



# Critical Thinking and Clinical Reasoning *Is Artificial Intelligence Intelligent?*

***Richard M. Schwartzstein, MD***

Executive Director, Shapiro Institute for Education and Research

Chief, Division of Pulmonary, Critical Care and Sleep Medicine

Vice President for Education

Beth Israel Deaconess Medical Center

Ellen and Melvin Gordon Distinguished Professor of Medicine and Medical Education

Harvard Medical School

*Education is at the heart of patient care.* ——— Shapiro Institute



# Disclosures

I have no financial conflicts or disclosures.



# Goals Today

- Describe the elements of critical thinking necessary for medicine
- Characterize the type of teaching necessary to support and develop critical thinking skills
- Distinguish knowledge from intelligence
- Describe the limits of artificial intelligence for most difficult parts of clinical reasoning



# 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.



# 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.

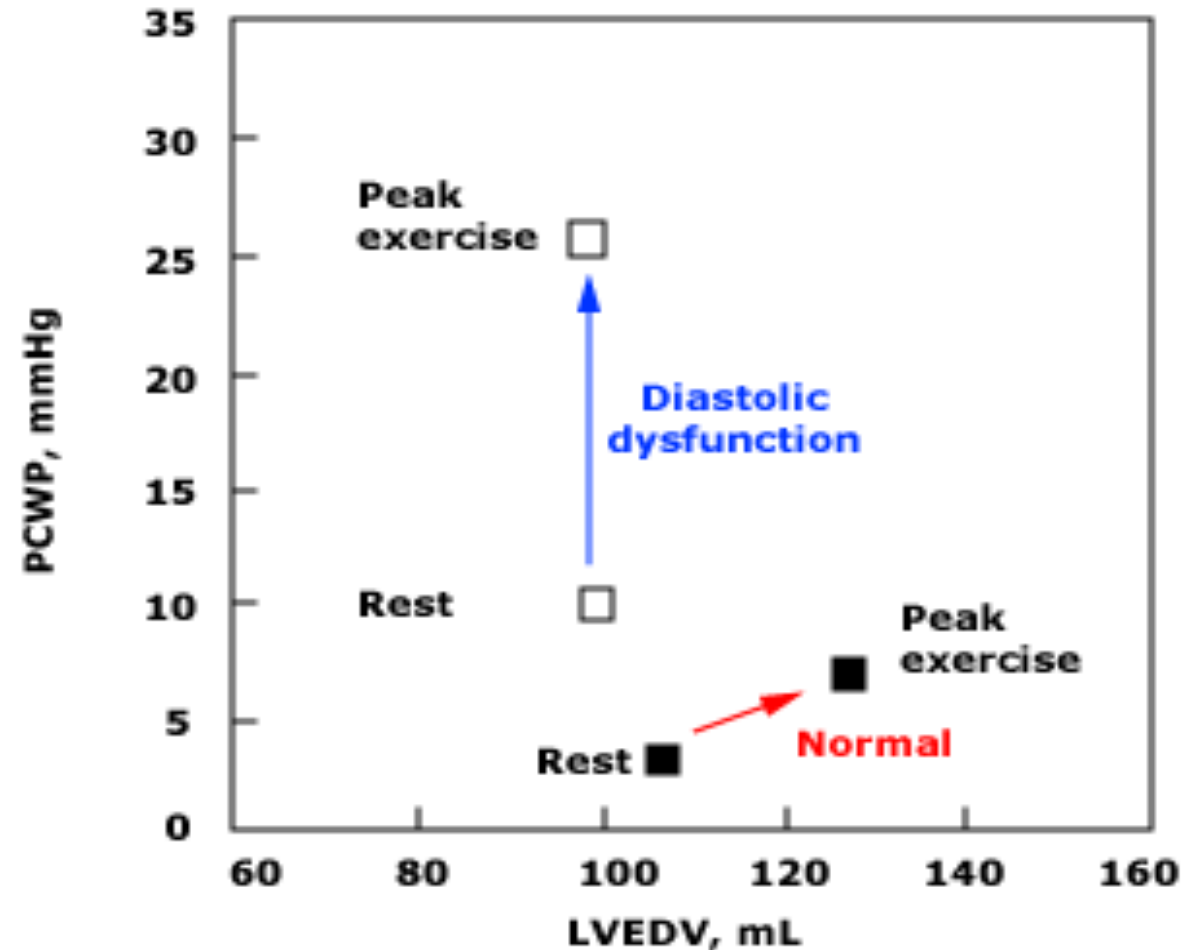
What is your diagnosis?

