TEACHING CLINICAL REASONING
Case-based, Coached

Jerome P. Kassirer, M.D.
Distinguished Professor, Tufts University School of Medicine
Visiting Professor, Stanford University
Editor-in-Chief Emeritus, New England Journal of Medicine
HOW WE USUALLY TEACH DIAGNOSTIC REASONING

WATCH ONE, DO ONE, TEACH ONE
(THE 2400- YEAR-OLD HIPPOCRATIC APPRENTICESHIP APPROACH)

JUST READ THE FIRST 300 PAGES OF HARRISON
(THE “GO-AWAY-AND-STOP-ASKING-QUESTIONS” APPROACH)

CARRY OUT A COMPLETE HISTORY AND PHYSICAL
( THE “YOU-DO-WHAT-I DON’T-DO” APPROACH)

DESPITE THE LACK OF A SYSTEMATIC APPROACH, MANY PEOPLE DO BECOME EXPERT DIAGNOSTICIANS, YET OTHERS FALTER --- CAN WE DO BETTER?
DIAGNOSIS IN ITS PURE FORM

DIAGNOSIS IS INITIATED BECAUSE OF A SYSTEM MALFUNCTION.

INFERENCES ARE GENERATED FROM OBSERVABLES AND INQUIRIES ABOUT THE NATURE OF THE MALFUNCTION.

THE INFERENCES YIELD A SERIES OF PROVISIONAL APPROXIMATIONS THAT ARE REVISED REPEATEDLY IN AN ITERATIVE PROCESS UNTIL ALL FINDINGS, POSITIVE AND NEGATIVE, ARE ACCOUNTED FOR.

INFERENCE IS THE FUNDAMENTAL PROCESS
(WHAT IS INFERENCE?)
PROLOGUE

There once was a boy named Pierre who only would say, “I don’t care!”
Read his story, my friend, for you’ll find at the end that a suitable moral lies there.
One day
his mother said
when Pierre
climbed out of bed,
“Good morning,
darling boy,
you are
my only joy.”
Pierre said,
“I don’t care!”
“What would you like to eat?”
“I don’t care!”
“Some lovely cream of wheat?”
“I don’t care!”
“Don’t sit backwards on your chair.”
“I don’t care!”
“Or pour syrup on your hair.”
“I don’t care!”
“You are acting like a clown.”
“I don’t care!”
“And we have to go to town.”
“I don’t care!”
“Don’t you want to come, my dear?”
“I don’t care!”
“Would you rather stay right here?”
“I don’t care!”
So his parents left him there. They didn’t take him anywhere.
Now, as the night began to fall
a hungry lion paid a call.
He looked Pierre right in the eye
and asked him if he’d like to die.
Pierre said, "I don’t care!"
“Is that all you have to say?”
“I don’t care!”
“Then I’ll eat you, if I may.”
“I don’t care!”
So the lion ate Pierre.
Arriving home at six o’clock, his parents had a dreadful shock! They found the lion sick in bed and cried, “Pierre is surely dead!”
They pulled the lion by the hair.
They hit him with the folding chair.
His mother asked, “Where is Pierre?”
The lion answered, “I don’t care!”
His father said, “Pierre’s in there!”
They rushed the lion into town.
The doctor shook him up and down.
And when the lion gave a roar—Pierre fell out upon the floor.
He rubbed his eyes and scratched his head and laughed because he wasn’t dead.
His mother cried and held him tight.
NEW APPROACHES CAN BETTER INFORM
WHAT WE TEACH AND HOW WE TEACH

MEDICAL PROBLEM-SOLVING
LINGUISTICS
COGNITIVE SCIENCE
COGNITIVE PSYCHOLOGY
COMPUTER SCIENCE
RESEARCH ON EXPERTISE
ADULT LEARNING
NEW APPROACHES CAN BETTER INFORM
WHAT WE TEACH

MEDICAL PROBLEM-SOLVING
LINGUISTICS
COGNITIVE SCIENCE
COGNITIVE PSYCHOLOGY
COMPUTER SCIENCE
RESEARCH ON EXPERTISE
ADULT LEARNING
INSIGHTS FROM STUDIES OF MEDICAL PROBLEM SOLVING:

DIAGNOSIS:

*IS NOT A ROTE INFORMATION-GATHERING PROCESS*

INvolves specific structural elements

Can be expressed unambiguously by a language of these elements

Is an inferential iterative process
NEW APPROACHES CAN BETTER INFORM WHAT WE TEACH

