grading” = administrative action
(advancement decision, summative)

Feedback = educational action
(formative)]

What is “the end”= “physician”?

Question 1: What is a “physician” What’s the role of science in practice



- Physics, physiology, physician
- Physis = “nature”

Moses ben Maimon

Commitment to understanding mechanism at all levels



System Science

Physician - physiology - physics

Physis = nature, process

Science

Systems
Organs
Cells
Genes
Molecules

Molecules To
Primary Medicine

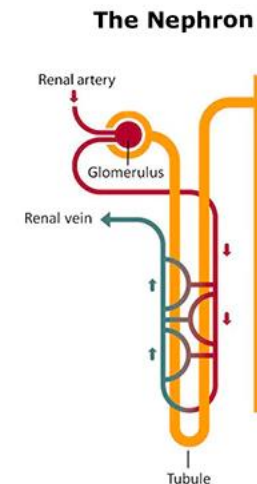


Pangaro, *JIAMSE*, 2010; *Med Sci Ed*, 2022

Do physicians use basic science?

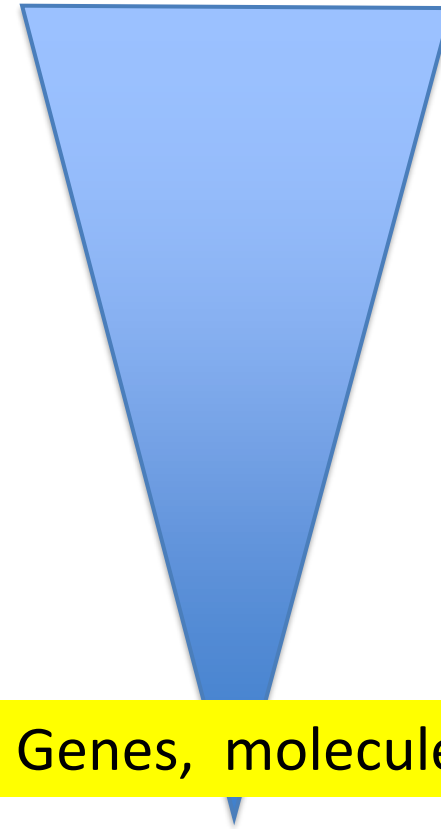
- Expertise as “encapsulation”
- The science is there, below the surface (Schmidt, Med Educ 2007)
 - Pathophysiology → illness scripts

- “Fast thinking” = pattern recognition
 - Polyuria-polydipsia
- Xray vision: osmotic diuresis
- “slow thinking” – figuring it out



the role of science in practice

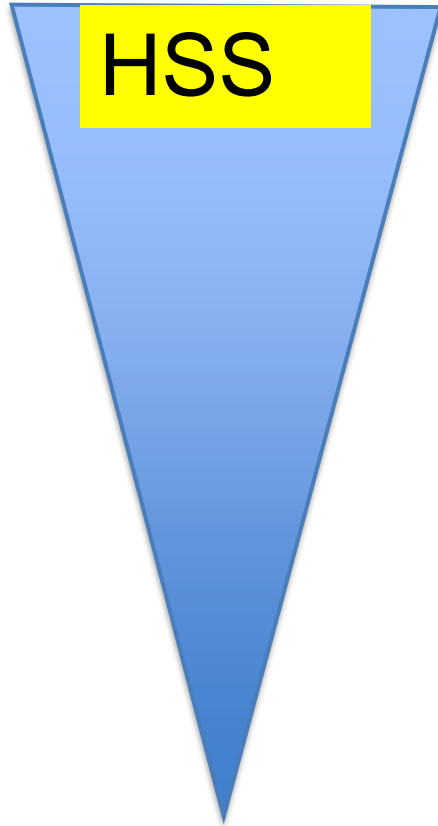
- Promise of duty and expertise
- What is a commitment to understanding?



Emmanuele Chapentier Jennifer Doudna

Nobel in Chemistry, 2020
CRISPR/Cas9 genetic scissors

Evolution and Revolution in Medical Education: Health System Sciences (HSS)



International Association of Medical
Science Educators webinar series

- HSS = “Third Pillar” of Medical Education:
- Dr. Gonzalo presented milestones between 1913 and
- HSS framework is built on evidence and is patient-centered.



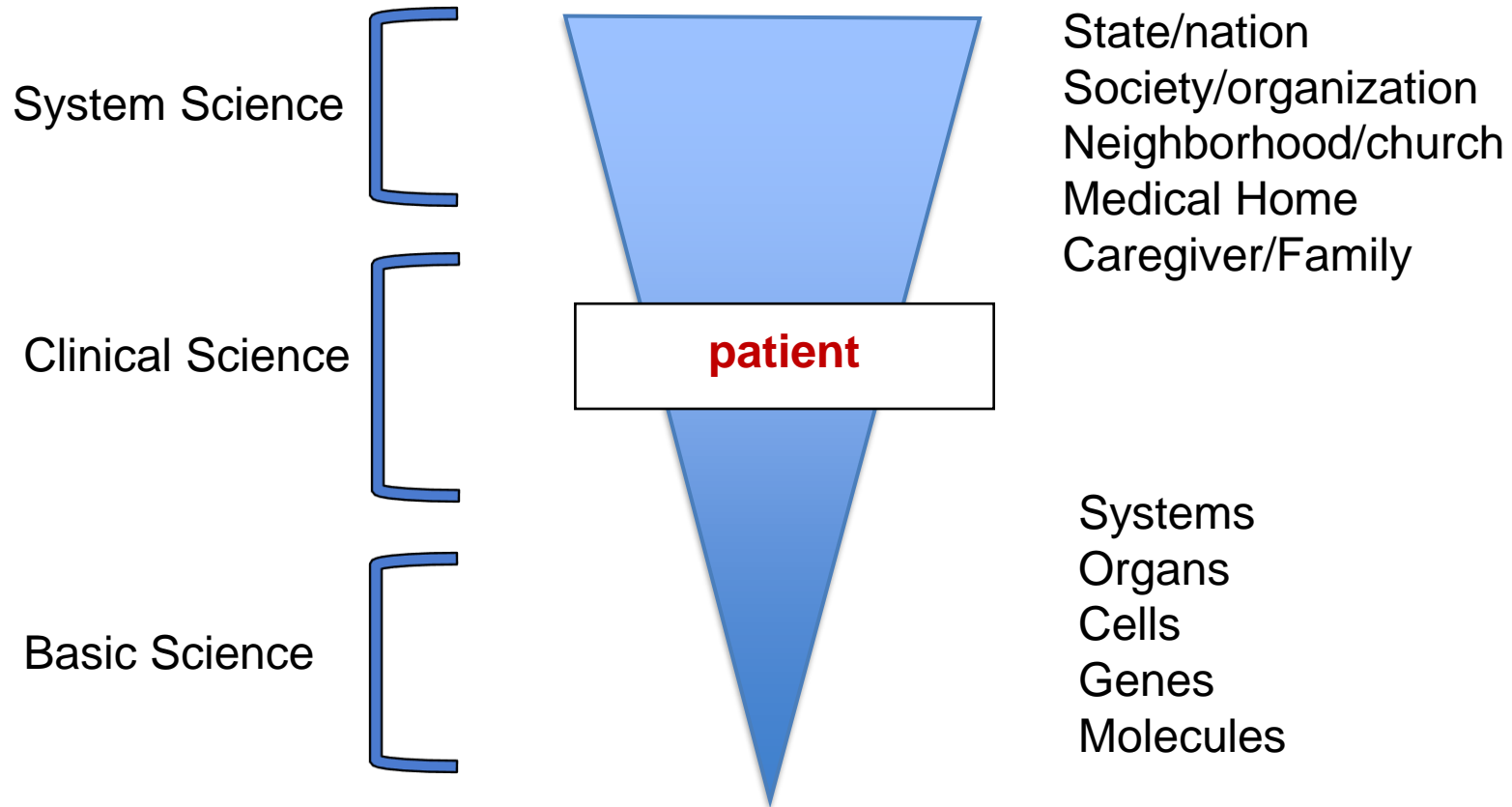
Rowe et al. Medical Science Educator (2021)