# ChatGPT

- ***Based on the patient's history, physical examination, and symptoms, the most likely diagnosis is chronic obstructive pulmonary disease (COPD) with possible exacerbation.***  
The patient's long-term history of smoking, asthma, and gradual onset of shortness of breath over 2 years, as well as his wheezing and decreased air movement on lung examination, suggest COPD. The sensation of "suffocating" and "urge to breathe" could be due to hypoxia and hypercapnia, which are common in patients with COPD. The mild increase in the AP diameter of the chest could also be due to hyperinflation of the lungs, which is a characteristic finding in COPD. The patient's obesity, hypertension, and mild diabetes may be comorbidities that can worsen his COPD. The S4 heart sound and JVP elevation suggest possible right-sided heart failure due to pulmonary hypertension, which can occur in severe COPD. Further testing, such as pulmonary function tests and imaging, may be necessary to confirm the diagnosis and assess the severity of the disease.
- **Wrong answer!! And wrong reasoning!!**

# 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

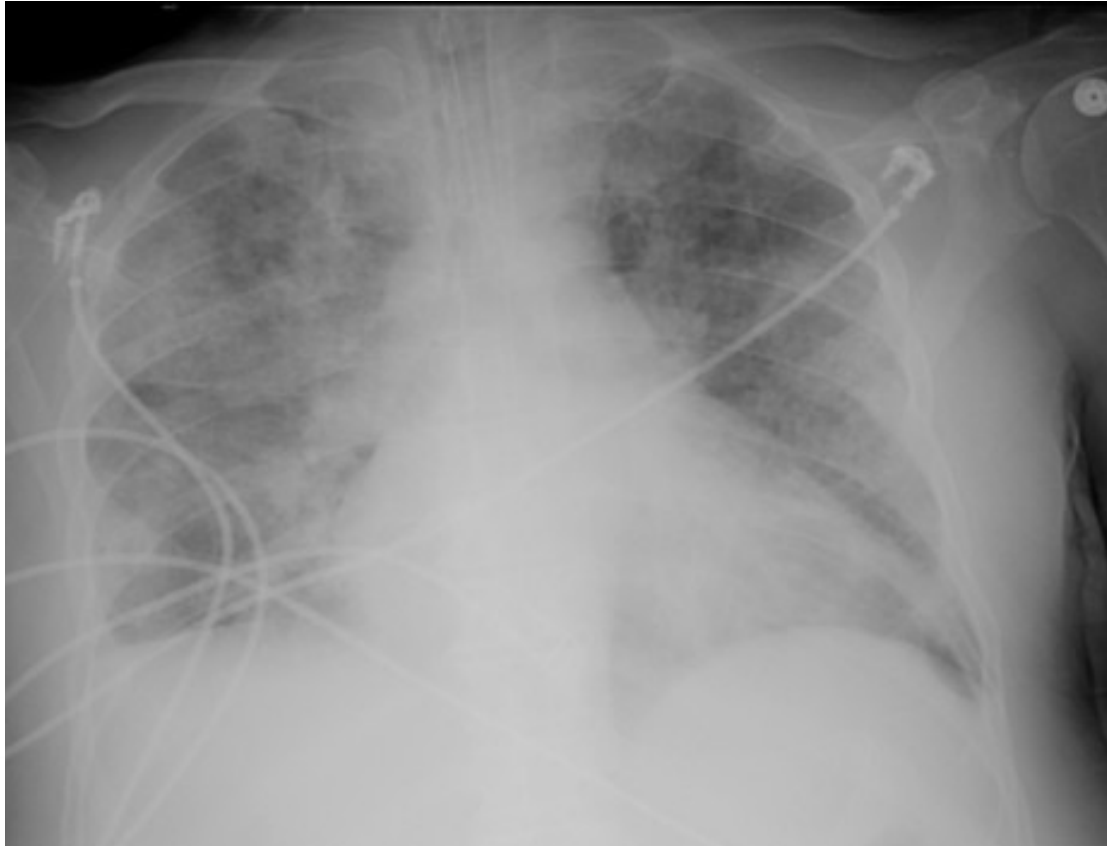


# What is critical thinking? Work the problem!



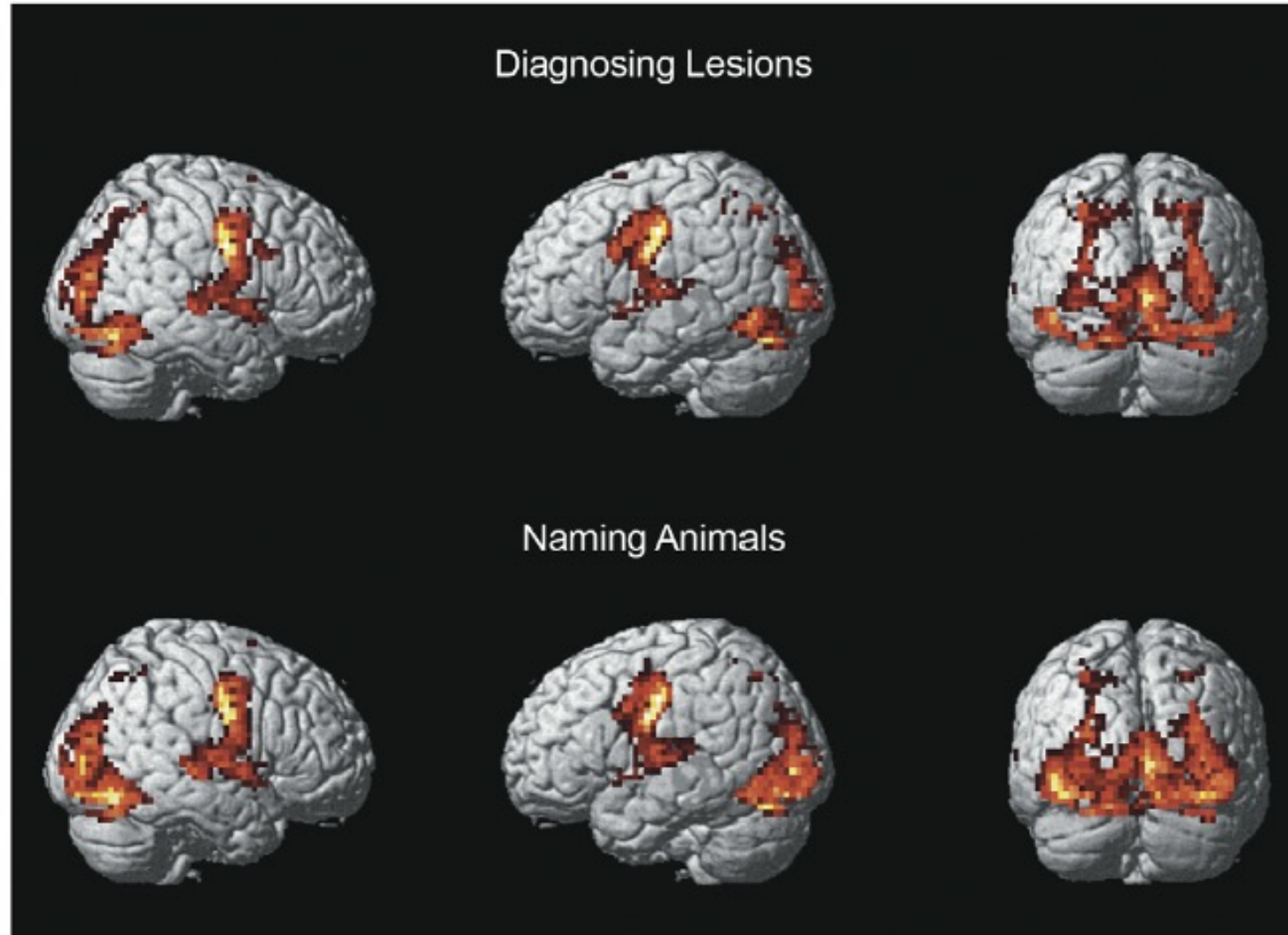


# What is the diagnosis?



# Neural Activation of Pattern Recognition

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



# Focus of Education Has Been (or should have been) Changing for Years Already!

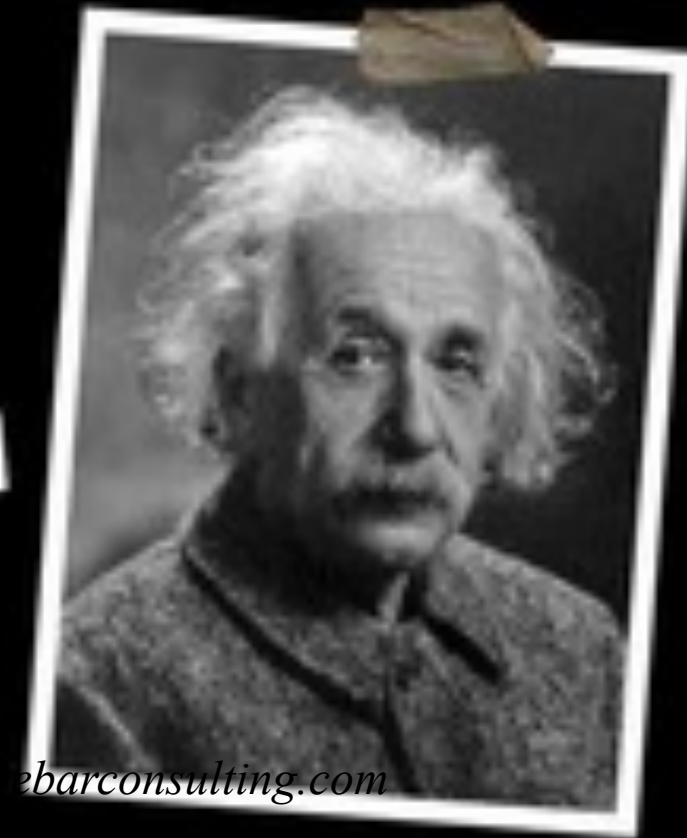
Education in universities in the future “will be more about how to process and use information and less about imparting it. ...in a world where the entire Library of Congress will soon be accessible on a mobile device...factual mastery will become less and less important.”

