NEJMHealer
POWERED BY LECTURIO

New Frontiers in Clinical Reasoning Development

How to incorporate clinical reasoning education into your program

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Introduction

Accurate clinical decision-making is at the center of modern patient care. Poor clinical reasoning contributes to diagnostic errors that affect millions of individuals and cause an estimated 40,000–80,000 deaths each year in the United States.[1]

85.7%

Of diagnostic errors are caused by clinical judgment factors[2]

[1] Rencic J et al. Clinical reasoning education at US medical schools: results from a national survey of internal medicine clerkship directors. J Gen Intern Med 2017 Nov; 32:1242.

[2] Newman DE et al. Serious misdiagnosis-related harms in malpractice claims: the "Big Three" — vascular events, infections, and cancers. Diagnosis 2019; 6:227.

Understanding the Clinical Reasoning Process

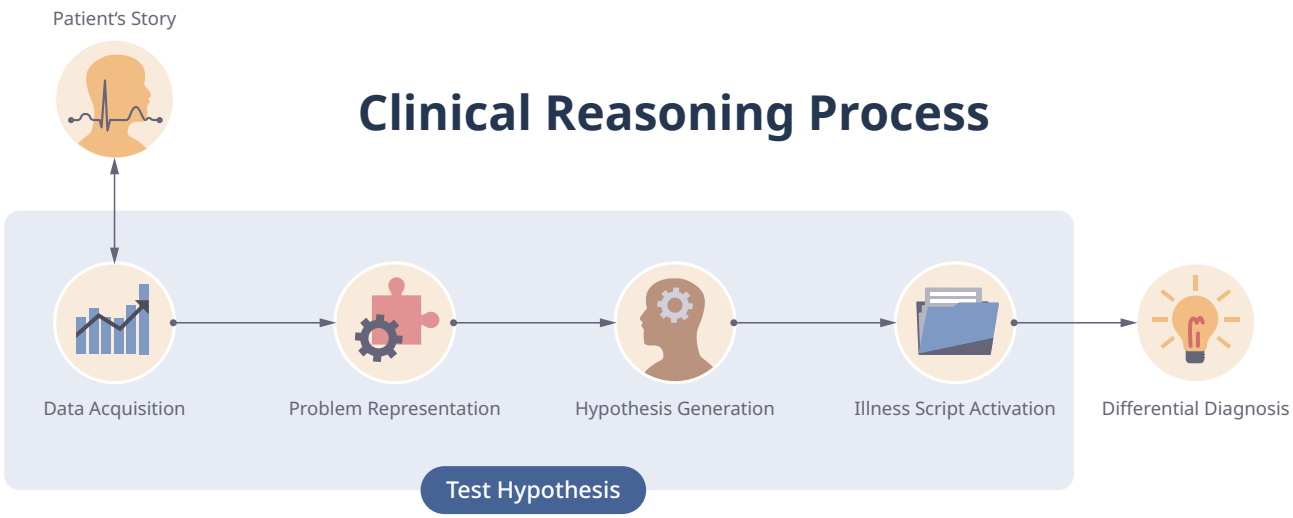
While clinical reasoning has long been the foundation of medical education, the process has not been well understood until recently. Now, advances in cognitive science allow the process to be broken down into repeatable, teachable steps.

The lack of focus on developing clinical reasoning and understanding the cognitive contributions to decision-making represents a major gap in education within all health care professions.

Educators should ensure that curricula and training programs across the career trajectory employ educational approaches that are aligned with evidence from the learning sciences.[3] Working from the dual process theoretical framework laid out by Nobel laureate Daniel Kahneman, the clinical reasoning process can occur rapidly through intuition or pattern (type 1), or more slowly and methodically through analytic reasoning (type 2). The type of clinical reasoning used depends on the clinician's experience with, and expertise in, diagnosing a particular disease. Experienced clinicians frequently use type 1 reasoning because the breadth and depth of their clinical knowledge and experience allow them to move quickly. Inexperienced clinicians or clinicians working outside their area of expertise often must rely on less-efficient type 2 reasoning.