Building Health Systems Science Education from the Core Domain of Interprofessional Education at VTCSOM

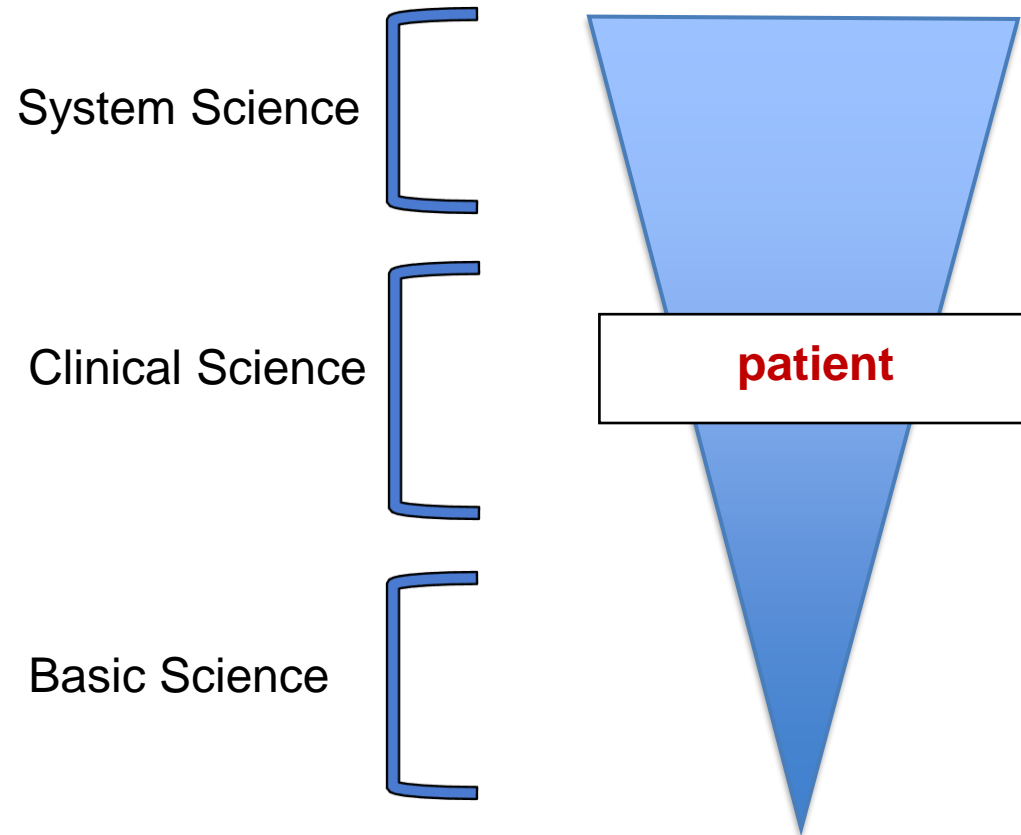
- Building in systems thinking
- Interprofessional Education - Radford University Carillon
- medical school curriculum mapping
 - “mapping” = how faculty organize structure material
 - How do students process and integrate?

Musick, *Med Sci Educ*, 2020

Mapping → Knowledge as domains to understand



Integration → all levels → Systems thinking



HSS can be an invitation to use systems thinking in basic and clinical science as well

What do these “sciences” have in common? basic, clinical and health systems

- What is a system:

... “A collection of different things which, working together ,
produce a result not achievable by the things alone.”

*Rechtin, Systems Architecting of Organizations:
‘Why Eagles Can’t Swim’ (1999)*

Trying to maximize something, to avoid something, to protect something

Physiology as homeostasis

- Maximizing x (the system would be "happy if...")
- Avoiding y (...would drop dead....literally)
- Maintenance of the *internal milieu*
- A set point
- Constant maintenance , constant dialogue about something really important

Claude Bernard

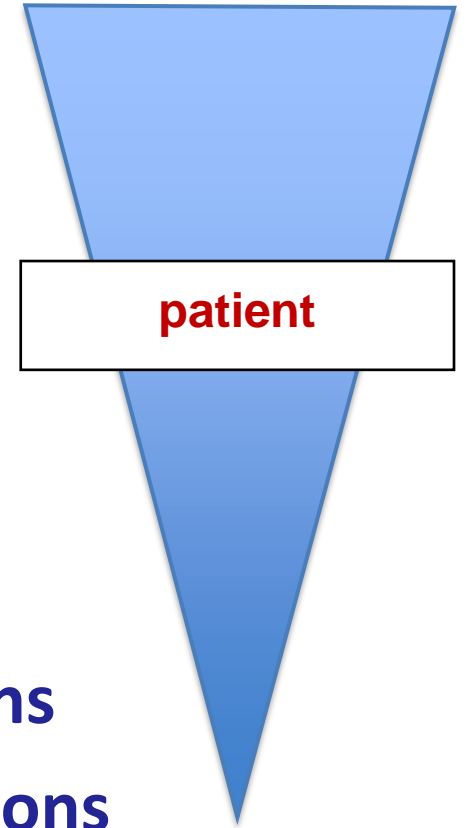
Physiology as homeostasis

- Maintenance of the internal milieu
 - MAINTAIN cerebral glucose
 - AVOID hypoglycemia

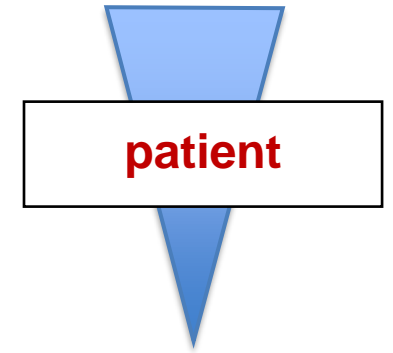
- Survival in order to thrive

What must the student internalize?

- At each 'level'
 - What must be internalized ?
 - What must be developed ?
 - What should be maximized?
-
- **Expertise = capability to ask and answer these questions**
 - **Duty = commitment to define and answer these questions**



priorities in the three sciences:



Basic science

- Osmolality
- Glucose
- pH

The Patient

- My pain?
- My job?
- The cost?

The care System

- Safety
- Value
 - (Efficacy/cost)

Faculty: Can the student identify the priority at each “level”?

Professionalism is a promise of expertise and a promise of duty



Edmund Pellegrino

Kennedy Institute of Ethics J, 1995

Question 2: what does expertise look like?



Faculty judge:

What has the student internalized?

- Cognitive
- Understanding → action

Understanding → **Action**

Reporter/Interpreter

Manager/Educator

Cognitive

Ethical

Expertise > Duty

Expertise = Duty

What is understanding? What is knowledge?

Understanding → Action

Observation → Reflection → Action

Knowledge

Sampling

Values

Data → Information → Certainty → Wisdom

Observe the resident → Teacher Feedback →
Many observations → Competency Committee

Cognitive progress

Create, study, extend

Evaluate and make decisions

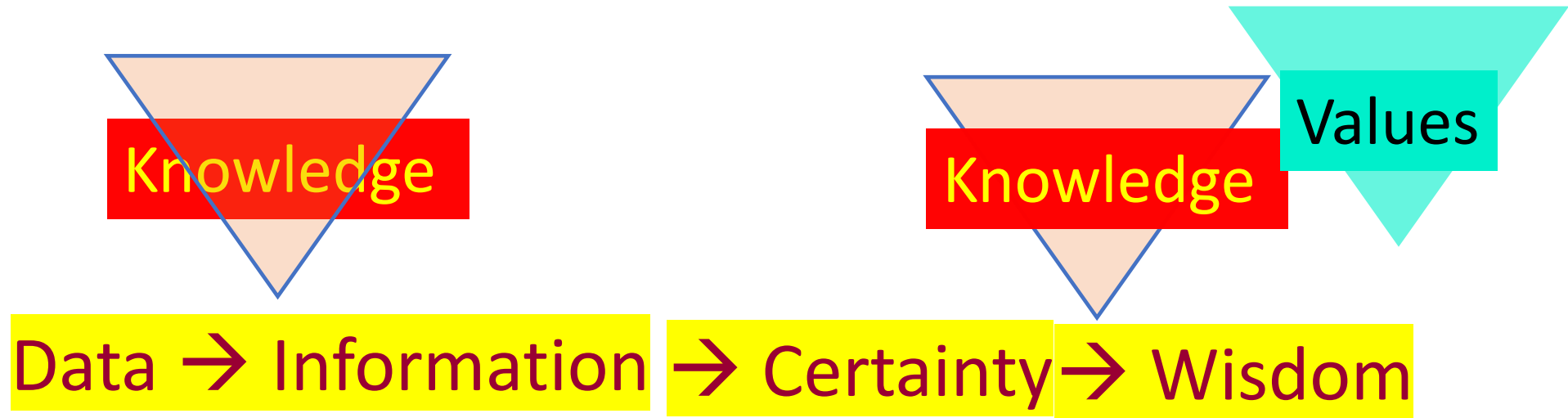
Apply and Justify

Explain

Remember as True

Bloom's Taxonomy revised x2

Q3. What is knowledge?



