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Clinical Reasoning

An Inductive Approach to Critical Thinking

Richard M. Schwartzstein, MD

Ellen and Melvin Gordon Professor of Medicine and Medical Education

Associate Chief, Division of Pulmonary and Critical Care Medicine

Director, Shapiro Institute for Education and Research

Director, Harvard Medical School Academy

Education is at the heart of patient care.



Disclosures

I have no financial disclosures relevant to the content of this presentation.



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What direction are we driving?



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Sometimes, simple signs don't help



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Case 1

- A 60 year old man presents with a complaint of shortness of breath that has gradually worsened over 2 years. Now can only walk for 50 yards at which time he stops with a sensation of “suffocating” and “urge to breathe.” His wife notes “wheezing” when this happens.



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Case 1, cont.

- PH: asthma since childhood, hypertension for 30 years, mild diabetes, 30 pack year smoker
- PE: obese. BP 160/90, HR 92, RR 16

Mild increase in AP diameter of chest. Lungs with mild decrease in air movement, I/E=1/1.5; JVP=10 cm. +S4. Abdomen benign. No edema.

You walk him in corridor: after 50 yards, patient is wheezing.

Treatment: bronchodilators – yes/no



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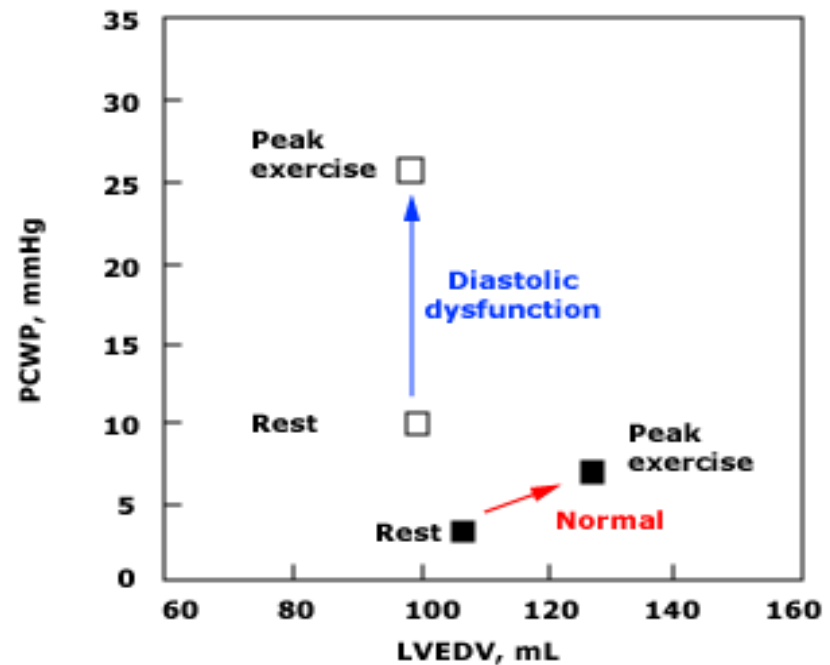


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Diastolic Dysfunction

- 1/3 of cases of CHF are due primarily to diastolic dysfunction
- Failure of LV to accommodate increased volume load
- Symptoms often isolated to exercise



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Today's Objectives: At the end of this session, you should be able to...

- Define the elements of critical thinking and the dual processing model used to describe how we approach problems
- Describe the role of cognitive bias in contributing to clinical errors
- Distinguish hypothetical deductive reasoning, commonly used in clinical practice, from inductive reasoning, which may be less subject to cognitive biases
- Describe strategies for developing critical thinking in our learners



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What is critical thinking?



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An Experiment

Take out a piece of paper....



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WRITE DOWN YOUR ANSWER



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The Limits of Patterns



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What is the diagnosis?



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Neural Activation of Pattern Recognition

Melo M, et al., PLoS ONE 6(12):e28752, 2011



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Students' Experience of Medical School



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Focus of Education

Education in universities in the future “will be more about how to process and use information and less about imparting it. ...in a world where the entire Library of Congress will soon be accessible on a mobile device...factual mastery will become less and less important.”

Larry Summers, NY Times, Jan 22, 2012



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Thinking!