Type 2 clinical reasoning is synonymous with the scientific method, whose goal is to arrive at the hypothesis (from a group of hypotheses) that best explains a given set of observations.

[3] Improving Diagnosis in Health Care, National Academy of Sciences. 2015.



Acquiring diagnostic reasoning expertise requires practice with many cases in many contexts. Deliberate practice in simulation settings is one approach.[4]

[4] Bowen JL. Educational strategies to promote clinical diagnostic reasoning. N Engl J Med 2006; 355:2217.

Clinical Reasoning in Medical Education

Formalizing the underlying cognitive process of clinical reasoning is a relatively new focus area in the changing field of medical education. Studies suggest that educating physicians about the science of cognitive decision-making, especially during medical school and residency when trainees are still forming clinical habits, may enhance awareness of individual cognitive biases and has the potential to reduce diagnostic errors and improve patient safety.[5]

While medical educators largely believe clinical reasoning should be taught throughout the four years of medical school, with the greatest emphasis in the clinical years, only a minority report having a formal clinical reasoning curriculum as part of the didactic process. They cite a lack of curricular time and faculty expertise as the largest barriers.6 Even programs with well-developed clinical reasoning curricula struggle to find ways for learners to practice their skills.

[5] Iyer S et al. Development and evaluation of a clinical reasoning curriculum as part of an internal medicine residency program. Diagnosis (Berl.) 2019 Jun 26; 6:115.

[6] Rencic J et al. Clinical reasoning education at US medical schools: results from a national survey of internal medicine clerkship directors. J Gen Intern Med. 2017 Nov; 32:1242.

Barriers to formally teaching and assessing clinical reasoning

Clinical reasoning is complex

Diagnostic reasoning is a complex multistep, iterative process, dependent on a large body of knowledge.

Clinical reasoning is difficult to assess

Clinical reasoning has always been difficult to measure. Traditional tools fail to assess these skills, leading to a significant gap in the ability to measure and improve learner performance.

Clinical reasoning is difficult to teach

By the time clinicians become educators, their own clinical reasoning process has become second nature. They may struggle to integrate the process into their curriculum, especially since there are few proven, standard methods for doing so.

Faculty time and resources are strained

From academic and research responsibilities to administrative and clinical ones, educators have a lot on their already overflowing plate. It is very challenging to find the time to teach clinical reasoning in a personalized, engaging, and effective way or to assess it through direct observation or post-encounter presentations.

While most programs are finding ways to include clinical reasoning in their curriculum, many lack a structured way of teaching or assessing it and providing the right balance of objective and subjective feedback. NEJM Healer addresses these problems by providing a systematic way of teaching, assessing, and learning clinical reasoning.

"What makes NEJM Healer innovative is its approach to tap into the science of clinical problem-solving (reasoning) through the use of illness scripts and by prompting users to consider how data contributes to the final diagnosis in clinical cases. This product can be of tremendous value to students as they prepare for real patient encounters."

Anthony A. Miller

MEd, PA-C (Emeritus) Distinguished Professor, Division of Physician Assistant Studies Shenandoah University

Deliberate Practice and Assessment for Learning

Regardless of whether clinical reasoning is considered an art or a science, we now know it is a process that can be taught and learned with deliberate practice. While exposure to cases and clinical scenarios are essential, learners can't rely on clinical experience alone. While learners are reviewing data they need new, safe, and appealing ways to engage in deliberate practice and provide educators with objective data used to assess their progress and mastery. Educational frameworks that allow for formative, systematic assessment of clinical reasoning, which fosters a climate of assessment for learning, are particularly valuable.[7]

Educators should … create training opportunities for deliberate practice, appropriate for a given individual at a given level of skill development.[8]