“Justified true belief”

Knowledge (“JTB”) as the bedrock of U → A

- “True”: the student must remember accurately and report it accurately **Teacher’s role: Recall question**
- “Justified”: the student can apply it to a situation and interpret findings accurately **Application question**
- “Belief”: there is a commitment to acting, basing management on it, an emotion of confidence to risk a patient’s health. **Assess/foster Confidence**
 - When that confidence is absent, I need to learn more!

“What Do I Need to Know?”

- About a test
 - How does it work? (physiology and/or anatomy)
 - How good is it?
 - How “bad” is it?
- About a disease or syndrome
- About a therapy

Internalize this concept:
Can the student ask and answer:
What does adequate knowledge look like?

Self-regulated learning
Metacognition
Reflection-in-action

Understanding → Action

Reporter

Interpreter

Manager/Educator

Curriculum = a series of invitations
that fosters this progress

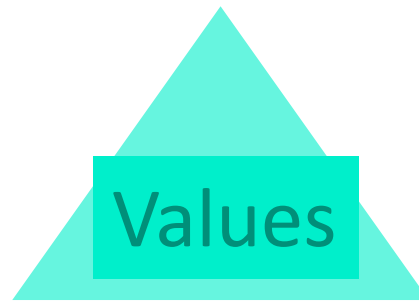
Q4. But what is action?



- Moving from Understanding into Shared decision making
- Being a “Manager”
 - Sub-intern: suggesting plans
 - Resident: effective, safe plan
- Applying ‘knowledge’ to specific situations

Where and how is understanding formed?

Understanding → Action



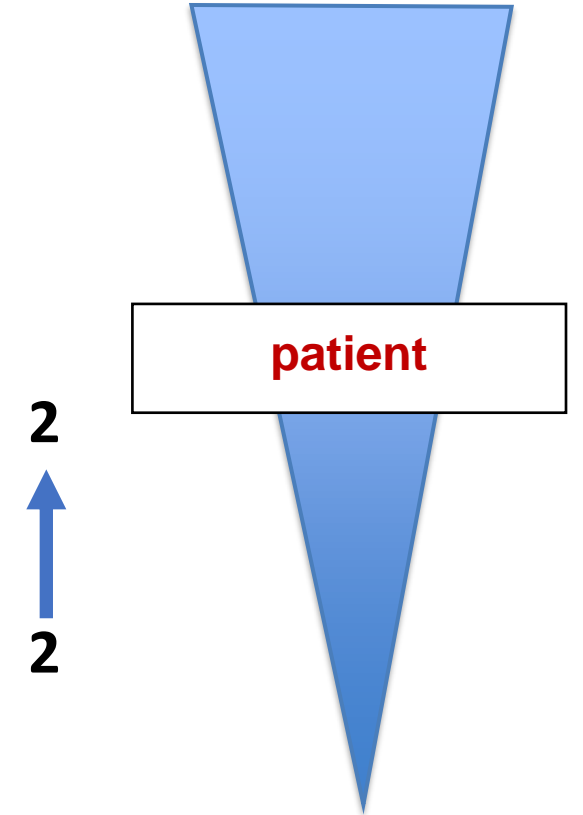
- Ethical \geq Cognitive
- Context of the patient's life and the world in which they live
- Criticality of systems thinking

clinical science begins with real patients

- This has been accomplished by actual student-patient contact under preceptor supervision in ambulatory clinic settings, nursing homes, hospice centers, etc., as well as more use of standardized patients. Vari, Advan in Physio Ed, 2002
- At the Virginia Tech Carilion School of Medicine, clinical science begins with real patients—and in the first week of school
 - This takes dedicated clinical faculty
 - “faculty” = create capability

“20th century” models

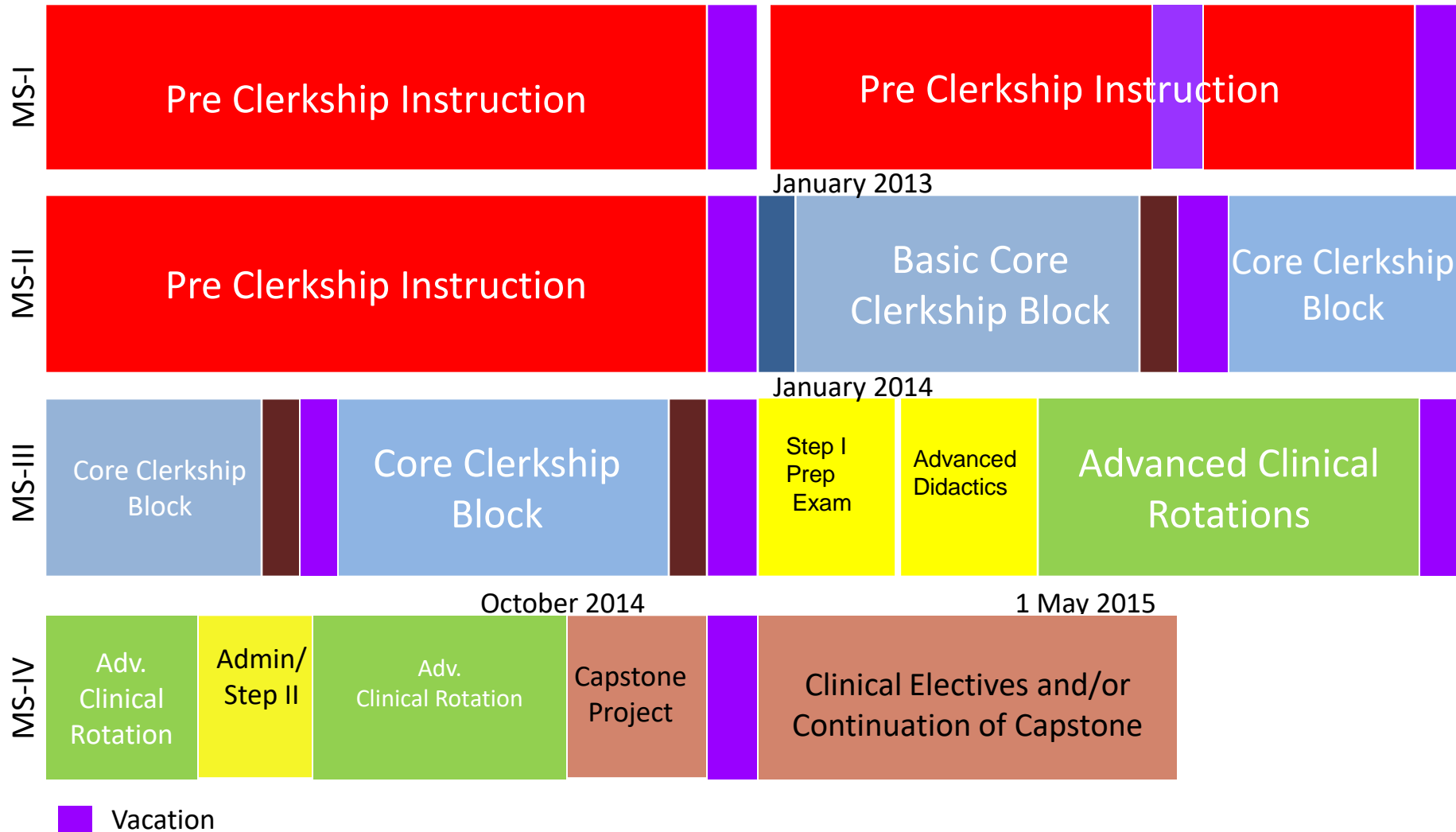
- *Flexner Report (Carnegie I) = “2 +2”*
- *Exclusively apprenticeship model*
→ *academic model*