MEDICAL PROBLEM-SOLVING
LINGUISTICS
COGNITIVE SCIENCE
COGNITIVE PSYCHOLOGY
COMPUTER SCIENCE
RESEARCH ON EXPERTISE
ADULT LEARNING
THE LANGUAGE AND STRUCTURAL ELEMENTS OF DIAGNOSIS

HYPOTHESIS GENERATION
CONTEXT FORMULATION
HYPOTHESIS REFINEMENT
TEST INTERPRETATION/BAYES’ RULE
PROBABILISTIC, PHYSIOLOGIC, AND CAUSAL REASONING
DIFFERENTIAL DIAGNOSIS
HYPOTHESIS VERIFICATION: ASSESSING FOR ADEQUACY, COHERENCE, PARSIMONY
WORKING (FINAL) DIAGNOSIS
COGNITIVE ERRORS
NEW APPROACHES CAN BETTER INFORM
WHAT WE TEACH

MEDICAL PROBLEM-SOLVING
LINGUISTICS
COGNITIVE SCIENCE
COGNITIVE PSYCHOLOGY
COMPUTER SCIENCE
RESEARCH ON EXPERTISE
ADULT LEARNING
CRITICAL IMPORTANCE OF KNOWLEDGE

KNOWLEDGE AND REASONING ARE INTERDEPENDENT
KNOWLEDGE FORMS THE BASIS OF EXPERTISE
BUT EXPERTISE REQUIRES ONGOING EFFORT AND FEEDBACK
STRUCTURE OF KNOWLEDGE UNCERTAIN (SCRIPTS, FRAMES, IF-THEN RULES)
REPEATED EXPERIENCE MATTERS
MEMORY: SHORT TERM, LONG TERM, WORKING MEMORY; CAN BE TRAINED
SHOULD NOT UNDERESTIMATE AMOUNT OF MEDICAL KNOWLEDGE
REASONING: A DUAL PROCESS SYSTEM

INTUITIVE
AND
ANALYTIC

INTERACTIONS
INTUITIVE COMPONENT

INSTINCTUAL, RAPID RESPONSES; EFFORTLESS AND AUTONOMOUS
REQUIRE NO ACTIVE THOUGHT
PATTERN RECOGNITION
FIRST IMPRESSIONS, NO INPUT FROM ANALYTIC COMPONENT
HYPOTHESIS GENERATION AN EXAMPLE
VALUABLE AND USUALLY ACCURATE BUT CAN BE SOURCE OF COGNITIVE ERRORS
LEARNED BY REPEATED EXPOSURE AND FEEDBACK
INTUITIVE REASONING

History: A 24-year old Chinese man was seen in the Emergency Department for weakness in his arms and legs and hypokalemia (serum K 2.0)…

Clinician: “One possibility that comes to mind is hypokalemic periodic paralysis, alone, or in association with hyperthyroidism…”
THYROTOXICOSIS
ABDOMINAL PLAIN FILM
ABDOMINAL PLAIN FILM
IN RENAL TUBULAR ACIDOSIS
ANALYTIC COMPONENT

DELIBERATE, MINDFUL
NOT INSTANTANEOUS
BASED ON SCIENCE, CAUSAL RELATIONS, LOGIC, PROBABILISTIC ASSOCIATIONS
REQUIRES CONSIDERABLE COGNITIVE WORK
CREATES MODELS IN WORKING MEMORY, MAINTAINS A COHERENT STORY
LESS LIKELY TO BE ERROR-PRONE
SERVES AS A CHECK AND, IF NECESSARY, AN OVERRIDE ON INTUITIVE RESPONSES
ANALYTIC REASONING

History: a 31-year-old man diagnosed with cirrhosis by liver biopsy, admitted for liver transplantation. Exam unremarkable, undistended neck veins, no splenomegaly. Platelet count normal. Liver function studies showed preserved synthetic function.

Clinician: Diagnosis of cirrhosis is in doubt. Was the biopsy read by an expert? Despite neck veins, echo showed pericardial calcium and cardiac cath was consistent with constriction. Pericardectomy relieved all symptoms.
History: a 44-year-old sewage inspector admitted twice with fever, confusion, and ataxia. Examination revealed no focal findings and extensive studies were unrevealing. All symptoms cleared during both hospitalizations.

Clinician: “Is he taking any health foods of any kind?”

