AI and Diagnostic Excellence: The Journey Ahead for Health Professions Education

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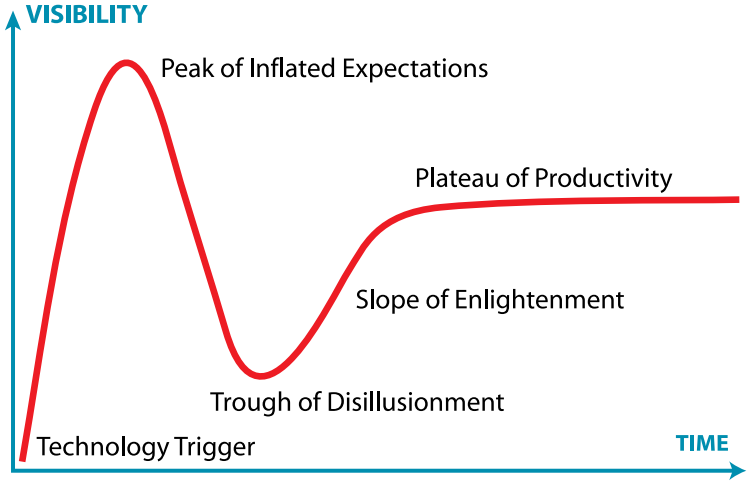
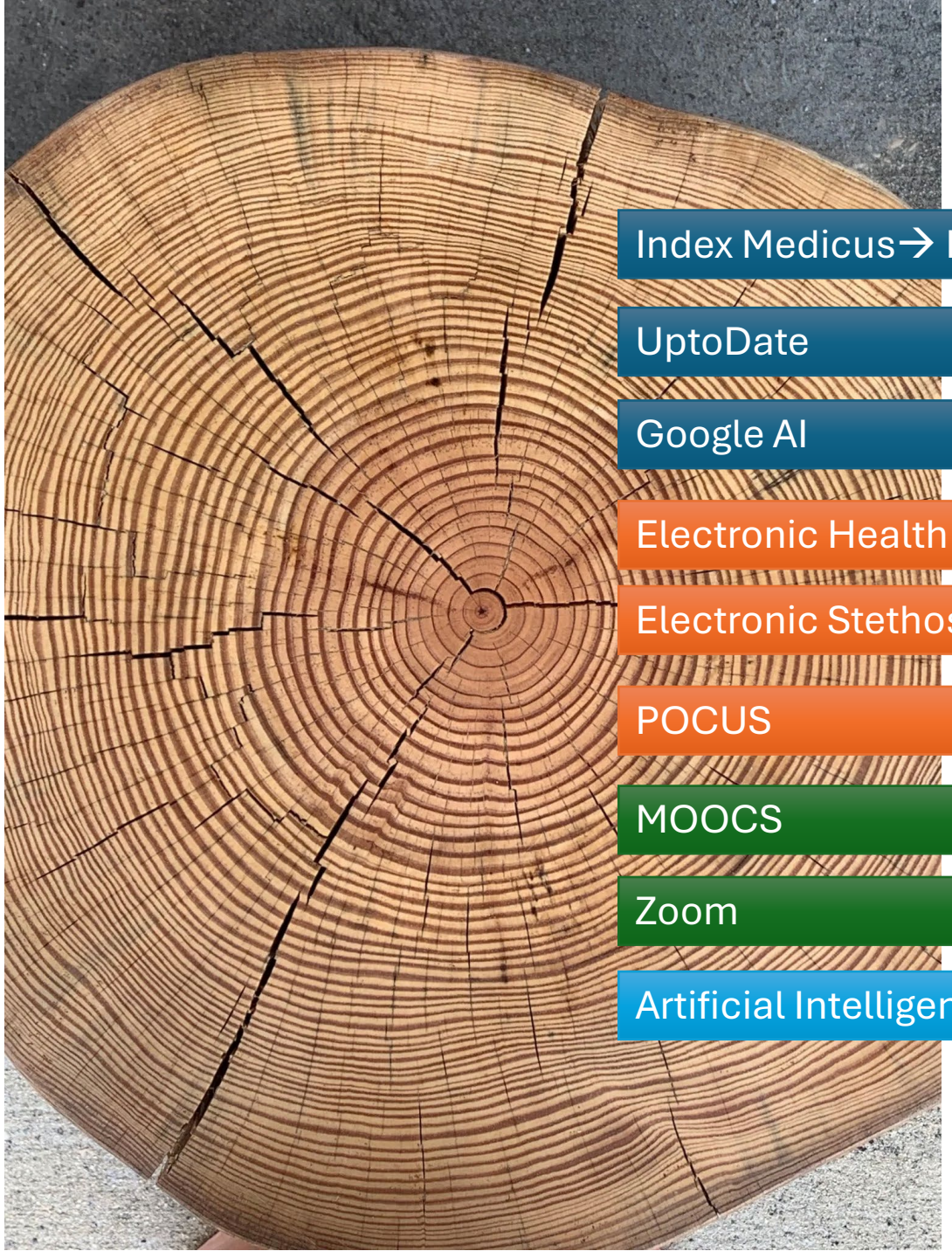
***I have no disclaimers or conflicts*.**