Flexner Revisited: The Role and Value of the Basic Sciences in Medical Education

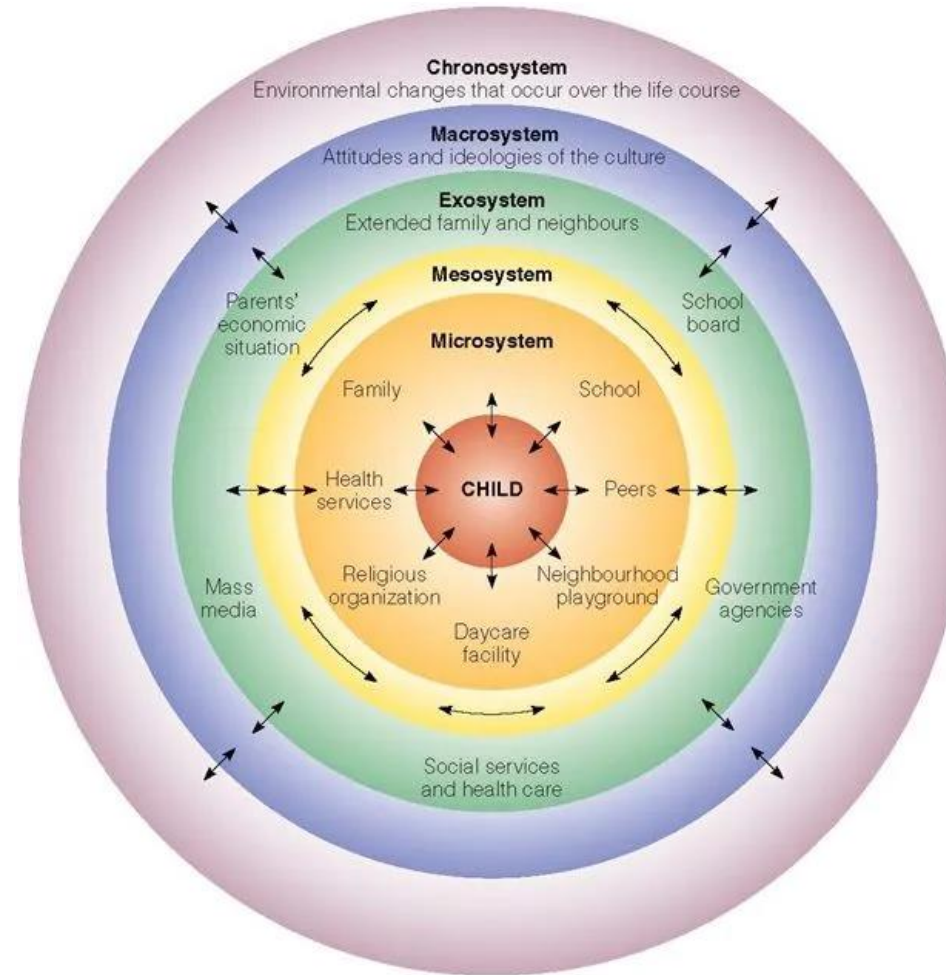
Finnerty, Chauvin, Bonaminio, Andrews, Carroll, Pangaro, *Acad Med*, 2010

Understanding → Action



Goal to be internalized: the patient's universe

The patient (child)
at the center



System levels

“Chrono”

“Macro”

“Exo”

“Meso”

“Micro”

Bronfenbrenner: the environmental framework

Guy-Evans, www.simplypsychology.org/Bronfenbrenner.html, 2020

Can understanding be formed
in the context of the classroom?

Alternatives:

- Spiral curricula
- VTCSOM's method
- Abandon Flexner's 2+2 ?



Q5. Evaluation of expertise and duty Judgment about success in JTB and application?

Evaluation – importance, “strength”, capability

the “strength” we have in mind, the purpose

- Is this resident building capability?
- Is there progress toward independence?
- Internalization of an idea of expertise and duty?

Q.6 : What is the capability we must create?



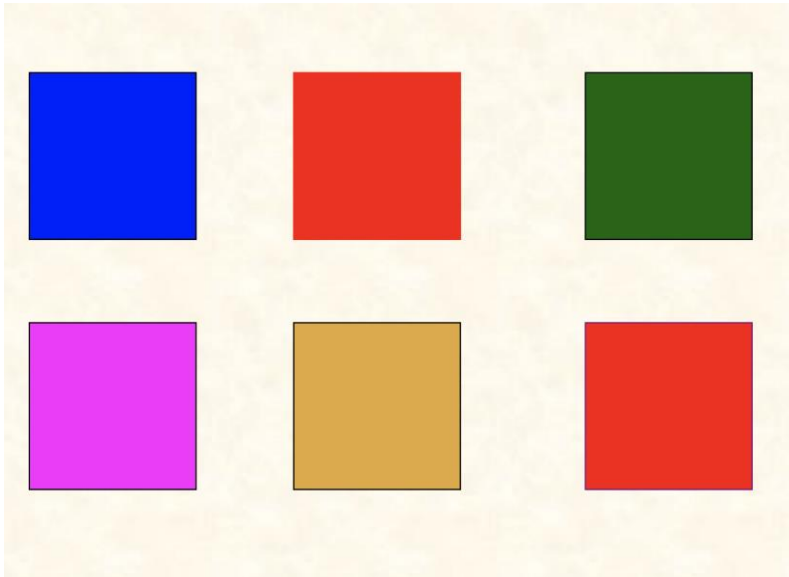
- An internalized "set point"
- A standard against which learners judge their current performance?
 - "What they did", not "who they are".
- A mental model of what expertise and duty look like
- Preclerkship = developing "JTB"
- Clinical years = moving from understanding to action

What “capability”?

- “Train” to what’s common, typical and predictable; guidelines work
 - Probably don’t need physicians for simple problems in simple patients
- “Educate” for the unpredictable, complex, rare; need to figure it out and use shared decision making.

Competence defined (analytic framework)

The habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and the community being served.



Epstein, Hundert, *JAmerMedAssoc*, 2002

Competence Defined Synthetically

**The ability to give to each
situation all that belongs to
that situation, and no more.**

Pangaro, Med Teach, 2000

Capability = thinking, reasoning, decision making

Commonality of assessment frameworks

- Observation → Reflection → Action
- Data → Information → Knowledge → Wisdom
- Reporter/Interpreter → Manager/Educator

What about ACGME Milestones?

Make the six competencies 23 sub-competencies
“understandable”

- 23 Milestones
- Five stages each
- 3 -5 behavioral anchors per stage

Internal Medicine PC milestones {needs expert judgment}

1. Gathers and synthesizes essential and accurate information to define each patient's clinical problem(s). (PC1)				
Critical Deficiencies			Ready for unsupervised practice	Aspirational
Does not collect accurate historical data	Inconsistently able to acquire accurate historical information in an organized fashion	Consistently acquires accurate and relevant histories from patients	Acquires accurate histories from patients in an efficient, prioritized, and hypothesis-driven fashion	Obtains relevant historical subtleties, including sensitive information that informs the differential diagnosis
Does not use physical exam to confirm history	Does not perform an appropriately thorough physical exam or misses key physical exam findings	Seeks and obtains data from secondary sources when needed	Performs accurate physical exams that are targeted to the patient's complaints Interpreter	Identifies subtle or unusual physical exam findings
Does not generate own database or differential diagnosis	Does not seek or is overly reliant on secondary data	Consistently performs accurate and appropriately thorough physical exams	Synthesizes data to generate a prioritized differential diagnosis and problem list	Efficiently utilizes all sources of secondary data to inform differential diagnosis
Fails to recognize patient's central clinical problems	Inconsistently recognizes patients' central clinical problem or develops limited differential diagnoses	Uses collected data to define a patient's central clinical problem(s)	Effectively uses history and physical examination skills to minimize the need for further diagnostic testing I/early M	Role models and teaches the effective use of history and physical examination skills to minimize the need for further diagnostic testing
Fails to recognize potentially life threatening problems	Observer	Reporter		R, I, M/E

Can we simplify this?