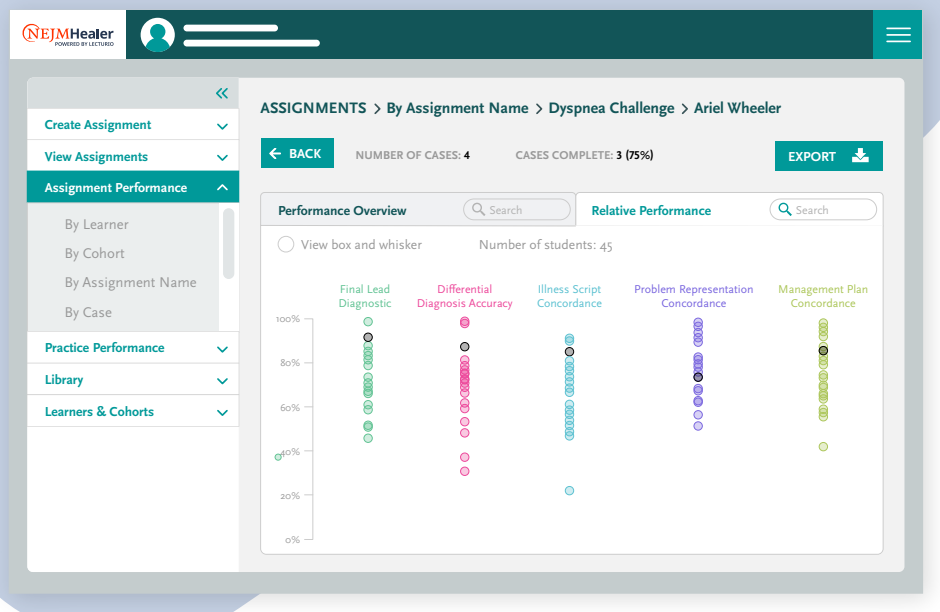
NEJM Healer moves beyond developing clinical reasoning through mere observation and repetition, instead providing built-in coaching and feedback from experts. Learners gain deep insights into their abilities in multicomponent areas of the reasoning process to arrive at a holistic picture of their strengths and weaknesses.

Learners should be encouraged to read about their patients' problems in a way that promotes diagnostic reasoning, rather than to read about topics in a rote-memorization fashion, without context. The organization of knowledge stored in memory facilitates the recall of key concepts for application to the next relevant clinical case.[9]

[7] Thampy H, Willert E, Ramani S. Assessing clinical reasoning: targeting the higher levels of the pyramid. J Gen Intern Med 2019; 34:1631.

[8] Ericsson KA. Deliberate practice and acquisition of expert performance: a general overview. Academic Emergency Medicine 2008; 15:988.

[9] Bowen JL. Educational strategies to promote clinical diagnostic reasoning. N Engl J Med 2006 Nov 23; 355:2217.



Empowering Learners to Thinklike Clinical Experts

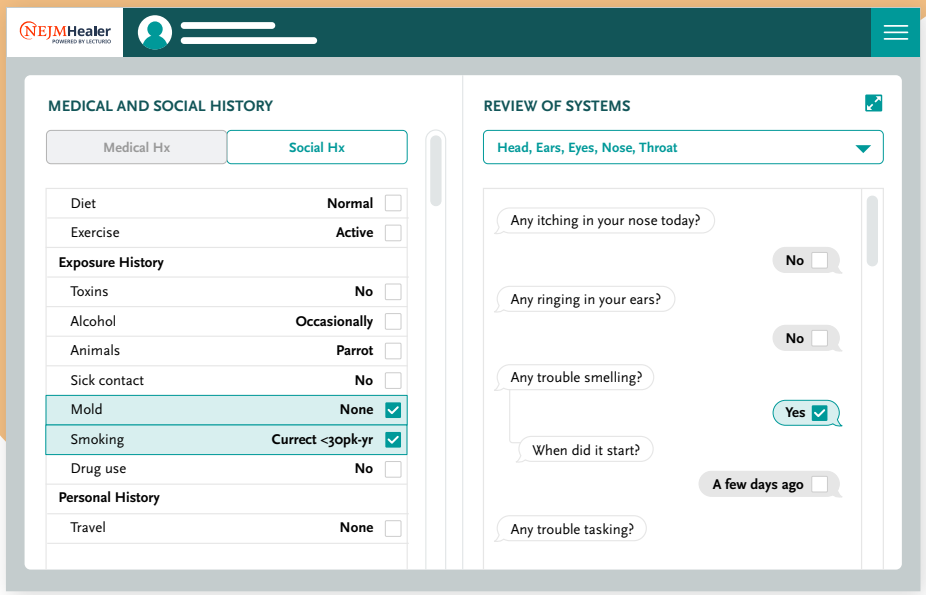
NEJM Healer aligns with current cognitive models and reinforces learning with a data-driven process that presents detailed feedback and expert rationales to learners, allowing them to measure and comprehend the different ingredients of clinical reasoning to a degree that even experts, taking shortcuts based on their years of experience, may find difficult to articulate. NEJM Healer brings expert-created illness scripts and diagnostic schemas together with highly interactive patient cases, ensuring that learners combine clinical knowledge with critical thinking as they build their differential diagnosis.