Larry Summers, NY Times, Jan 22, 2012



# Thinking!

**"Education is not  
the learning of  
facts, but the  
training of the mind  
to think."  
-Albert Einstein**

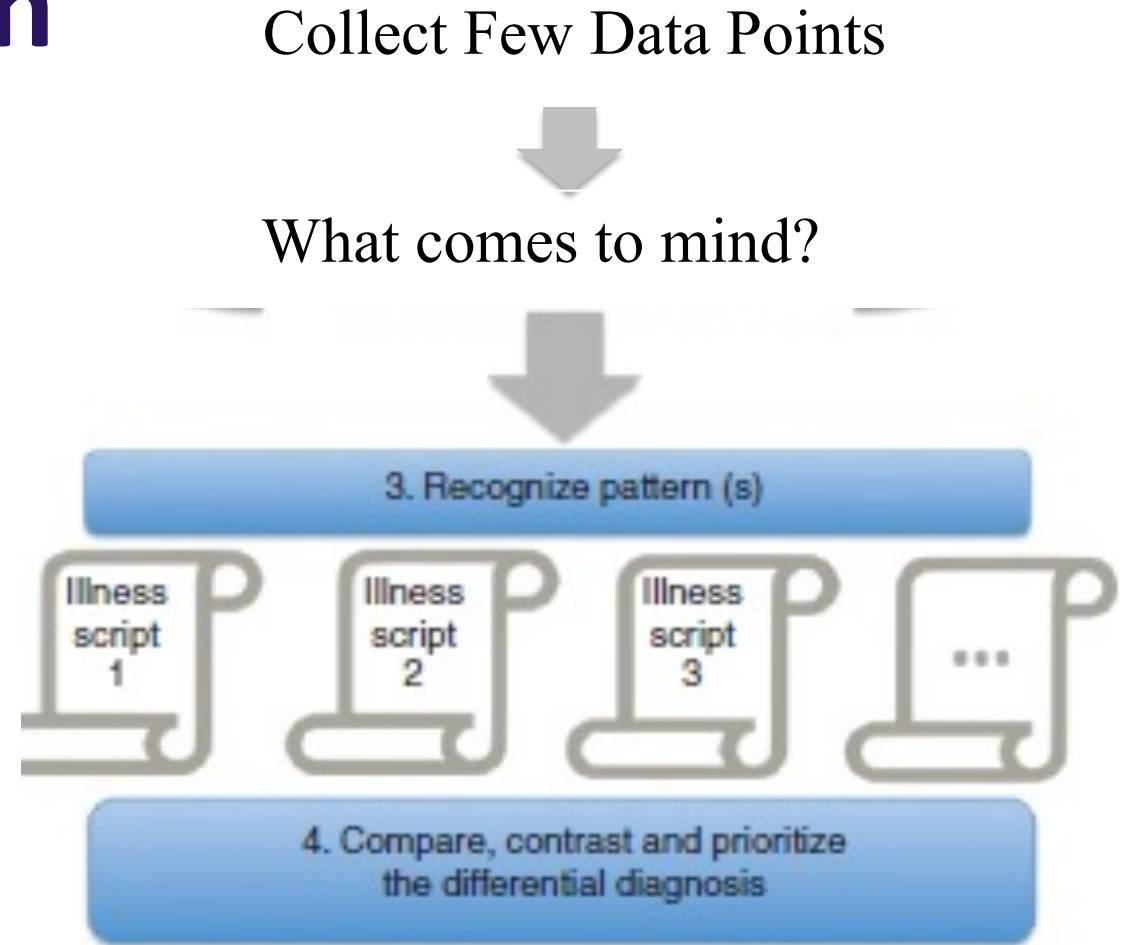


# Conventional Approach to Clinical Reasoning

*Illness Scripts:* An illness script is an organized mental summary of a provider's knowledge of a disease. Usually as short as a 3x5 pocket card although some would postulate it could be as long as a book chapter.