Obstetrics

Antepartum Care and Complications of Pregnancy — Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
<p>Demonstrates basic knowledge of normal obstetrical care and common medical complications seen in pregnancy</p> <p>Reporter</p>	<p>Provides complete antepartum care for women with uncomplicated pregnancies M</p> <p>Recognizes basic risk factors, symptoms, and signs of common medical complications (e.g., hypertension, diabetes, infectious disease s)</p>	<p>Manages common medical complications (e.g., hypertension, diabetes, infectious disease s)</p> <p>Manages common obstetrical complications (e.g., previous Cesarean section, abnormal fetal growth, multifetal gestation)</p> <p>Manager</p>	<p>Int, advanced M</p> <p>Demonstrates a comprehensive understanding of the varying patterns of presentation and treatment options for a variety of medical and obstetrical complications</p> <p>Recognizes atypical presentations of medical and obstetrical complications</p>	<p>Advanced M</p> <p>Manages patients with complex and atypical medical and obstetrical complications</p> <p>Applies innovative approaches to complex and atypical antepartum conditions and implements treatment plans based on emerging evidence</p> <p>M/E</p>
	<p>Effectively supervises and educates lower level residents in antepartum care</p> <p>Collaborates and provides consultation to other members of the health care team in antepartum care</p> <p>M/E</p>			

RIME-stones (Hemmer)

Frame of Reference

Performance Dimensions[EPAs]

REPORTER

- Gather a history and perform a physical exam
- Document a clinical encounter in the patient record
- Provide an oral presentation of a clinical encounter
- Collaborate as a member of an interprofessional team

INTERPRETER

- Prioritize a differential diagnosis following a clinical encounter
- Recognize a patient requiring urgent or emergent care
- Recommend* and interpret common diagnostic and screening tests

MANAGER

- Enter and discuss orders and prescriptions
- Give or receive a patient handover to transition care responsibility
- Obtain informed consent for tests and/or procedures
- Perform the general procedures of a physician

EDUCATOR

- Form clinical questions and retrieve evidence
- Identify system failures and contribute to safety and improvement

“MODERN MEDICAL CURRICULA”

- Pedagogy has changed to focus more on student-centered learning vs. faculty-centered delivery
 - more case discussions,
 - problem-based learning instead of more traditional didactic presentations.

What should be the content of these conversations?

- *Vari, Advances in Physiol Educ, 2001*

Simple evaluation of learner knowledge

- Teacher should be happy if....

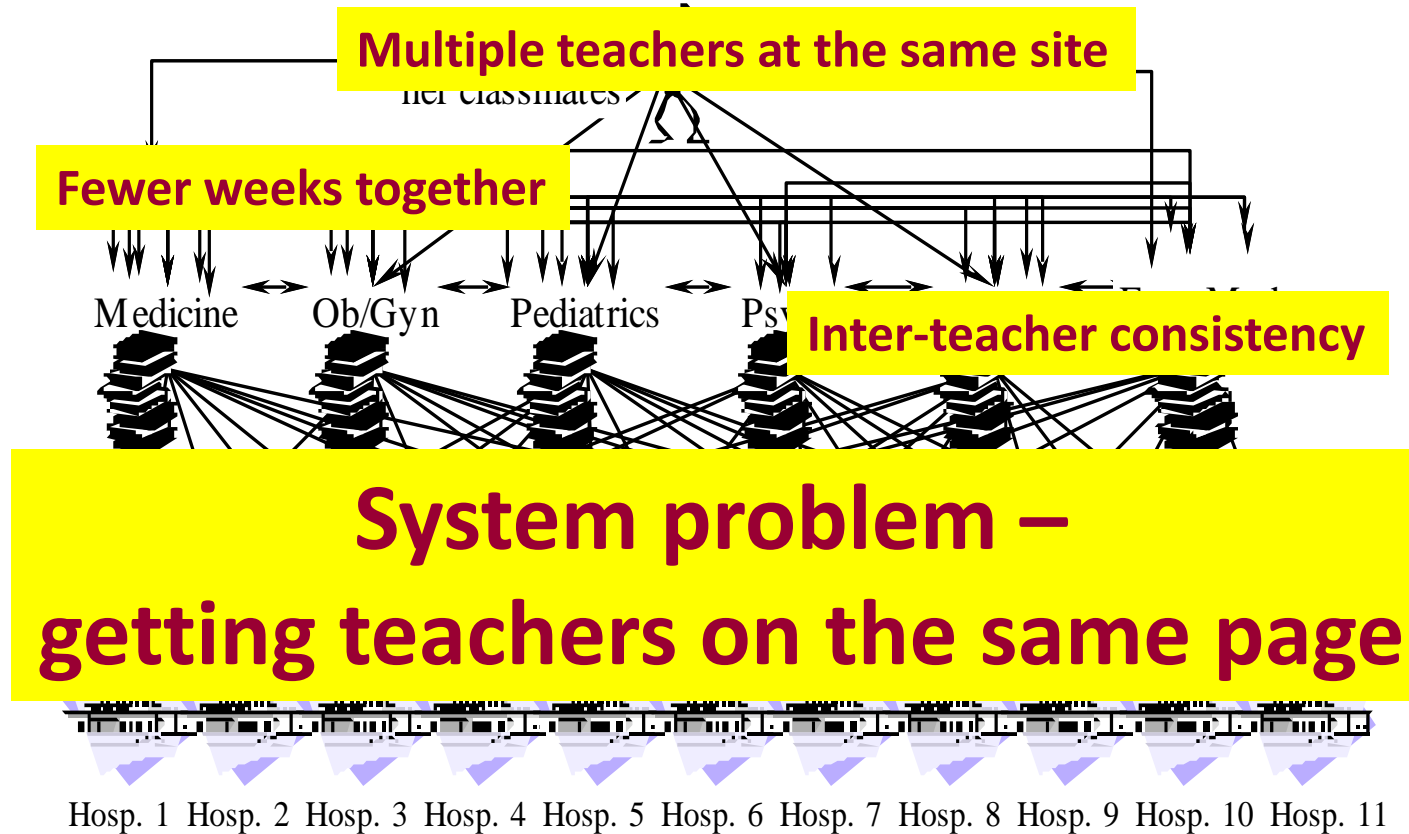
They could describe iodine metabolism and how methimazole worked.

evaluation of whether
the expectation (set point) has been internalized

If not knowing these basic mechanisms, they were not restless until they filled the gap

1. Recognizes the gap
2. Has a concept of adequate knowledge **KSA**
3. Search strategy
4. Commitment

How does the system coordinate itself?



Student's perspective, Armstrong, Harvard Macy Institute

“ a crap shoot” for students?

Evaluation = Professionalism

- Professionalism = promise
 - of expertise and duty
 - faculty promise expertise and duty in evaluation

- If a learner cannot trust the faculty's evaluations, then what does "professionalism" mean?

Evaluation = professionalism

- to society : competence (P/F)
- to students : transparency, feedback and trust of faculty
- to teachers : time and training; 'protection' (emotional and career)

Feedback to learners

- I would be happy if....

The feedback I gave a student today helped her with her next medicine attending.

Feedback to learners

If the feedback I
have a student
made things worse
with his next
attending!

I would drop dead with
embarrassment if....

Q.7: How does physiology help?