Conclusions

- Artificial Intelligence holds great promise for the supporting diagnostic excellence of health professionals.
- Artificial intelligence is not well suited to replacing human diagnostic reasoning, which depends on the ability to gather, organize, prioritize and synthesize highly unstructured data from the patients who seek our care.
- Our understanding of how expert diagnosticians think and decide can guide future studies on the human- AI interface in achieving the goal of diagnostic excellence.
- Health professions educators should be active participants in this work.

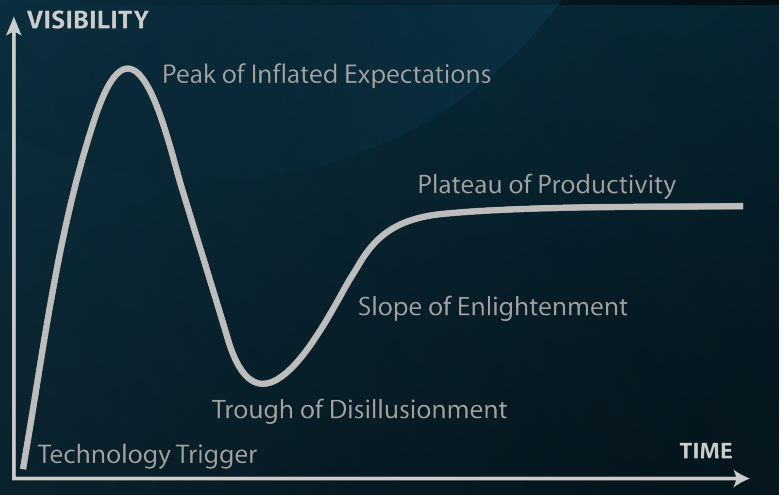
Health Professions education has been adapting to new information technologies since the Dark Ages.





- Index Medicus→ PubMed
- UptoDate
- Google AI
- Electronic Health Records
- Electronic Stethoscopes
- POCUS
- MOOCS
- Zoom
- Artificial Intelligence

AI in Medicine and Diagnostic and Teaching Excellence



The Peak of Unrealistic Expectations:

- Autonomous Diagnostic or Teaching Processes

The Trough of Disillusionment:

- Expense and Energy Impact and Availability of GPUs
- Limitations of general LLMS
- Data overload from wearables, etc
- The Challenge of Unstructured, Nondigital, Unconfirmed, Incomplete Data (history and physical exam)

The Plateau of Productivity

- Automating administrative tasks
- Rapid access to information syntheses for health professionals and the public
- AI effective in interpreting large structured data sets (Radiology/Pathology) for clinician review
- Clinician utilization of AI to confirm or expand diagnostic possibilities

HP Educational Design

Future Role	Competency	Assessment	Educational Experiences
• What will our graduates be called upon to do?	• What skill sets will they need to assume that role?	• How will we know they are ready?	• What content and methods will prepare them to succeed?

The Ideal Future Role: Diagnostic Excellence

Every person in every community, regardless of power or privilege, will be cared for by health professionals who have the diagnostic excellence that we desire for the people we love.