Learners receive detailed feedback comparing their performance to an expert's perspective for each virtual patient encounter and can track their progress against key performance indicators over time. Educators can gauge progress, identify learners at risk, and discover where learners went wrong.

Because developing illness scripts for every disease is impossible, teachers should emphasize that learners should focus on the development of robust, accurate illness scripts for typical presentations of common and can't-miss diagnoses in their fields of interest. Through experience, learners will revise these scripts throughout their training.[10]

[10] Bowen JL. Educational strategies to promote clinical diagnostic reasoning. N Engl J Med 2006 Nov 23; 355:2217

How It Works



NEJM Healer breaks the elements of clinical reasoning into discrete but related skills of data acquisition, problem representation, hypothesis generation, illness script selection, and differential diagnosis. It journeys through the stages of a clinical encounter, allowing learners to understand the reasoning process at a deep level while also yielding detailed and meaningful feedback for the learner and assessment insights for educators.

Data acquisition

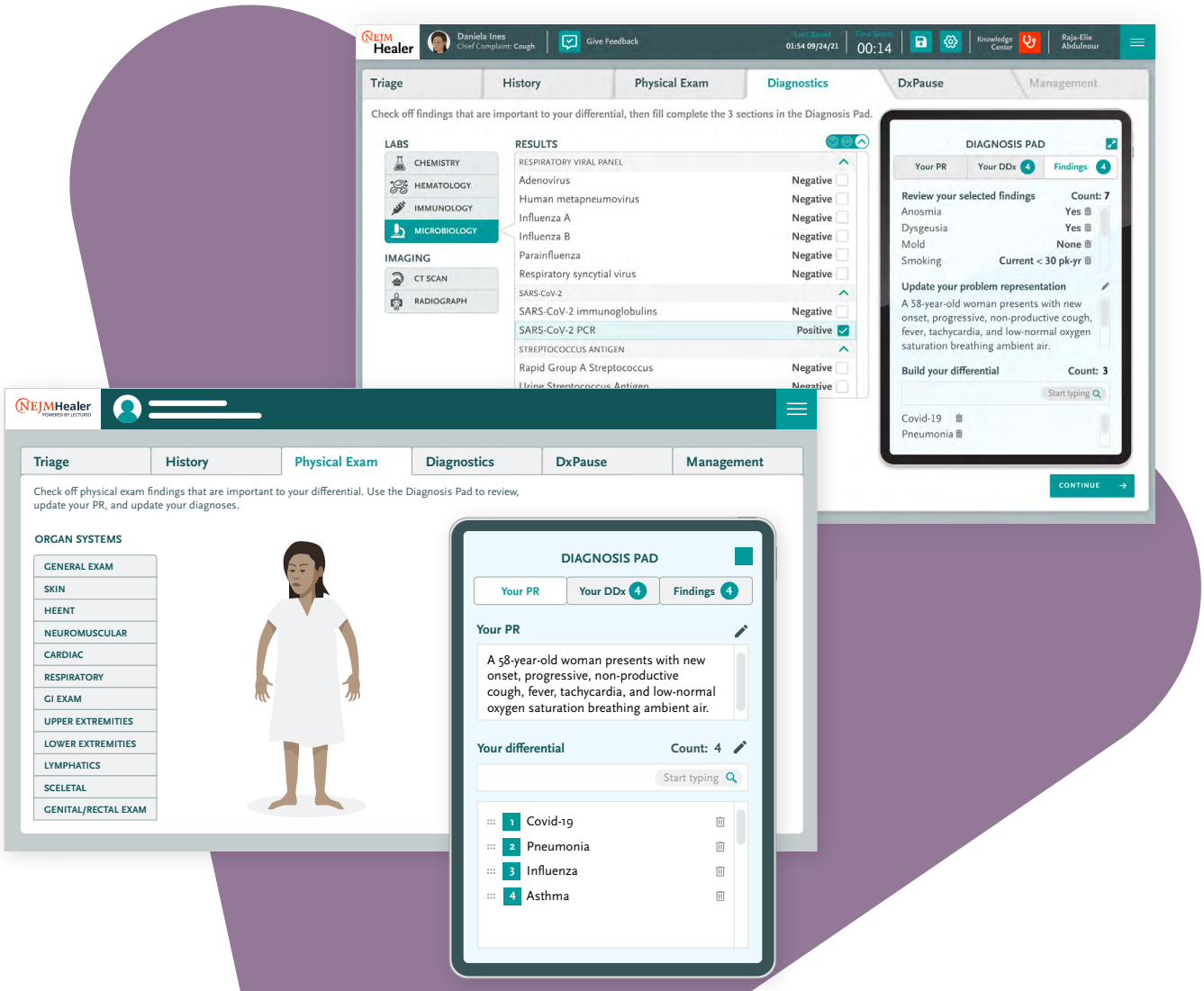
NEJM Healer requires learners to gather clinical findings that they will use to define the clinical problem and justify their differential diagnosis during illness script building. Just like in the real world, there many of individual data points to sift through and important follow-up questions to ask. NEJM Healer teaches the learner, in context, which questions are worth asking, which exams are worth performing, and which tests are worth ordering.