Faculty are the observers

- What is the faculty's 'set point' for expectations?
- Construct alignment across teachers

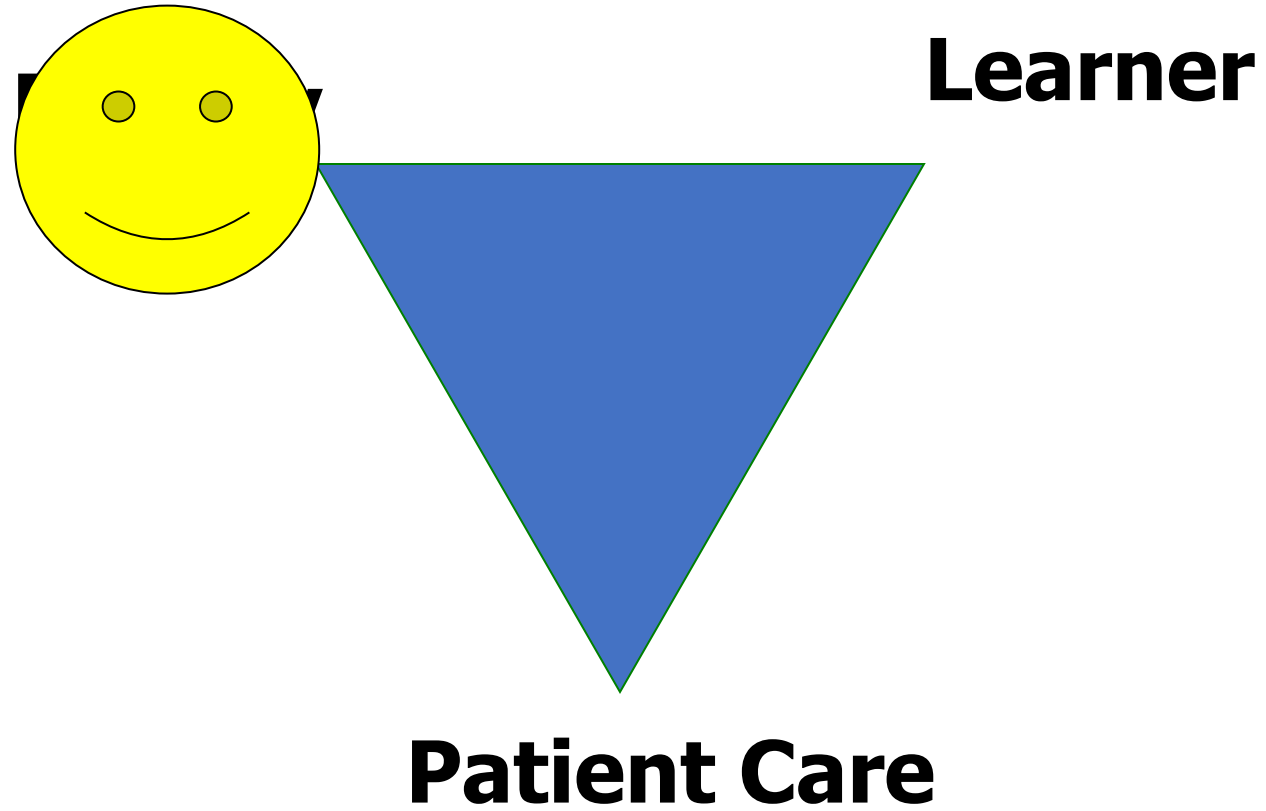
- Physiologic communication
 - Receptors
 - "processing"
 - Response = action

Re-imagining Faculty Development in Health Professions Education

- “communities of practice create longitudinal spaces where relationships are formed over time towards a common goal”.
- What is an “educator”?
 - Ex-ducere = to lead out of (dependence) into independence (readiness)
 - Communicating knowledge, explaining decisions
 - Creating capability

Belovich, et al Med Sci Educ. 2020

The goal: progressive independence



After Stanford Faculty Development Center

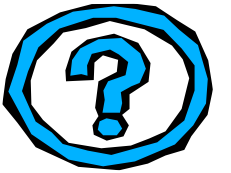
Q.9: what is physiologic communication



- Anatomy: afferent → spinal reflex → efferent

Three phases:

1. Signal received
2. Integration
3. Response



What is physiologic communication

- Chemical:– receptor → processing→ cellular change

Three phases:

1. Receptor
2. Intracellular processing
3. Cell signaling

A final plea for simplicity.

Fairness to faculty.

The rhythm is simple and always the same!

H&P.....

.....S.O.....

Reporter

Assessment..

....A.....

Interpreter

Plan.....

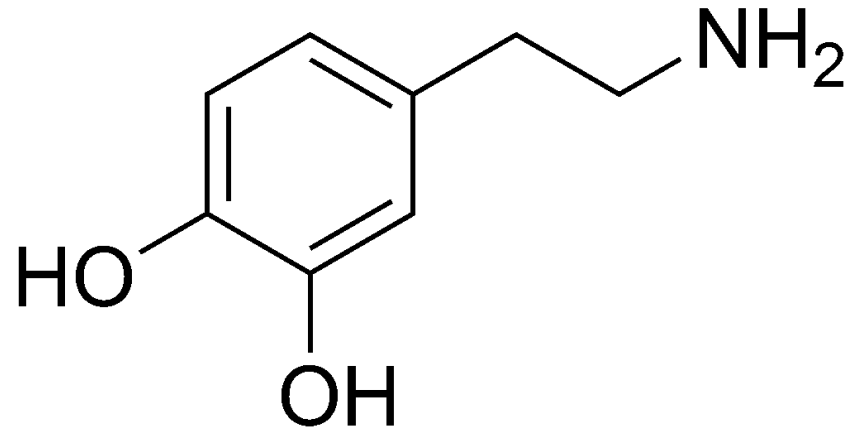
....P.....

**Manager/
Educator**

Simplicity : Communication = “Neurotransmitters”