Guiding Principles to Achieve Diagnostic Excellence by All and for All

- Health professions education must establish **diagnostic excellence as a core competency for all** practicing clinicians and implement effective & efficient instructional and assessment strategies
- Understanding how to use and evaluating the risk/benefit of **currently available** tools and information technologies should be part of the instruction and assessment strategies.
- Learners must be prepared to **evaluate new technologies** as they arise, **just as we teach them to evaluate other scientific discoveries.**

Expert Diagnostician(s) in the 21st Century are those that navigate this process well

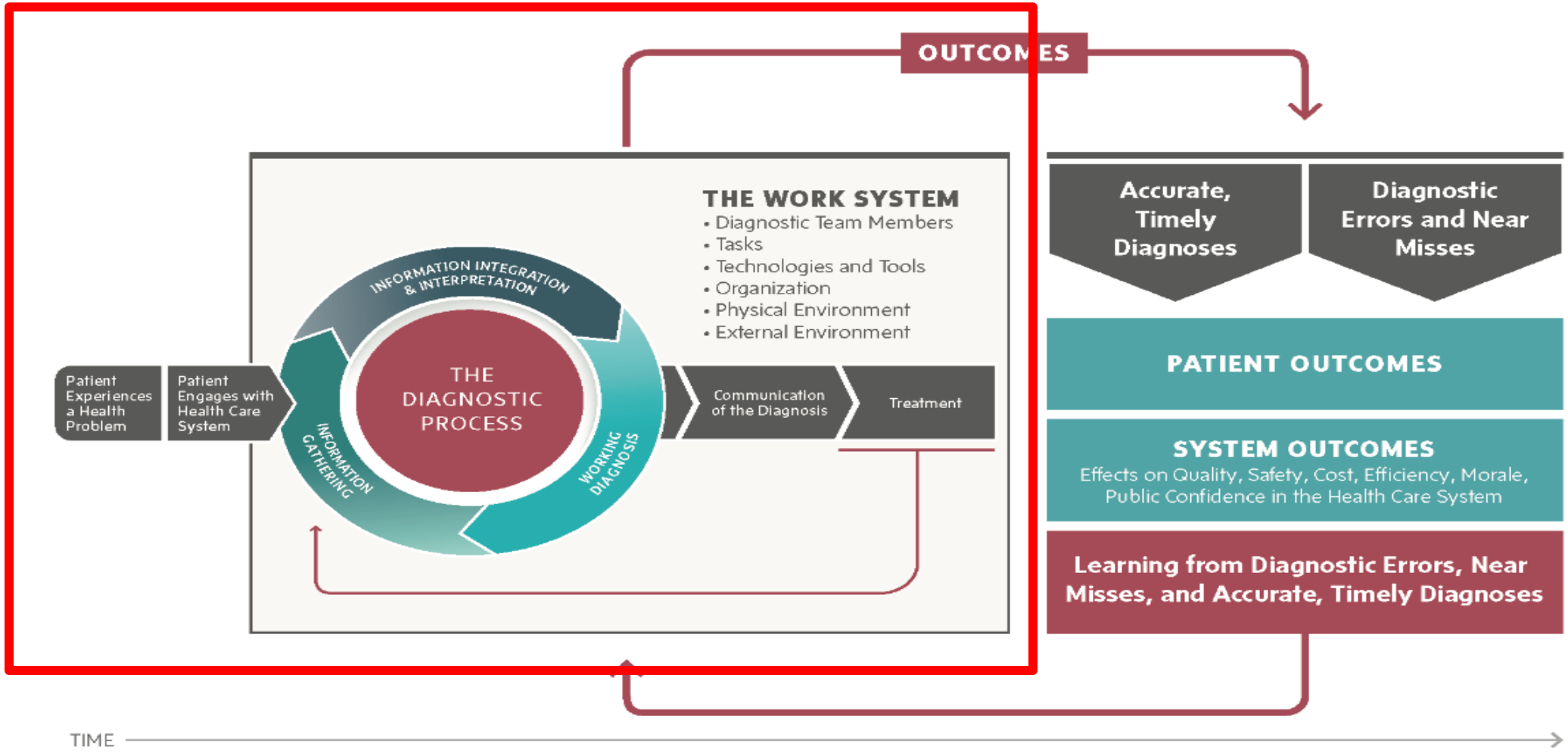
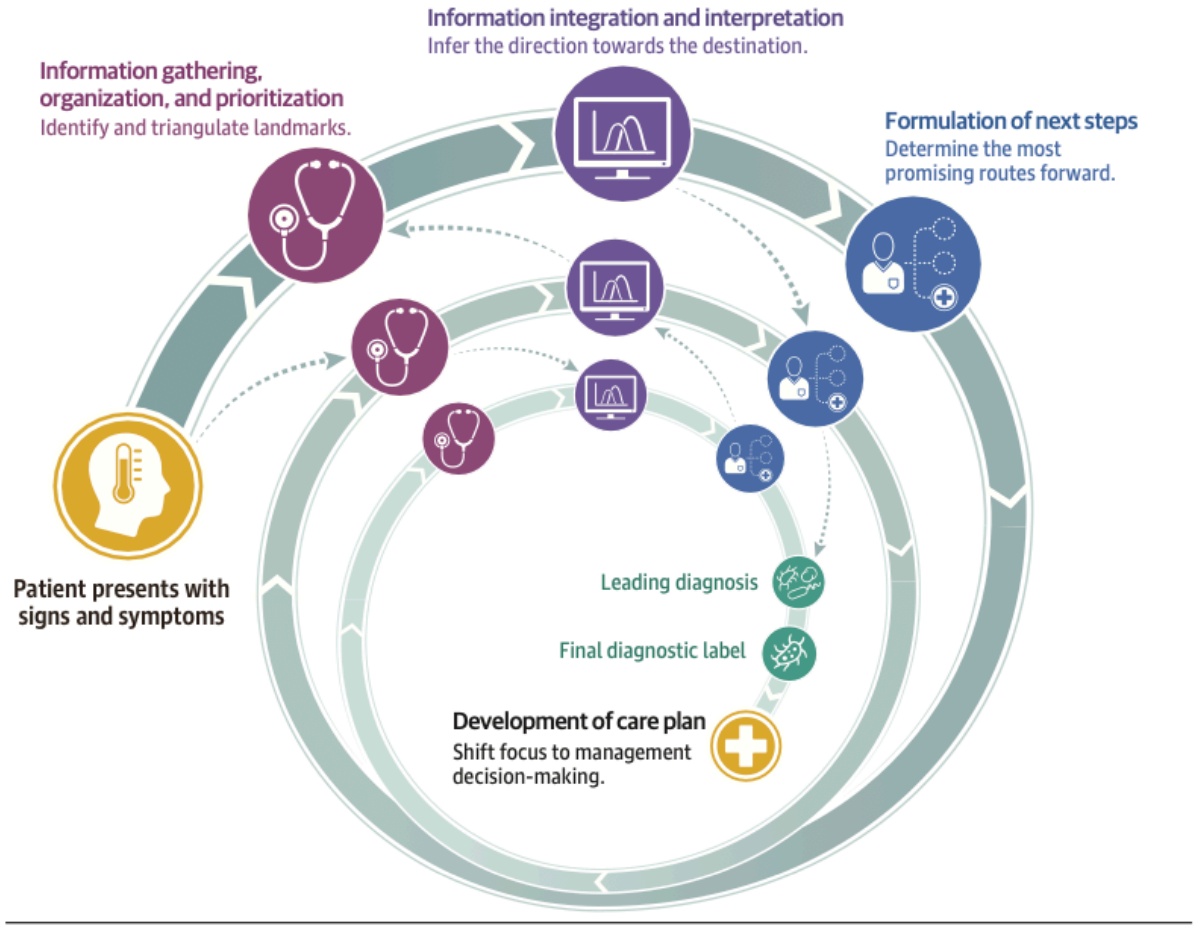