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Retention and Use of Knowledge

- Long term memory develops in three phases
 - Information presentation
 - Information processing
 - Information integration
- How do you learn?
 - Do you look for frameworks for the knowledge to be learned?
 - Do you build on prior learning?



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How we think...Dual Processing

- Conscious thought
- Unconscious thought
 - Cognitive Biases



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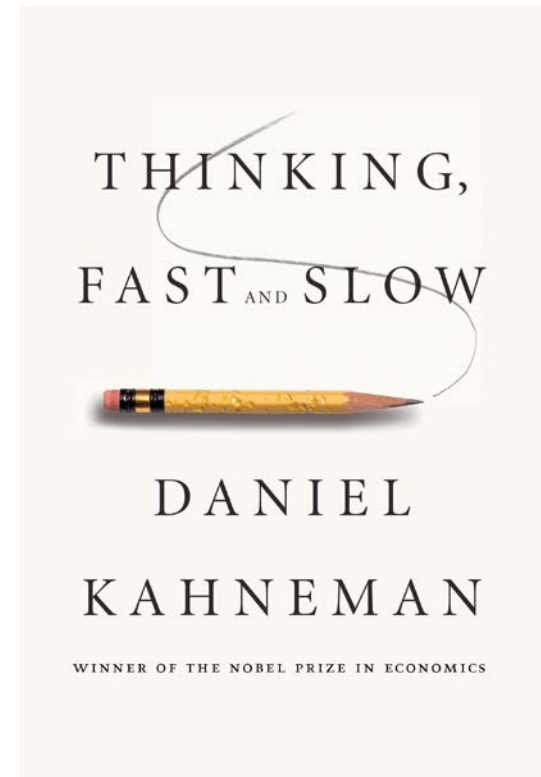
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Judgment Under Uncertainty

Tversky and Kahneman, Science, 1974

“...people rely on a limited number of heuristic principles which reduce the number of complex tasks of assessing probabilities...to simpler judgmental operations” which can “lead to severe and systemic errors.”



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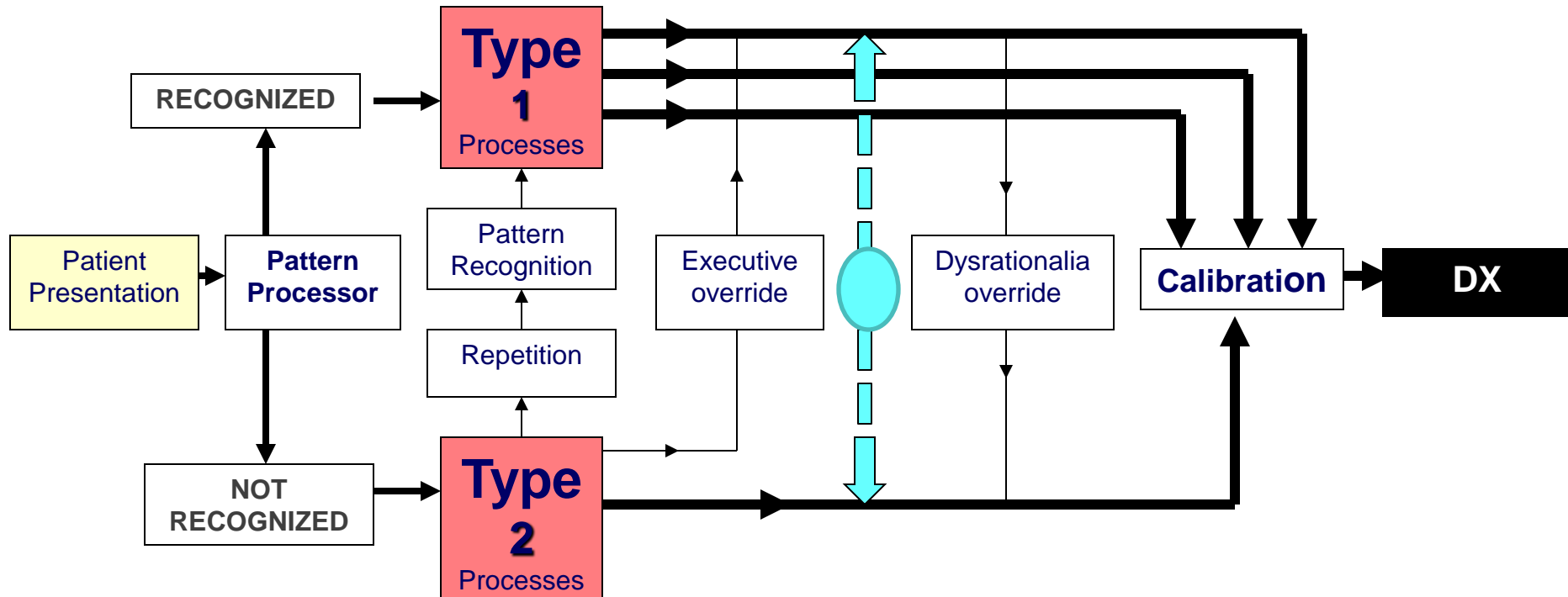
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Dual Processing