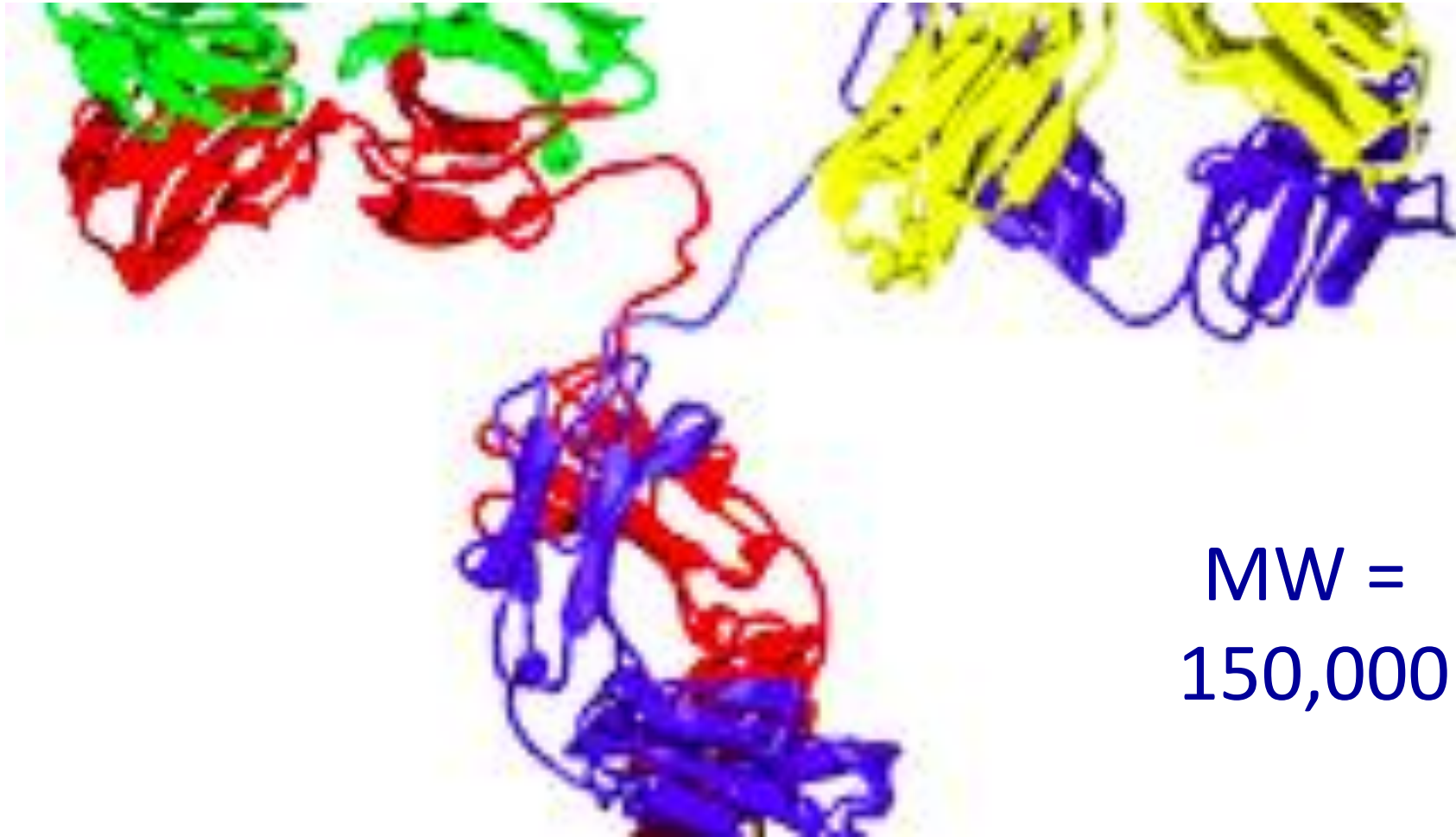


dopamine



MW =
150.

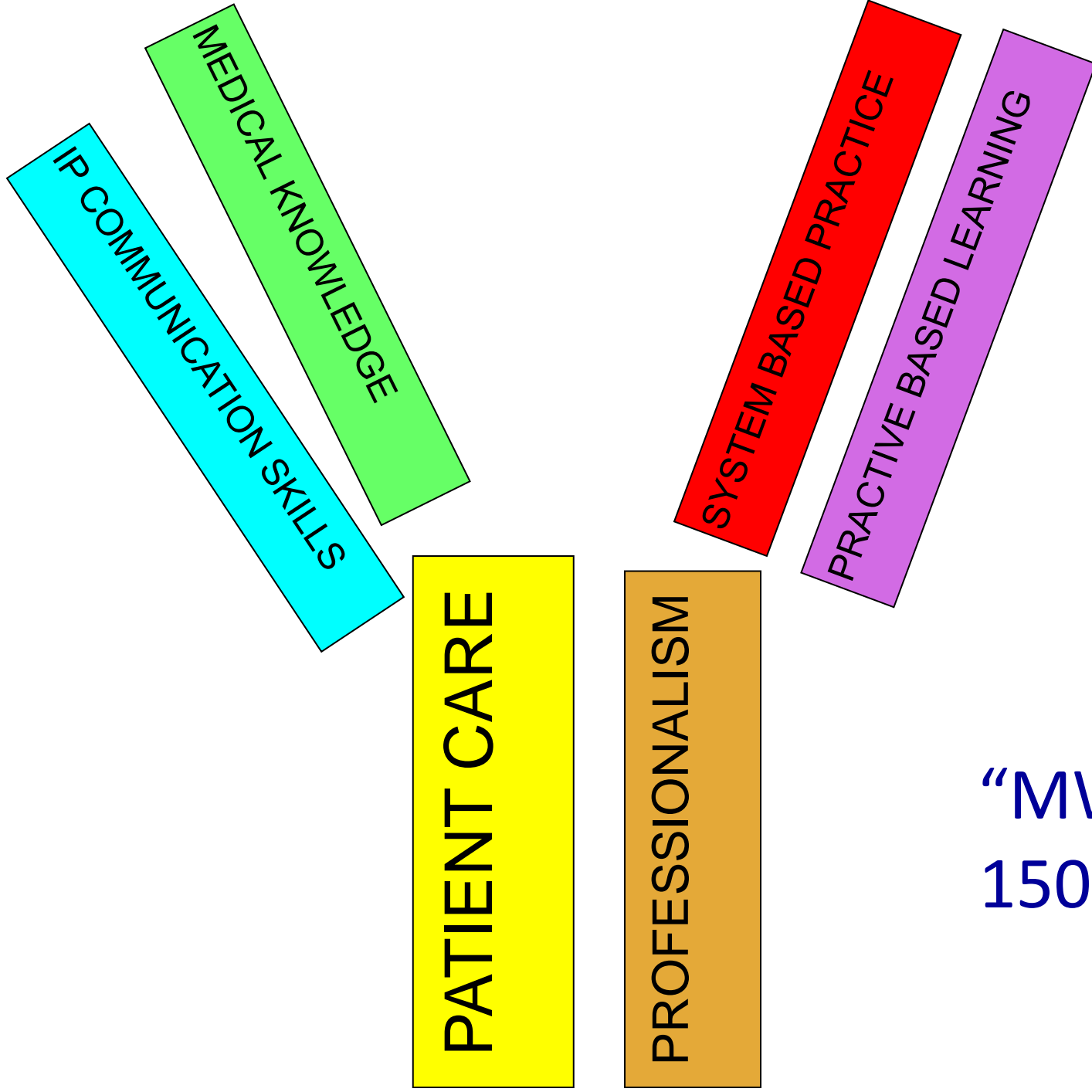
Immunoglobulin



MW =
150,000

ACGME “Competencies”

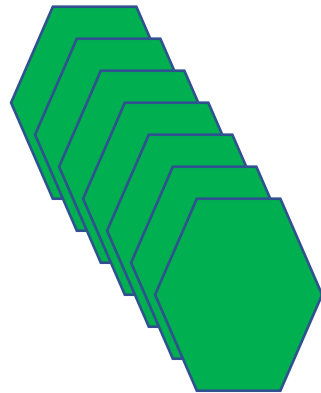
- **Medical Knowledge**
- **Interpersonal & communication skills**
- **Professionalism**
- **Patient Care**
- **Practice-based learning & Improvement**
- **System-based Practice**



“MW” =
150,000

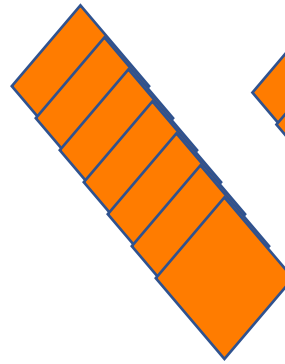
Smaller molecules to communicate ?

R



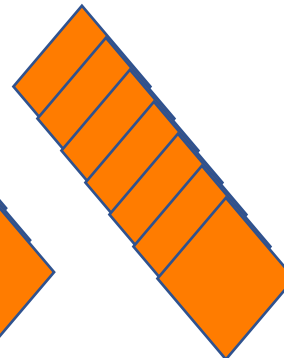
6 competencies

I

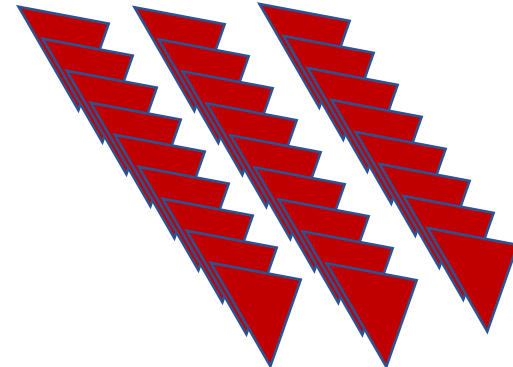


13 EPAs

M



E



**23 subcompetencies
23 milestones**

The Rhythm

REPORTER

The Details (“EPAs”)