FIGURE S-3 The outcomes from the diagnostic process.

IOM 2015 Improving Diagnosis in Health Care

AI as a Partner in the Journey To Diagnostic Excellence

Figure. The Dynamic Diagnostic Refinement Process



The solid arrows illustrate the diagnostic process, and the dashed arrows illustrate how new information can alter the process. New information may increase uncertainty, causing a return to an earlier point and consideration of a broader set of possible next steps, or it may also enable jumping ahead in the process, avoiding an additional cycle. The diagnostic label is final in that it meets the administrative requirement for entering a code for billing purposes, but ongoing revision of the diagnosis, which drives treatment, is possible.

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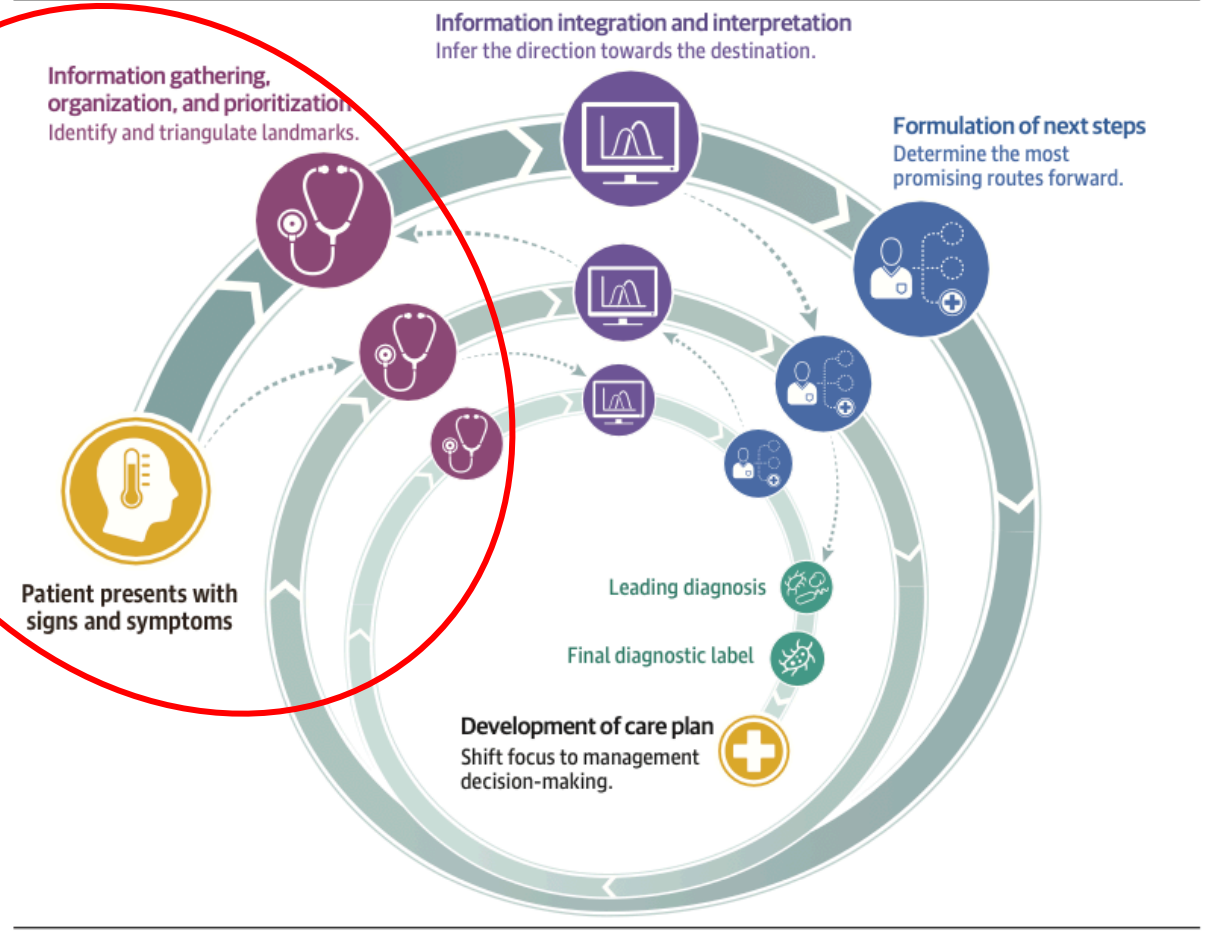