A case vignette-based clinical reasoning curriculum can effectively increase residents' knowledge of clinical reasoning concepts and their self-assessed ability to recognize and apply clinical reasoning concepts.[11]

[11] Iyer S. Development and evaluation of a clinical reasoning curriculum as part of an Internal Medicine Residency Program. Diagnosis (Berl) 2019 Jun 26; 6:115.

Problem representation and hypothesis generation

While learners are reviewing data, they can do the work of reasoning in their Diagnosis Pad, where they can see the data they've selected as most important, create and modify their problem representation, and build their differential diagnosis. As these data are updated from stage to stage, they are saved for assessment and feedback to provide unique insights into the learner's reasoning as it occurs.



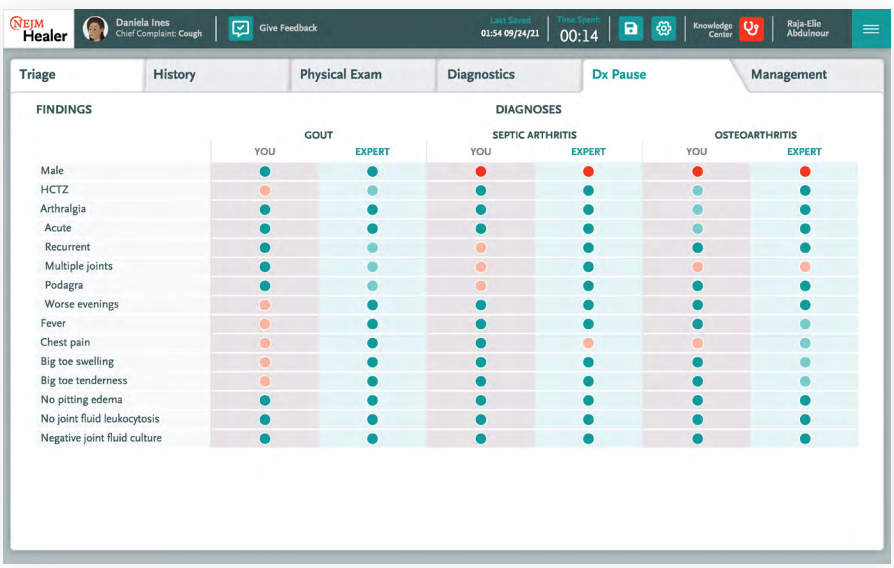
Illness script building and differential diagnosis