Typically constitutes a “pattern”:

- Acute vs chronic
- Few pieces of classic hx and PE
- Possibly a key lab/radiograph

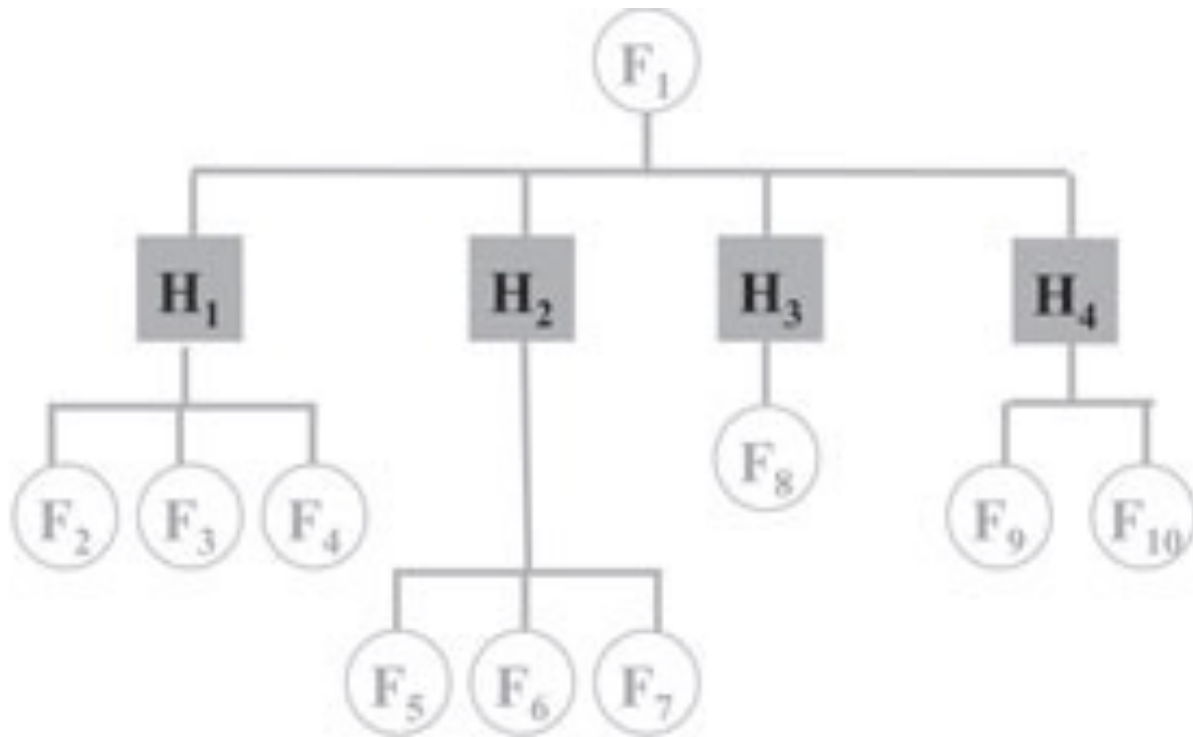


*Thammasitboon et al.*  
*Diagnosis 2018;5:197-203*

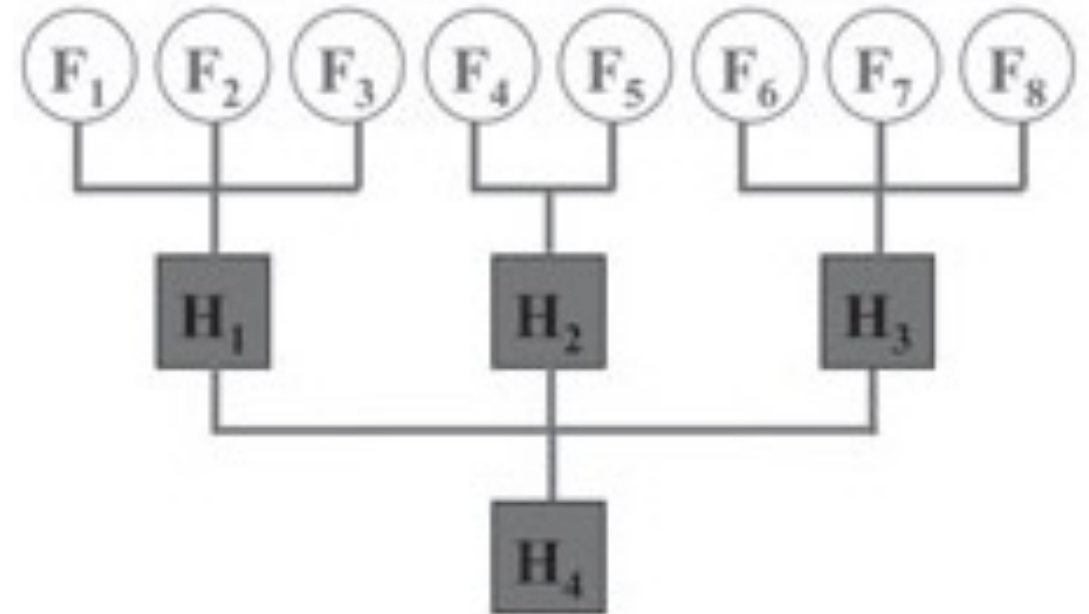
# Contrasting Thinking Approaches

*Modified from Pottier et al. Med Ed 2010*

## Deductive Reasoning



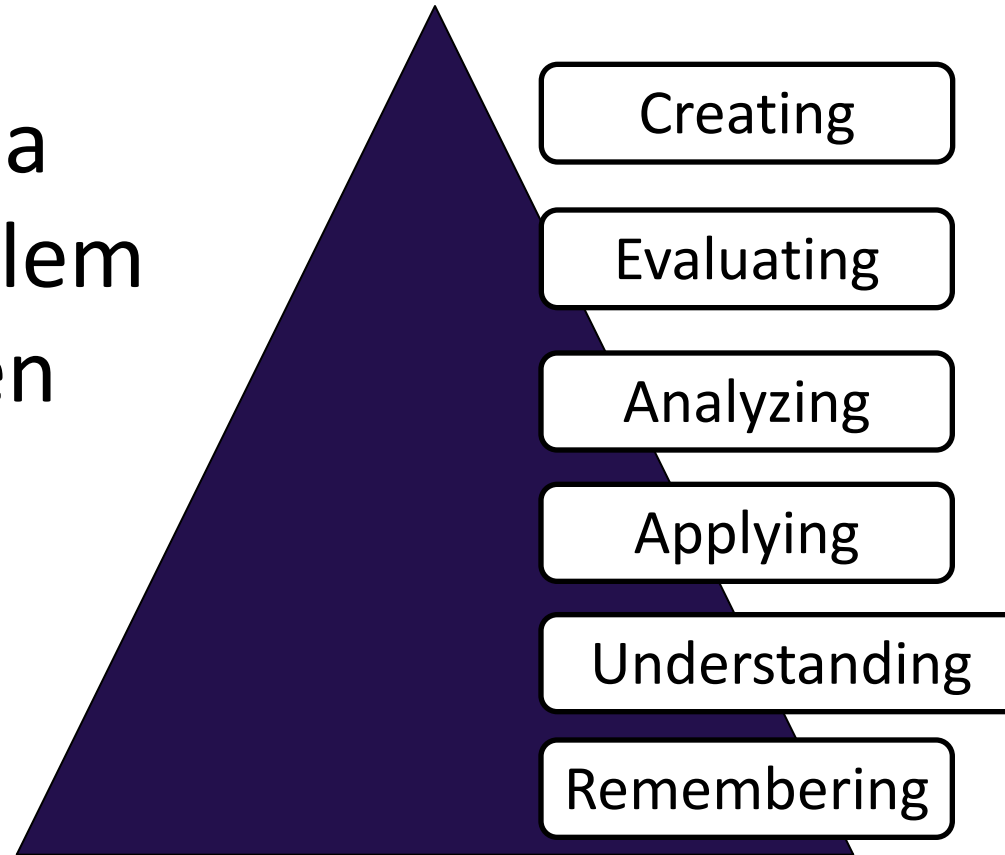
## Inductive Reasoning



# Expertise and Creativity

Can you create a solution to a problem you haven't seen before?

*www.nwlink.com*



# Artificial “intelligence” ??



- Computers have been able to detect sex from retinal images
- AI → pattern recognition on steroids? Is that what we mean by “thinking”? Intelligence?
- Greater use of APPs whose training has less pathophysiology; focus on patterns.
- What is the role of the doctor?



# ChatGPT – Is Artificial Intelligence “intelligent”?

- Reportedly could answer questions from Step 1 board review books
- Are review books focused on knowledge, not thinking?
- What do doctors need for future?
- Are we teaching thinking skills?
- Question from Homeostasis case session given to ChatGPT
- Why would a person breathing through a 2-foot long snorkel get short of breath?
- ChatGPT → problem with snorkel; individual out of shape –Wrong answer!! nothing about resistance or dead space associated with tube
- Add prompt: Consider physiology, it got closer

# A phone call at night....

Patient with hx of heart failure admitted 2 days ago with bleeding ulcer. Endoscopy showed large ulcer in fundus with visible vessel but no active bleeding. Within last 15 minutes, patient lightheaded. BP falls from 110/80 to 60 systolic. Extremities cool; poor capillary refill. Hct stable.

Norepi started. HR 110 → 140. No change in BP. Phenylephrine is added. ECG: sinus tachy; chronic ST-T wave changes; more prominent ST depression.

Resident: I think the patient is in cardiogenic shock and needs urgent cath or an intra-aortic balloon pump.