Courtesy of P. Croskerry, MD, Millennium Conf 2011

NEJM 368;26:2445, 2013



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Inductive vs. deductive reasoning

- Most doctors learn the hypothetico-deductive approach to patient care -- clinical reasoning
 - With a few “facts” create a differential dx
 - State what you know about those diagnoses and see how well the data fit.
- Inductive approach (taught to engineers) – critical thinking
 - Create “basic” or mechanistic hypotheses before creating ddx



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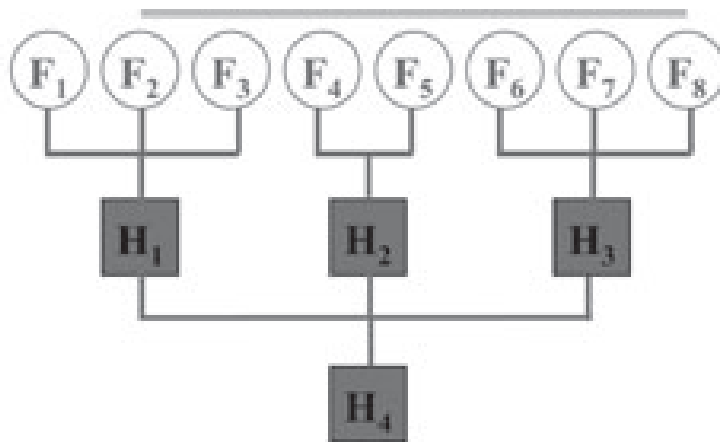
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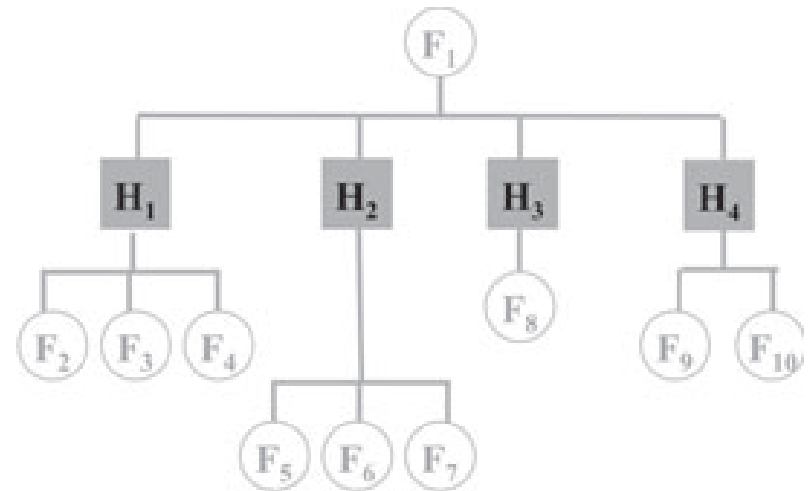
Thinking Approaches