At key steps in the process, learners take a diagnostic pause to narrow their differential diagnosis and build illness scripts. Here, they see how the data fit the diseases they are thinking of and apply medical knowledge in a probabilistic manner by indicating whether each datum makes the presence of a given disease more or less likely. This activity allows learners to compare and contrast diseases and suggest a lead hypothesis.

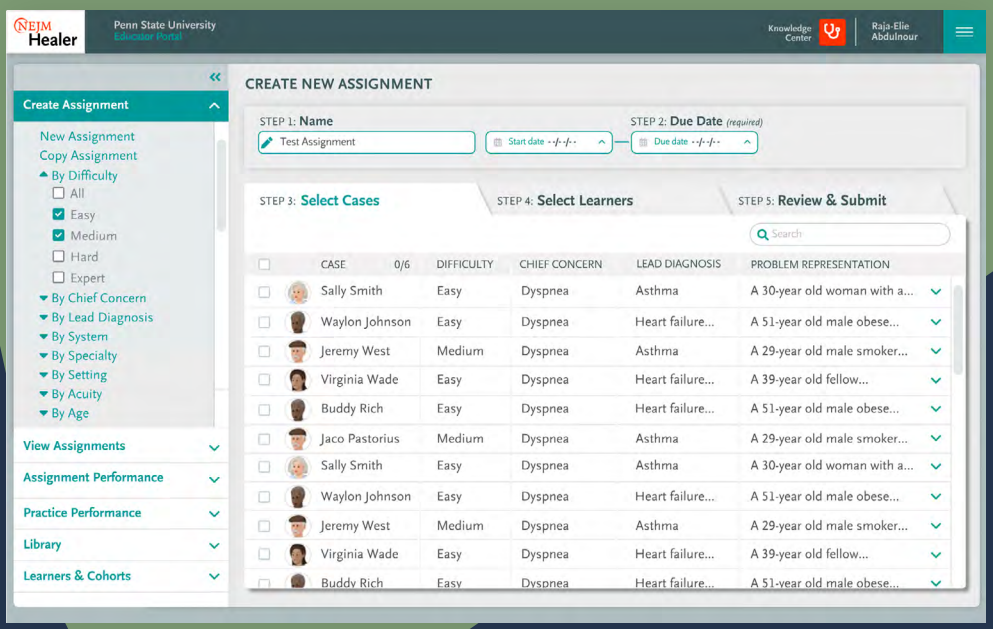
Clinically oriented learning from virtual patients can capture intrinsic motivation and promote mastery learning. Virtual patients can also enhance trainees' application of foundational knowledge to promote the development of clinical reasoning, the foundation of medical practice.[12]

Performance assessment and feedback

NEJM Healer improves the evaluation of clinical reasoning with a proprietary, quantitative assessment that provides formative and summative performance scoring and detailed feedback on the learners' clinical reasoning process. At a glance, learners can compare their performance against an expert's clinical reasoning, getting the equivalent of hours of expert insight. The entire experience is selfdirected, thought-provoking, and engaging, motivating learners through focused repetition until they achieve mastery.



[12] Berman NB et al. The role for virtual patients in the future of medical education. Academic Medicine 2016; 91:1217.



Consistent, Objective Feedback over a Wide Range of Cases

The NEJM Healer Educator Portal makes it easy to identify the cases that best suit educators' teaching needs, using filters to sort by presentation, specialty, case difficulty, disease acuity, patient age, and organ system involved.

Detailed reporting on learner performance and progress helps educators track individual learners and cohorts at each stage of a case and for the case as a whole, giving them powerful insights into each learners' clinical reasoning profile according to both objective and self-assessed measures. Educators can also view individual learner's accounts to review specific patient encounter reports and examine the learner's reasoning process as it happened, allowing them to provide immediate and targeted feedback.