Gather a history and perform a physical exam

Document a clinical encounter in the patient record

Provide an oral presentation of a clinical encounter

Collaborate as a member of an interprofessional team

INTERPRETER

Prioritize a differential diagnosis following a clinical encounter

Recognize a patient requiring urgent or emergent care

Recommend* and interpret common diagnostic and screening tests

MANAGER

Enter and discuss orders and prescriptions

Give or receive a patient handover to transition care responsibility

Obtain informed consent for tests and/or procedures

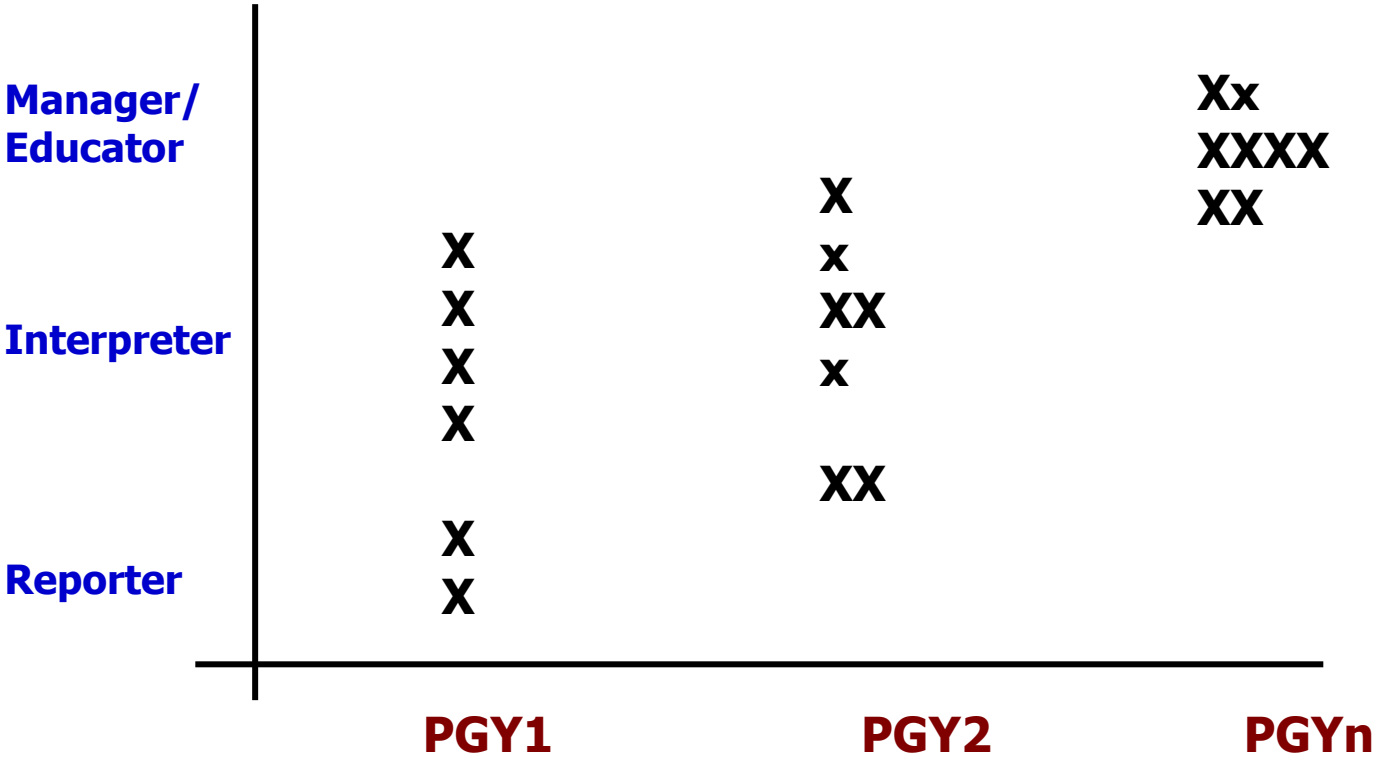
Perform the general procedures of a physician

EDUCATOR

Form clinical questions and retrieve evidence

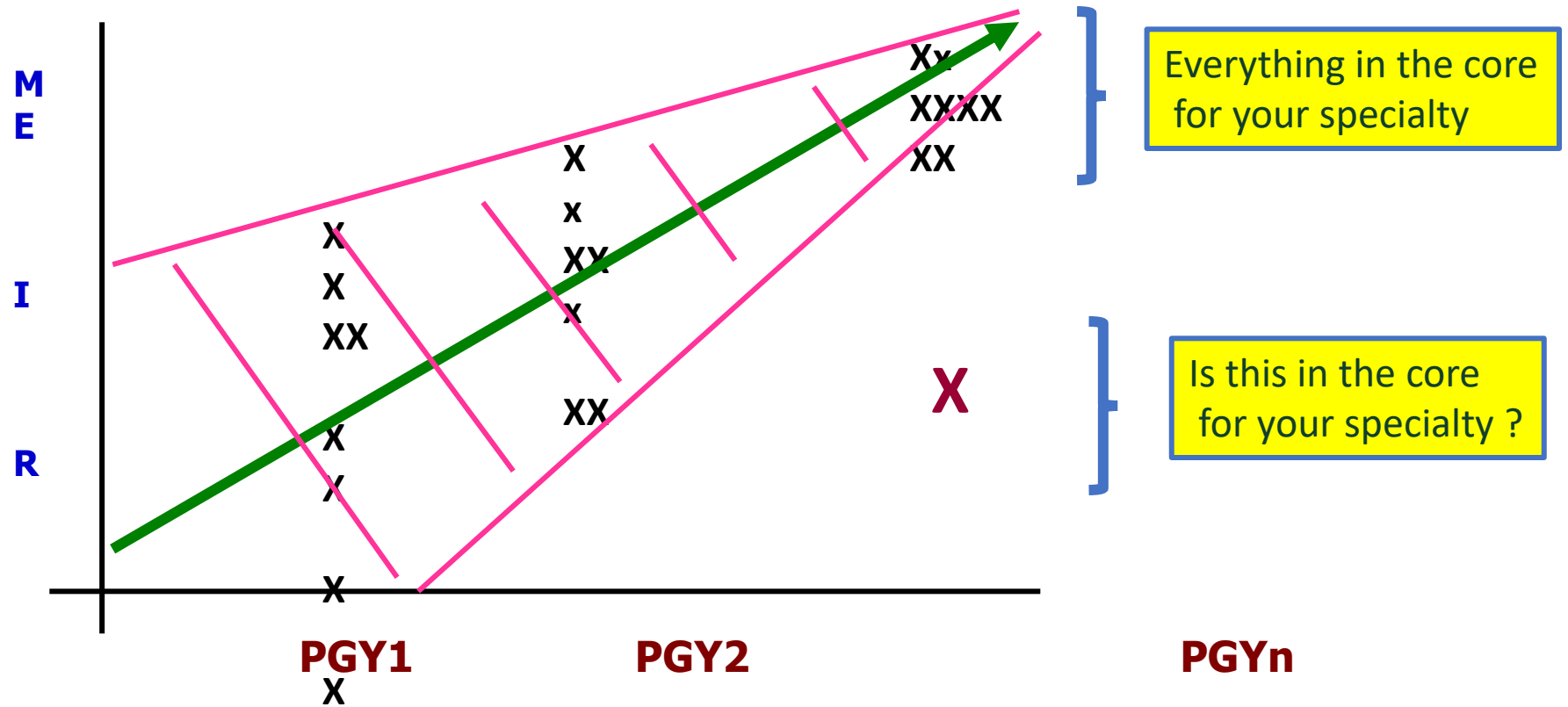
Identify system failures and contribute to safety and improvement

**A mental model, concept
for expected GME progress toward independence**



x = proficiency with a patient

Not just improving but “ready” in all core problems



The Lessons of physiology – unifying ideas

- Expect understanding of mechanisms
- Build capability
 - Internalize a physiologic set point for what expertise and duty and duty look like
- Framework
 - use the mental models for which clinicians already have “receptors”
 - ❖ The rhythm of RIME

**Embrace complexity,
act with simplicity.**

Thank you, Rick!



Thank you for the privelege

- louispingaro@aol.com
- Please write if further conversation will help
- Annotated bibliography for RIME system also posted.