Modified from Pottier et al. Med Ed 2010

Inductive Reasoning



Deductive Reasoning



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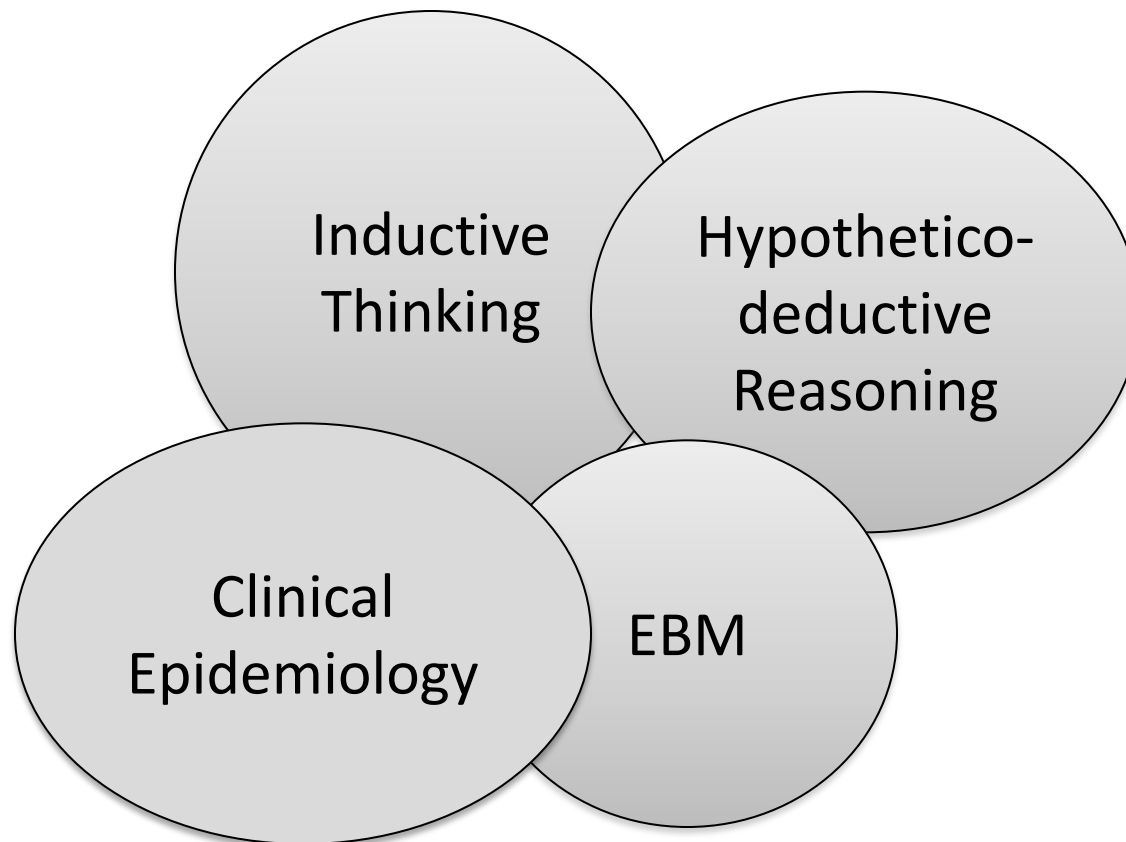
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Clinical Reasoning: Overlapping Concepts



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A phone call at night...

- You are covering the ICUs at night. You receive a call from a resident:
 - “Dr. S., my patient, who has a hx of cirrhosis and CRF and has been on a ventilator for two weeks following vascular surgery, has had a rise in his PaCO₂ from 40 to 70 mm Hg in the past 3-4 hours, without any changes in the ventilator. CXR is unchanged. I think he had a pulmonary embolism. I want to get a CTA.”
 - Your answer?



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Your Answer

- A) Sure, go ahead and call me with the results.
- B) Get an echocardiogram instead.
- C) Tell me why you think it is a PE?
- D) What is going on with the oxygenation?
- E) Why are you calling me?



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Resident's Thinking

- Patient is having a respiratory problem.
- Post-op patients are at risk of DVT and pulmonary embolism.
- PE can cause PaCO₂ to rise.

You are the attending. How do you respond?



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Get the resident to “work the problem”

- Go the bedside with the resident.
- What do we know about CO₂ elimination?
 - $VA \propto VCO_2/PaCO_2$
- Questions: did alveolar ventilation change? Did CO₂ production change?
- Patient on pressure control ventilation; getting V_T of 175-225 ml - Has this changed? What does this mean?



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Asking Questions

- Why?
- How?
- Tell me how you think about this problem?
- What do you know about X?
- Avoid questions that have one word answers; quiz show questions
- “You know more than you think!”



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Back to the case...