Objective Measurements

- Lead diagnostic accuracy
- Differential diagnostic accuracy
- Illness script concordance

Learner-Informed Self-Assessments

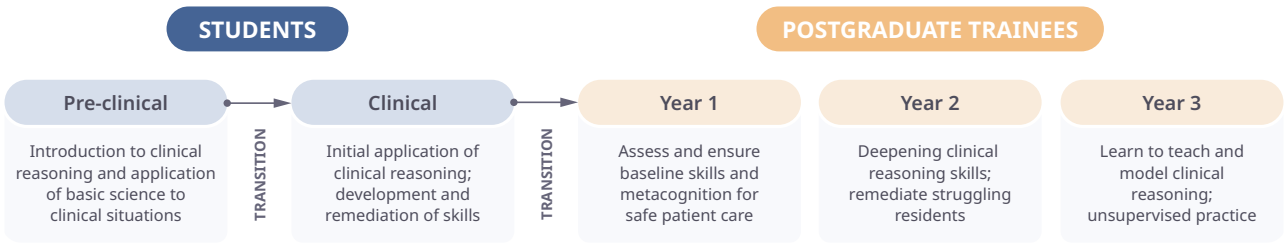
- Problem representation concordance
- Management plan concordance
- Degree of concern for the patient's status
- Degree of certainty with the diagnosis

"As an educator, the most exciting aspect of NEJM Healer is the objective data! Historically, clinical reasoning is assessed by an educator's gestalt: does the student 'get it' or not? NEJM Healer breaks down the clinical reasoning process into welldefined steps that can be easily measured to help determine the strengths or deficits in the clinical reasoning process. This creates an incredible potential for remediating students with clinical reasoning difficulties."

Nicholas Duca, MD

Assistant Professor of Medicine, Clerkship Director for Internal Medicine, Penn State College of Medicine

Enable Deliberate Practice Across Learner Cohorts



With an abundance of expertly developed cases, using a variety of diagnostic schemas and illness scripts, learners will experience many disease presentations and fill in gaps in their clinical exposure. Whether your learners are preclinical students preparing for clerkship or preceptorship, in their clinical rotations, transitioning to residency, or later in their residency, NEJM Healer better prepares them for the next stage of training and patient care.

Medical schools can use NEJM Healer to give preclinical learners confidence in gathering patient information, making broad differential diagnoses, and narrowing diagnostic uncertainty. It can also help learners fine-tune their skills and evaluate and prepare them during the transition to residency.

Graduate training programs can use NEJM Healer to establish a baseline for incoming residents and identify those who would benefit from lower-patient-touch, initial rotations. Educators can use these insights to remediate struggling residents and support mastery of their skills.

PA programs can use NEJM Healer in both didactic and clinical years to obtain a formative assessment of PA students, supplement lecture-based instruction and multiple-choice exams, and identify students who need remediation.

How NEJM Healer Can Help

Educators can use NEJM Healer in a variety of ways to create or augment a curriculum in clinical reasoning:

- Deliberate practice and focused repetition
- Practice and assessment for clinical skills or clinical reasoning courses
- Augmenting objective structured clinical examinations (OSCEs) — adding objective data
  and insights and potentially reducing the number of standardized patients required
- Initial translation of basic science into practice during preclinical training
- Transition to clinical work, residency, practice
- Asynchronous learning — assign cases singly or in batches
- Flipped classroom — incorporate an innovative tool into didactic sessions
- Post-case debriefs — discuss a case that the class has completed
- Illness script and diagnostic schema familiarity
- Formative and summative feedback and assessment
- Point-in-time assessment (start/finish of clerkships/rotations)
- Remediation for students struggling with clinical reasoning and the associated clinical knowledge
- Regular part of multi-year curriculum

"NEJM Healer is most exciting to me as a learning and assessment tool, providing unprecedented parameters and perspectives on learner growth and development. It fits perfectly within a competency-based medical education assessment for learning system."