Solution: Kava Kava and Valerian root, taken for depression, were discontinued; symptoms did not recur.
NEW APPROACHES CAN BETTER INFORM
HOW WE TEACH

MEDICAL PROBLEM-SOLVING
LINGUISTICS
COGNITIVE SCIENCE
COGNITIVE PSYCHOLOGY
COMPUTER SCIENCE
RESEARCH ON EXPERTISE
ADULT LEARNING
LEARNING FROM OTHERS:
(ANDERS ERICSSON ON EXPERTISE AND MEMORY)

EXPERTS KNOW MORE, PERCEIVE MORE, REMEMBER MORE

MEMORY (BOTH SHORT AND LONG TERM) IS EXPANDABLE, BUT IT TAKES WORK

TO ACHIEVE EXPERTISE REQUIRES FOCUS, STRUGGLE, CONCENTRATION, SACRIFICE, AND PAINFUL SELF-ASSESSMENT. REQUIRES ENGAGING IN DELIBERATE PRACTICE: TASKS BEYOND ONE’S CURRENT LEVEL OF COMPETENCE AND COMFORT.

“The development of genuine expertise requires struggle, sacrifice, and honest, often painful self-assessment. There are no shortcuts. ... and you will need to invest that time wisely, by engaging in “deliberate practice” – practice that focuses on tasks beyond your current level of competence and comfort.”
NEW APPROACHES CAN BETTER INFORM HOW WE TEACH

MEDICAL PROBLEM-SOLVING
LINGUISTICS
COGNITIVE SCIENCE
COGNITIVE PSYCHOLOGY
COMPUTER SCIENCE
RESEARCH ON EXPERTISE
ADULT LEARNING
ADULT LEARNING THEORY

EXPERIENCE IS THE LEARNER’S TEXTBOOK
NEW KNOWLEDGE IS LEARNED MOST EFFECTIVELY WHEN IN CONTEXT OF REAL LIFE APPLICATIONS
BEST TIME TO LEARN IS WHEN MATERIAL IS IMMEDIATELY USEFUL
LITTLE IS “TAUGHT”; LEARNING IS ONLY FACILITATED
SPONTANEITY IS ENCOURAGED
OPEN CRITICISM AND ACCEPTANCE OF CRITICISM IS KEY
IDEA IS TO FACILITATE ABSTRACT CONCEPTS AND GENERALIZATIONS FROM MATERIAL
IMPORTANT, ACTIVE ROLE OF COACH
WHAT AND HOW TO TEACH DIAGNOSTIC REASONING

EXPERIENCE SHOWS THAT WITH APPROPRIATE EXPOSURE TO WELL-SELECTED CLINICAL MATERIAL, MANY BECOME EXPERT DIAGNOSTIC PROBLEM SOLVERS.

THOUGH WE KNOW LITTLE ABOUT THE DEVELOPMENT OF SUCH EXPERTISE, WE CAN INFERENCE THAT DELIBERATE EXPOSURE TO REAL CASES AND IMAGES, LEARNING THE LANGUAGE AND THE ELEMENTS OF DIAGNOSIS AND THOUGHTFUL MENTORING PROMOTES SUCCESS.

THUS THE PROPOSAL THAT TEACHING DIAGNOSIS BE CASE-BASED AND COACHED (MENTORED)
TEACHING DIAGNOSTIC REASONING
CASE SELECTION

REPEATEDLY EXPOSE STUDENTS TO CASE-BASED CLINICAL REASONING DILEMMAS UNDER SUPERVISION OF AN EXPERIENCED CLINICIAN-COACH.

DEPENDING ON LEVEL OF LEARNERS, BEGIN WITH BROAD OUTLINE OF DIAGNOSTIC PROCESS AND “LANGUAGE OF DIAGNOSIS.” SELECT CASE EXAMPLES BY LEVEL.

SELECT CASE EXAMPLES OF EXCELLENT AS WELL AS FAULTY CLINICAL REASONING

EXAMPLES SHOULD BE GENUINE TO RELECT MESSINESS OF DATA AND INFORMATION GATHERING IN REAL WORLD. NO “MADE UP” CASES.

DON’T OMIT KEY DATA TO ADD TO THE MYSTERY.

CASE MATERIAL SHOULD BE ORGANIZED IN ACTUAL SEQUENCE (PROSPECTIVELY).

PROVIDE INFORMATION WHEN REQUESTED, AND IN CHUNKS.
TEACHING DIAGNOSTIC REASONING
ROLE OF THE COACH

COACH NEED NOT KNOW THE SOLUTION TO THE PROBLEM. ASK WHY THEY REQUESTED INFORMATION; ASK THEM TO EXPLAIN WHAT THEY LEARNED FROM IT. BRING OUT INTERMEDIATE REASONING, NOT JUST FINAL RESULT.