Resident still insisting that the problem is pulmonary embolism despite:

- No significant change in PaO₂ or BP
- Bilateral leg amputations



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Knowledge and Cognitive Biases

- *Cognitive bias and cognitive dispositions to respond*
- *Metacognition: think about how you are thinking*
- **Availability bias** - probability assigned based on ease of recall of specific examples
- **Confirmation bias** - selectively accepting or ignoring data
- **Anchoring bias** - defend your position



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Achieving Quality in Clinical Decision Making: Cognitive Strategies and Detection of Bias

Pat Croskerry, MD, PhD

TABLE 2. Strategies in Decision Making

Pattern recognition
 Rule out worst-case scenario (ROWS)
 Exhaustive method
 Hypothetico-deductive method
 Heuristics
 Cognitive disposition to respond (CDR)

Acad Emerg Med
 2002;9:1184-1204

TABLE 3. Failed Heuristics, Biases, and Cognitive Dispositions to Respond

Aggregate bias	Confirmation bias	Multiple alternatives bias	Posterior probability error	Sutton's slip
Anchoring	Diagnosis momentum	Omission bias	Premature closure	Triage-cueing
Ascertainment bias	Fundamental attribution error	Order effects	Psych-out error	Unpacking principle
Availability and non-availability	Gambler's fallacy	Outcome bias	Representativeness restraint	Vertical line failure
Base-rate neglect	Gender bias	Overconfidence bias	Search satisfying	Visceral bias
Commission bias	Hindsight bias	Playing the odds		Yin-yang out
				Zebra retreat



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Back to the case...

- Patient switched to volume ventilation
 - $V_T = 400$ ml
 - $P_{plat} = 45$ cm H_2O
 - $PaCO_2 = 70$ mm Hg; down from 73
- What do we know?
 - Compliance very low (lung or chest wall?)
 - V_E increased, but $PaCO_2$ did not change – somehow, dead space must be greater



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Skills - *Formulation of hypotheses*

- *How does the learner pose questions*
 - Going from the particular to the general (induction): “if they have X (PaCO₂ still high despite increased VT), what is it telling me?”
 - Are they testable? “I predict Y (reduced PaCO₂) will happen (if I reduce airway pressure by draining fluid from the abdomen).”
 - Revising with new data
- *Identifying the key issues*



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Back to the case...

- Further examination of the patient
 - Distended firm abdomen
 - **Hypothesis mechanism**: increased abd pressure → decreased chest wall compliance → high Ppl and Paw → increased Palv → deadspace (Zone 1 Lung)
- Check bladder pressure → 30 cm H₂O.
- **Hypothesis Rx**: paracentesis will reduce Pabd → ↑ chest wall compliance → reduce airway pressure → reduce V_D → lower PaCO₂.