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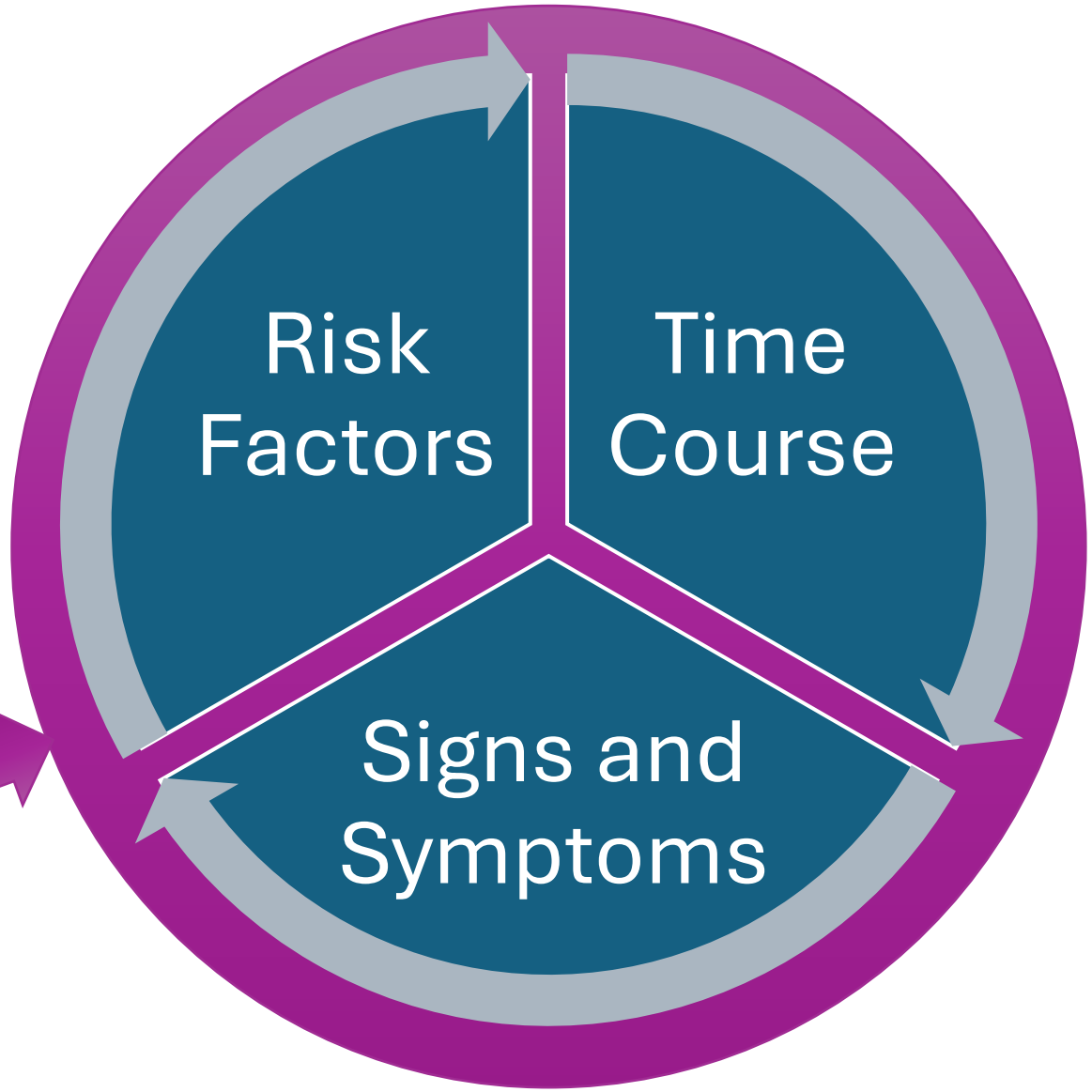
The unique ability of human professionals to contribute to a technology assisted diagnostic process is based on how experts learn and store information on diseases.

In essence, expert diagnosticians have developed a way to structure complex and ambiguous data so it can be acted upon, both in terms of gathering more, relevant data and determining next steps.