Myles Nickolich, MD
Assistant Dean for Education in the Clinical Learning Environment, Penn State College of Medicine
Associate Program Director, Penn State Cancer Institute Hematology-Oncology Fellowship Program

Reimagine How Clinical Reasoning Is Taught and Assessed

NEJM Healer gives resource-strapped educators a new way to teach, develop, and assess clinical reasoning, with tools appropriate for programs with a robust clinical reasoning curriculum, as well as those looking to begin one.

NEJM Healer does the following:

- Supplements educators' existing clinical reasoning curriculum with engaging teaching materials and an easy way to create and manage assignments
- Serves as a complete clinical reasoning resource for institutions that don't yet have formal training in this area
- Provides a structured approach to clinical reasoning, helping learners develop discrete skills derived from sound cognitive science
- Provides exposure to a broad variety of clinical presentations, diseases, and cases
- Speeds learning by providing easily accessible opportunities for deliberate practice of clinical reasoning
- Makes assessments more comprehensive and reliable, with more data points for comparison
- Reduces bias by providing extensive, objective feedback and assessment, allowing educator and learner to build consensus around the efficacy of the learner's clinical reasoning process
- Facilitates post-encounter reviews, making them faster, easier, and more objective by allowing educators to view specific patient encounter reports and examine the learner's reasoning process as it happened
- Helps educators quickly identify learners who are struggling, providing targeted opportunities for remediation and coaching

Investing in Clinical Reasoning Education

Medical schools, residency programs, and PA schools are embracing NEJM Healer as a wise and valuable investment for their education programs. They see it as a costeffective teaching approach that exposes more students to more cases more quickly than through traditional methods.

Reasons to incorporate this resource:

Complement to OSCEs

NEJM Healer provides a rich, cost-effective complement to standardized patient encounters. Educators can gather objective data on a learner's reasoning skills and knowledge to provide a more complete picture of student performance. Some programs may even be able to reduce the number of standardized patient encounters required for each student.

Time savings

NEJM Healer provides a way to systematically teach clinical reasoning skills or supply additional support without undue burden on educators. It allows learners to get through multiple cases quickly. It also provides immediate feedback to learners and gives educators insights that would typically take hours to obtain and convey.

Help ensure goals and requirements are met

NEJM Healer supports and integrates multiple milestones and EPAs and provides exposure to a diverse set of virtual patients and the core disease processes with which all clinicians should have experience.

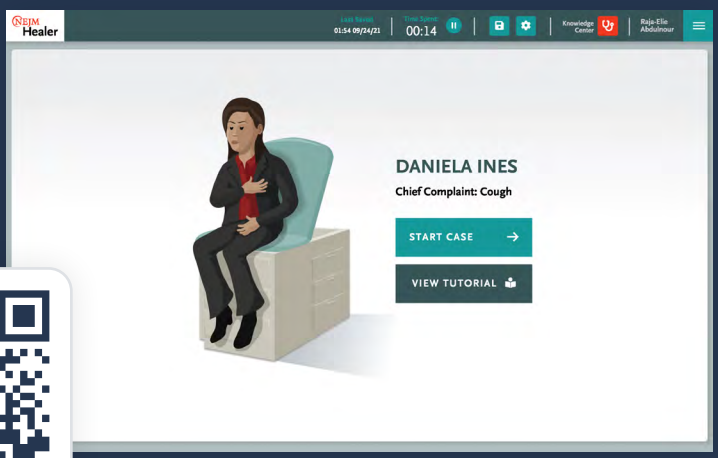
Risk reduction

NEJM Healer provides a safe opportunity to practice without risk to patients. It helps educators identify learners who need additional support quickly, minimizing the cost and time involved.

About NEJM Healer and Lecturio

NEJM Healer was developed by NEJM Group - the world's most trusted and influential source for gold-standard medical research and education. It is now powered by Lecturio, , an innovative leader in online medical and nursing education.

Lecturio offers a diverse collection of courses and tools designed to nurture the professional growth of students, educators, and practitioners. Our content is meticulously crafted by specialty experts to support the journey from foundational learning to comprehensive professional development, with an emphasis on improving patient outcomes.



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