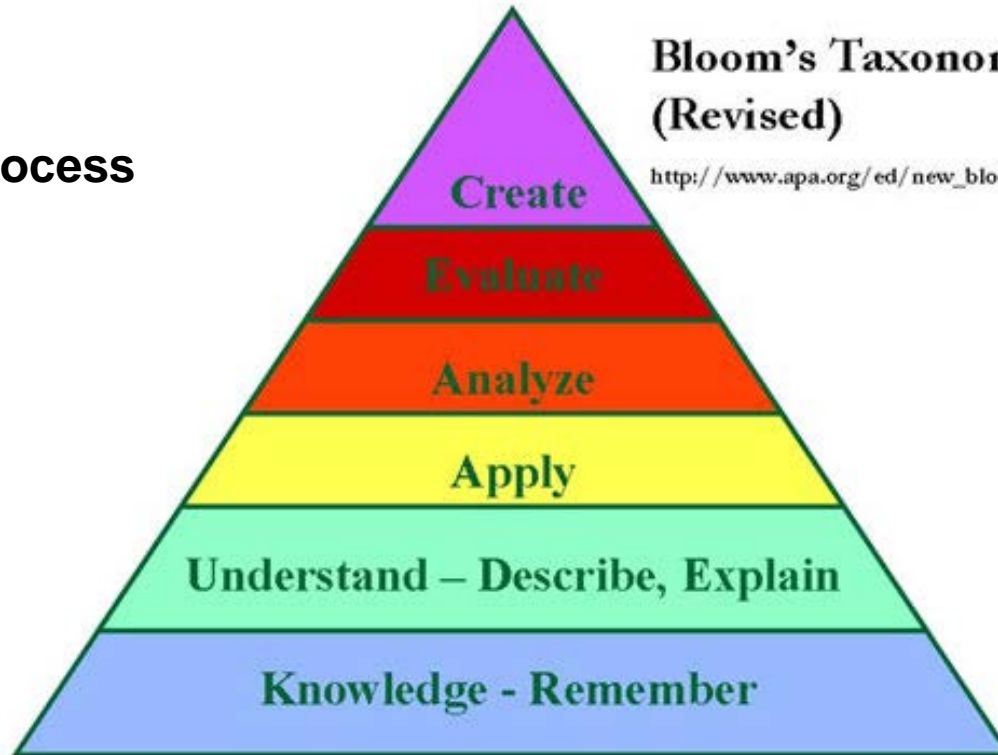


Expertise and Creativity

**Bloom's Taxonomy
(Revised)**

http://www.apa.org/ed/new_blooms.html

**Cognitive process
Dimension**



Based on an APA adaptation of Anderson, L.W. & Krathwohl, D.R. (Eds.) (2001)



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Routine vs. Adaptive Expert

Mylopoulos M, Regehr G. Med Ed 2007

- **Routine Expert**

- Novel problem → adapt problem to the solution with which they are comfortable
- Characterized by speed, accuracy, automaticity

- **Adaptive Expert**

- Use a new problem as a point of departure for exploration; expand knowledge and understanding
- Characterized by innovation, creativity



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How Do You Think about “Physical Diagnosis”

- Distinction between “physical exam” and “physical diagnosis”
- Inductive vs. hypothetico-deductive model of teaching and learning
 - Clues vs patterns
 - Mechanisms vs. diagnoses



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Bedside Evaluation

Reinforce fundamental concepts as manifested in physical exam (anatomy, physiol, biochem)

- JVP
- Signs of O₂ delivery
- Cardiac Gallops
- Respiratory patterns

What does the sign “mean” rather than what dx is it

- Wheeze = turbulent flow, narrowed airway rather than “asthma”
- Edema = increased total body volume, increased venous pressure, or decreased oncotic pressure rather than “CHF”



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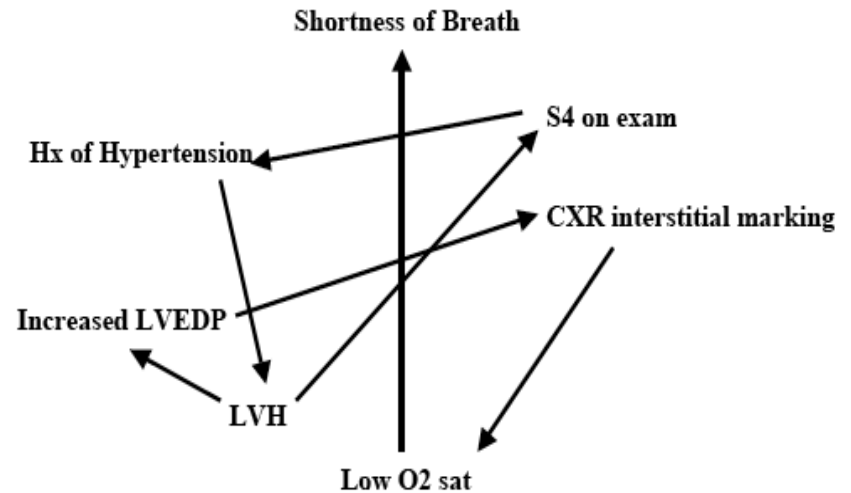
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Concept Maps

Guerrero, Acad Med 2001;76:385

- Graphic devices to represent relationships between multiple concepts
- Reinforce mechanistic thinking
- Make links explicit