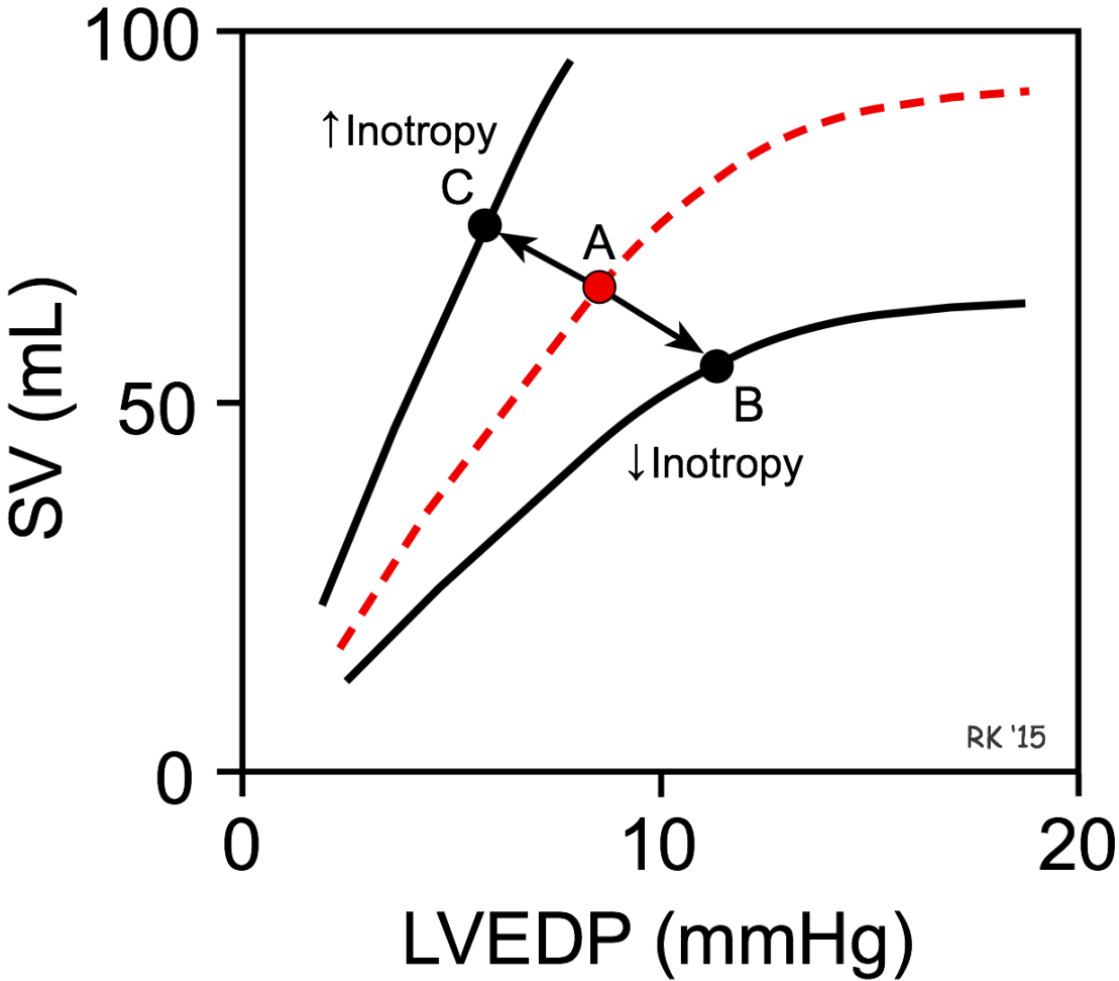
# Chat GPT response

- “Based on the information provided, the diagnosis is likely to be a hypovolemic shock. The patient's history of heart failure and bleeding ulcer, along with the lightheadedness, falling blood pressure, cool extremities, and poor capillary refill, are suggestive of hypovolemia or low blood volume. *The stable hematocrit suggests that the bleeding may have stopped, but the patient is still in shock due to the significant loss of blood.*”
- **Right answer but wrong reasoning** re: stable Hct! It’s stable because it is an acute bleed and insufficient time for new equilibrium with interstitial fluid.

# Why didn't the patient respond to Norepi?

- **Chat GPT:** “In some cases, the use of a single vasopressor may not be enough to reverse hypovolemic shock, especially if the underlying cause of the shock is not addressed. In this case, the addition of another vasopressor like phenylephrine may help augment the effects of norepinephrine and improve blood pressure and tissue perfusion.”
- **Correct answer:** The preload is so low that an increase in contractility will not improve stroke volume, as predicted by the Starling curve.