ENCOURAGE ALL INVOLVED TO ACTIVELY PARTICIPATE; CALL ON THEM IF NECESSARY.

MAKE THE SESSION INTELLECTUALLY CHALLENGING, ENJOYABLE, RESPECTFUL, NOT THREATENING.

DON’T BADGER THE PARTICIPANTS.

ENCOURAGE SPONTANEITY. WHAT MATTERS IS WHAT IS LEARNED, NOT WHETHER EVERY CASE HAS AN ANSWER. VEER AWAY IF APPROPRIATE.

LEAD RETROSPECTIVE “WRAP-UP” TO INCLUDE JUDGMENTS MADE, COGNITIVE ERRORS, THERAPEUTIC CHOICES; WHAT COULD HAVE BEEN DONE BETTER?
SHOULD WE TEACH PATTERN RECOGNITION?

INTUITIVE PATTERN RECOGNITION IS A POWERFUL TOOL

ENCOURAGE EXPOSURE TO IMAGES: RADIOLOGIC, DERMATOLOGIC, OPHTHALMIC, LABORATORY

IMAGES ARE POLYMORPHIC, THUS REQUIRING MANY EXPOSURES TO LIKE ITEMS
EHLERS-DANLOS SYNDROME
TEACH PATTERN RECOGNITION?

History: Smoker with cough and weight loss;

Na 142   Cl 70   BUN 12
------------------------------------
K 2.1   Cl 60   Creat 1.2
TEACH PATTERN RECOGNITION?

History: Smoker with cough and weight loss;

Na 142   Cl 70     BUN 12
------------------------------------
K 2.1      Cl 60     Creat 1.2

Consider ACTH-secreting lung cancer
CAN WE TEACH HOW TO AVOID COGNITIVE ERRORS?

PITFALLS TO AVOID: COMMON HEURISTICS THAT MISLEAD US (AVAILABILITY, REPRESENTATIVENESS, ANCHORING)

CASE-BASED LEARNING:

History: 79 year-old man whose wife had recently had a paralytic stroke seen for nausea, shivering sensations, drenching night sweats, 30 lb. weight loss. Prominent diagnoses were an inflammatory process, a secretory tumor, or some other serious disorder. Extensive testing revealed no abnormalities.

Solution: Eventually, an antidepressant was prescribed, and the patient recovered completely.

Comment: Salience of symptoms drew physicians off track.
CAVEATS

INCLUDES ONLY COGNITION AS APPLIED TO DIAGNOSIS, NOT QUANTITATIVE METHODS (BAYES, DECISION ANALYSIS) OR THERAPEUTIC ISSUES
NOT ABOUT COMMUNICATION WITH PATIENTS, INTERVIEWING, PHYSICAL EXAMINATION
DOESN’T INCLUDE EMOTIONAL INFLUENCES ON COGNITION
HIGHLY CONTEXT DEPENDENT
STILL LARGELY PRAGMATIC AND BASED MOSTLY ON THEORY, ASSUMPTIONS, COMMON SENSE
WIDELY ACCEPTED, YET DOGMATISM IS NOT APPROPRIATE
NATURALLY INTERDIGITATES WITH TEACHING ABOUT DISEASE ENTITIES
Teaching Clinical Reasoning: Case-Based and Coached
Jerome P. Kassirer, MD

Abstract
Optimal medical care is critically dependent on clinicians' skills to make the right diagnosis and to recommend the most appropriate therapy, and acquiring such reasoning skills is a key requirement at every level of medical education. Teaching clinical reasoning is grounded in several fundamental principles of educational theory. Adult learning theory posits that learning is best accomplished by repetitive, deliberate exposure to real cases, that case examples should be selected for their reflection of multiple aspects of clinical reasoning, and that the participation of a coach augments the value of an educational experience.

The theory proposes that memory of clinical medicine and clinical reasoning strategies is enhanced when errors in information, judgment, and reasoning are immediately pointed out and discussed. Rather than using cases artificially constructed from memory, real cases are greatly preferred because they often reflect the false leads, the polymorphisms of actual clinical material, and the misleading test results encountered in everyday practice. These concepts foster the teaching and learning of the diagnostic process, the complex trade-offs between the benefits and risks of diagnostic tests and treatments, and cognitive errors in clinical reasoning. The teaching of clinical reasoning need not and should not be delayed until students gain a full understanding of anatomy and pathophysiology. Concepts such as hypothesis generation, pattern recognition, context formulation, diagnostic test interpretation, differential diagnosis, and diagnostic verification provide both the language and the methods of clinical problem solving. Expertise is attainable even though the precise mechanisms of achieving it are not known.