Empiric data has shown us how experts learn about and store information about disease

- Experts store critical information about disease states in illness scripts; these are configured to allow ease of cognitive access in the clinical environment: they are unlimited in number; and become expanded and elaborated with the development of expertise
  - *Schmidt 1992 Acad Med| Charlin 2000 Acad Med| Schmidt 2007 Med Educ*
- These scripts contain encapsulated foundational science information at their core; information that is used to reason in challenging situations; those with a stronger foundational science understanding are better diagnosticians.
  - *Woods 2006 Acad Med| Woods 2005 Med Ed|Norman 1994 Teach Learn Med*

Elements of an Expert's Schema

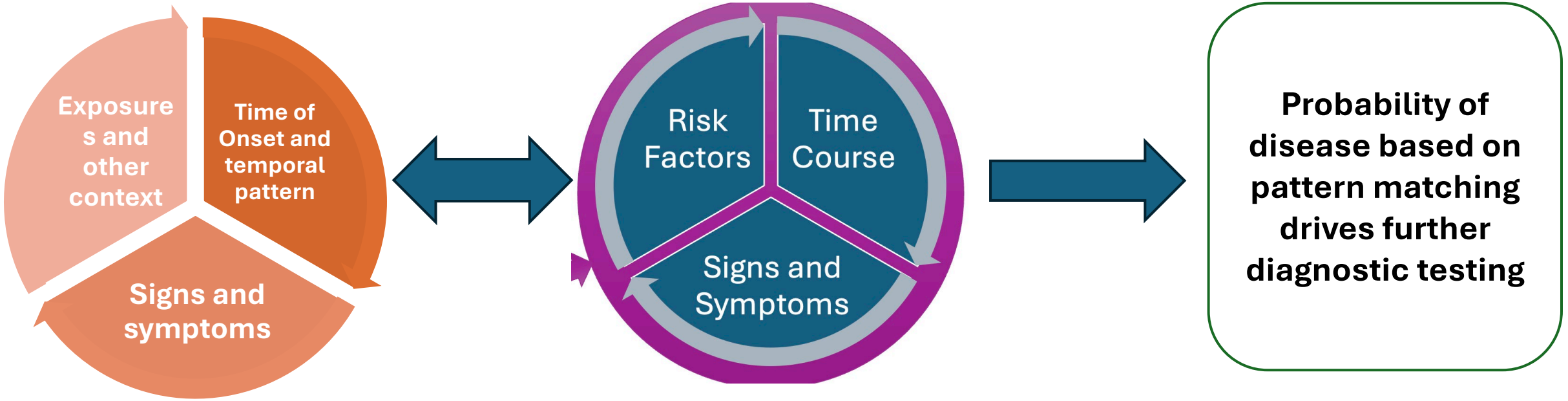


Molecular Mechanisms of Disease

Expert Diagnosticians use that storage mechanism to **select and organize** information from patients

- Develop **patient problem representations** using semantic qualifiers to activate the most relevant memory stores
  - *Schmidt 1993 Acad Med|Bordage 2007 Med Educ |Bowen 2006 NEJM*
- Use an interplay between intuitive/automatic (System 1) and analytic (System 2) strategies to determine next questions and next steps.
  - *Mamede 2010 Psyc Rev|Ark 2006 Acad Med|Ilgen 2013 Acad Med| Moulton 2010 Acad Med|*
- Engage in reflective reasoning to expand and organize knowledge as a form of deliberate practice
  - *Ericsson KA 1993 Psychol Rev| Mamede 2004 Med Ed|Norman 2016 Acad Med*

Structuring patient data into the same format as illness schema facilitates memory activation, data collection and prioritization of diagnostic likelihoods



Patient's illness schema

Disease Schema

HP educators have leveraged this knowledge of how novices become experts to support the development of diagnostic excellence.

- Using the illness script framework as the core of diagnostic reasoning education provides scaffolding for learners to learn about disease in a manner that supports expert reasoning.
- Like experts, students are taught to use this framework to select and organize data from their patients as they conduct history and physical exams.
- The illness script framework supports continuous, iterative cycles of hypothesis testing to arrive at a prioritized differential diagnosis.

Additional Elements to Preparing Learners for Current and Future Information Technologies

- The ‘Basic Science of AI’, such that
  - Guidance on when to use and when not to use makes sense
  - The risk of biases is clear and appropriate skepticism can be employed
- Strategies to recognize when the technology is wrong or not working
- Strategies to read and consider new uses of existing technology and new technologies.

Future Exploration: How might we use/train AI to…

- Improve our understanding of the origins of disease and thus our illness scripts?
- Recommend other questions that might change the direction of thinking or prevent premature closure and other biases?
- Coach learners to identify gaps in their knowledge of disease or their information seeking strategies?
- Identify diagnostic errors before they reach the patient
- Guide patients as they seek information from trusted sources?

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