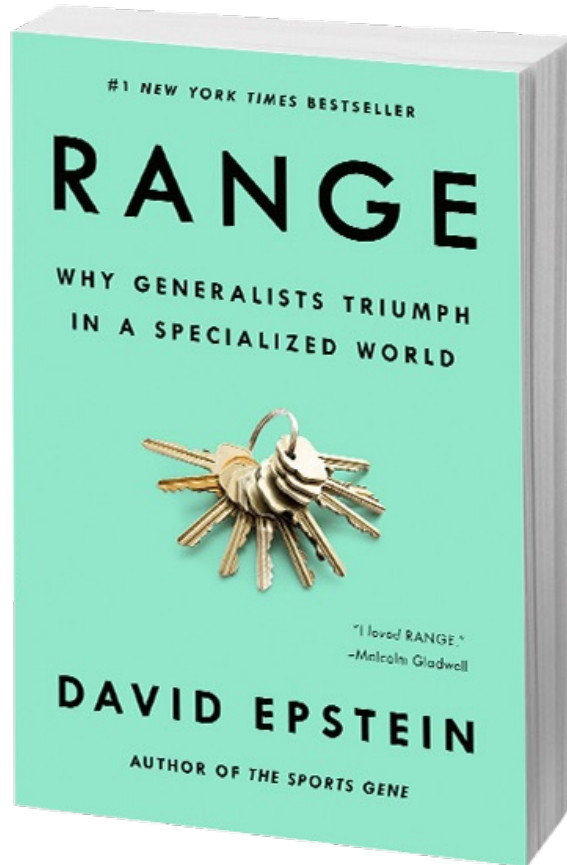
# Effect of Inotrope on Empty Heart



# The Importance of Questions in Medical Education

- Why?
- How?
- How do I think about this problem?
- What do I know about X?
- Adaptive expertise – reasoning from first principles to detect when the obvious is not right, when a piece doesn't fit
- Medicine is less about making esoteric dx and more about explaining new findings in patients with chronic disease

# Thinking (compared to pattern recognition) Yields Better Outcomes in “Wicked” Environments



- “Kind” learning environment – patterns repeat over and over; feedback accurate and repetitive (think chess)
- Medicine is a **“wicked” environment**. The rules of the game are often unclear or incomplete; may not be repetitive patterns; feedback may be delayed and inaccurate; demands cognitive flexibility
- Students (and computers) try to turn conceptual problems into procedural ones (algorithm)

# The Brain (and computers?) Hates Uncertainty

“The mind is designed to make the best possible case for a given interpretation rather than represent all the uncertainty about a given situation.”

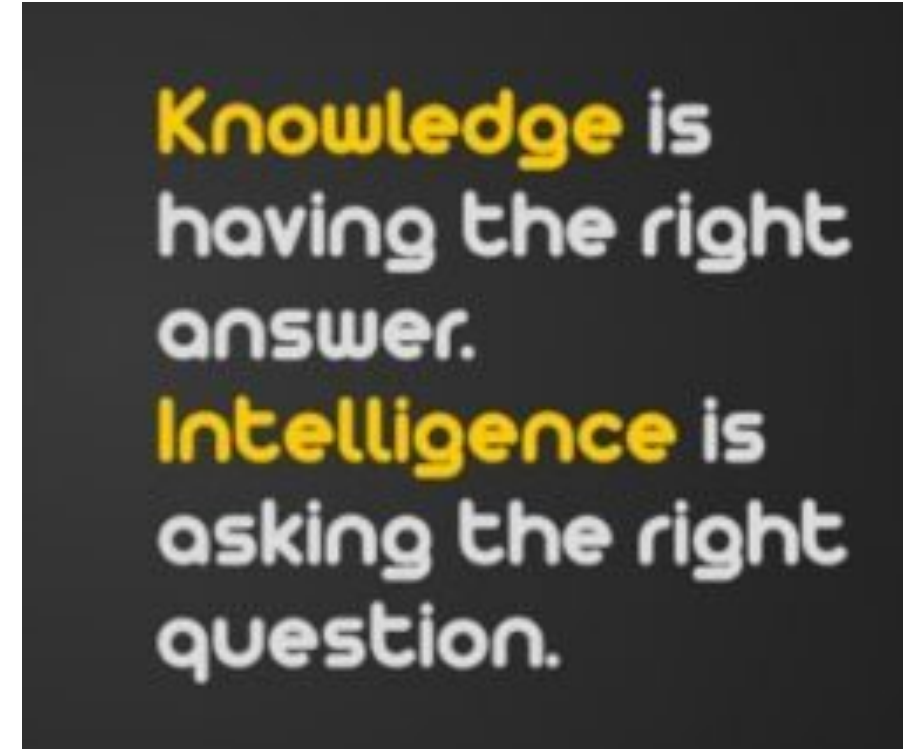
--- Amos Tversky





# The Importance of Questions

- Medical education must focus on deep understanding of fundamental principles and concepts, which can then be applied to patient problems
- Ask and answer the necessary and difficult questions
- Avoid the pitfalls of pattern recognition
- Prepare for the wicked environment of patient care.



<https://thedreamcatch.com/importance-of-asking-the-right-questions/>