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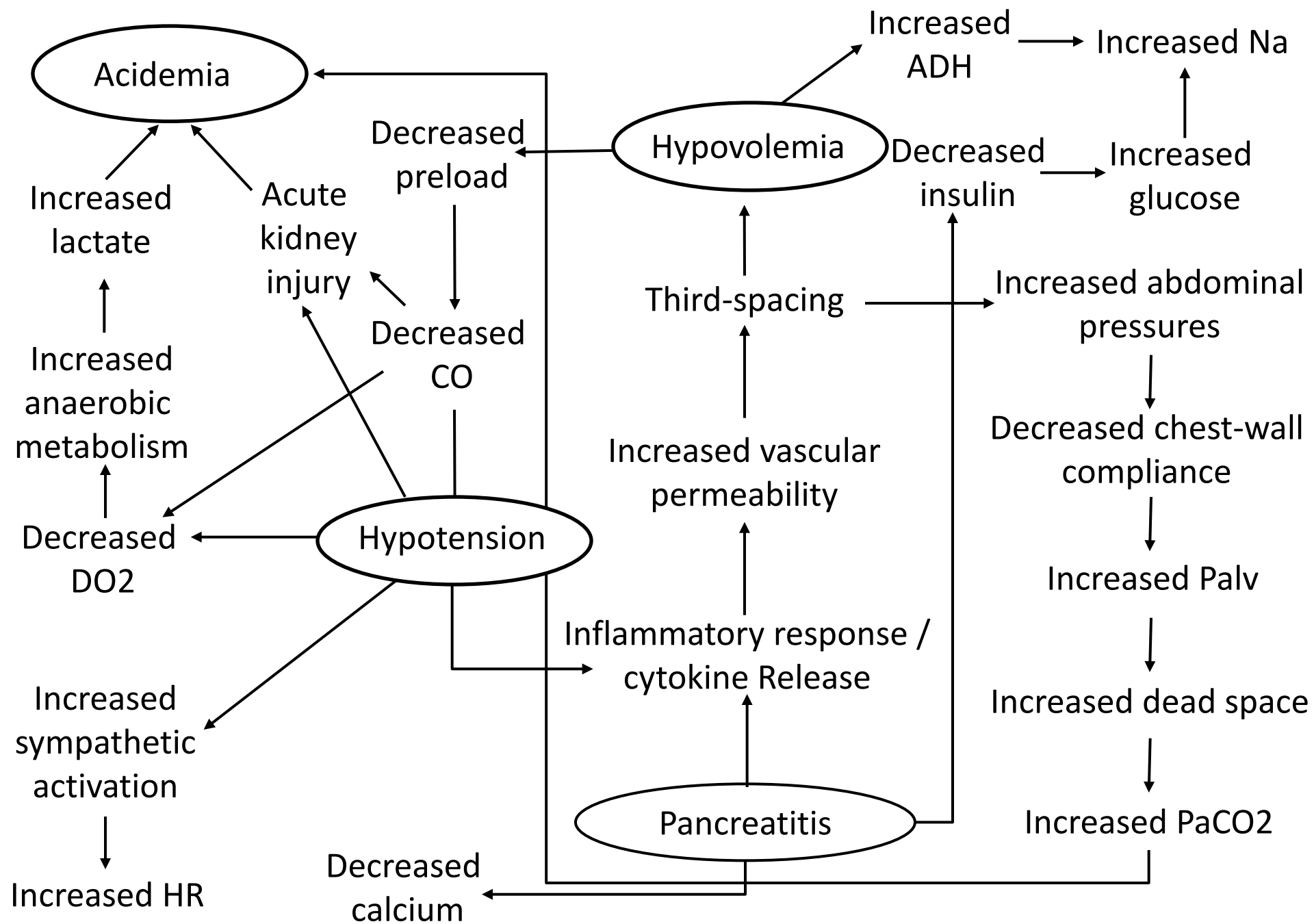
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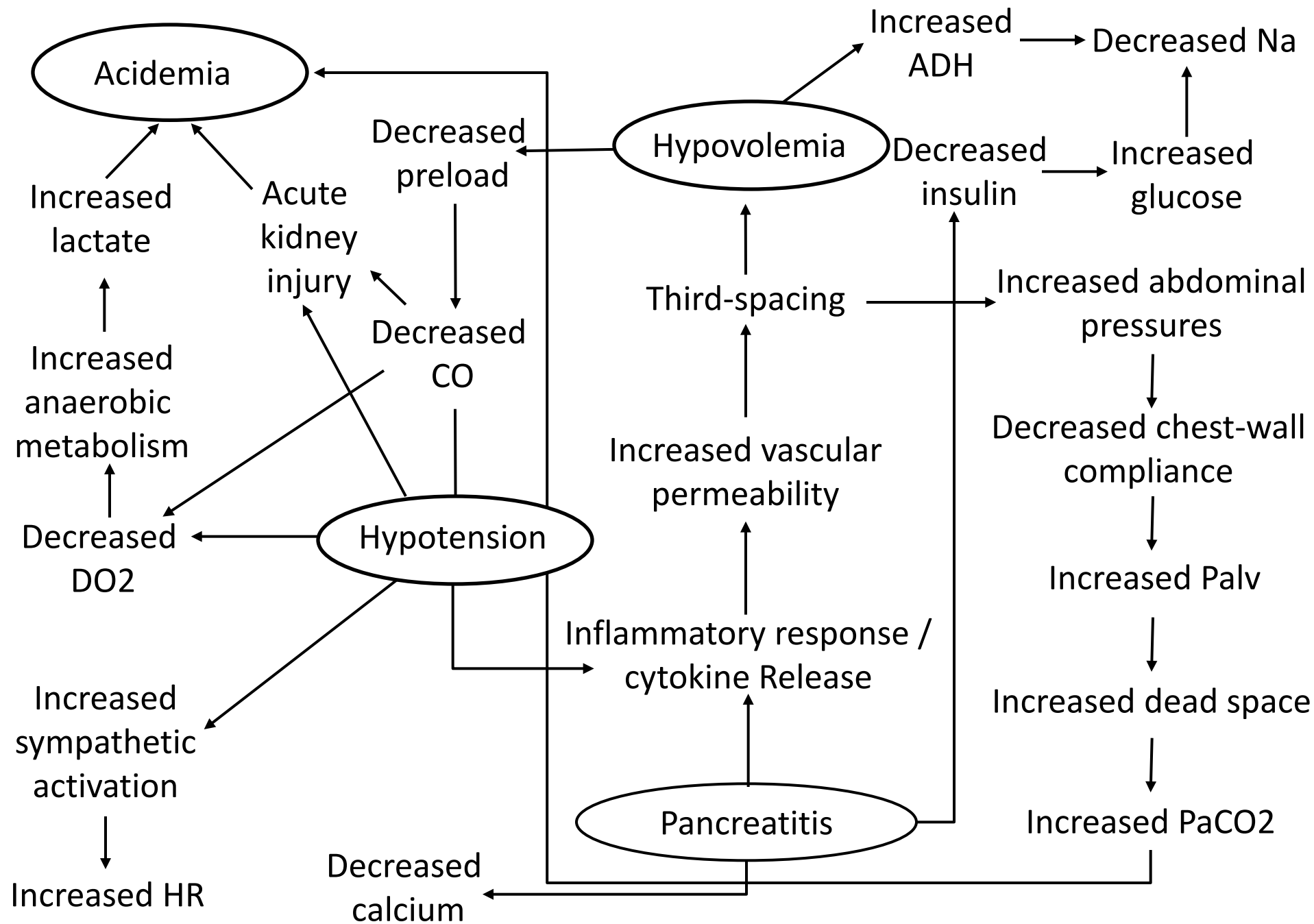
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One last Case...

- 45 year old man: hx of hypertension presents to the ED with fatigue, URI symptoms (sore throat, low grade fever, mild SOB). Traveled to Las Vegas last week
 - In ED: Exam normal except for dry mucus membranes and BP 85 systolic. Given 2L of fluid.
 - Labs on presentation: WBC 6K, Hct 35, BUN 46/Creat 1.1
 - Started on antibiotics and vaopressors.
 - Diagnosis? 1) sepsis, 2) MI, 3) PE, 4) GI bleed



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Last case (cont)

- Patient admitted to MICU with dx of sepsis
- Residents start pressors and fluids
- Present to attending....Hct 35 in young, healthy man with evidence of volume depletion? URI as cause of sepsis?....NG tube placed....blood in stomach; massive GI bleed



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Summary

- Clinical Reasoning likely a continuum between type 1 and type 2 thinking
- For type 2 thinking to be “faster”, you need to practice it, even when it is not absolutely needed
- Inductive reasoning may provide broader DDX and less susceptibility to cognitive biases
- “Concept maps” may help you and your learners engage in analytical approaches to patient problems



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