

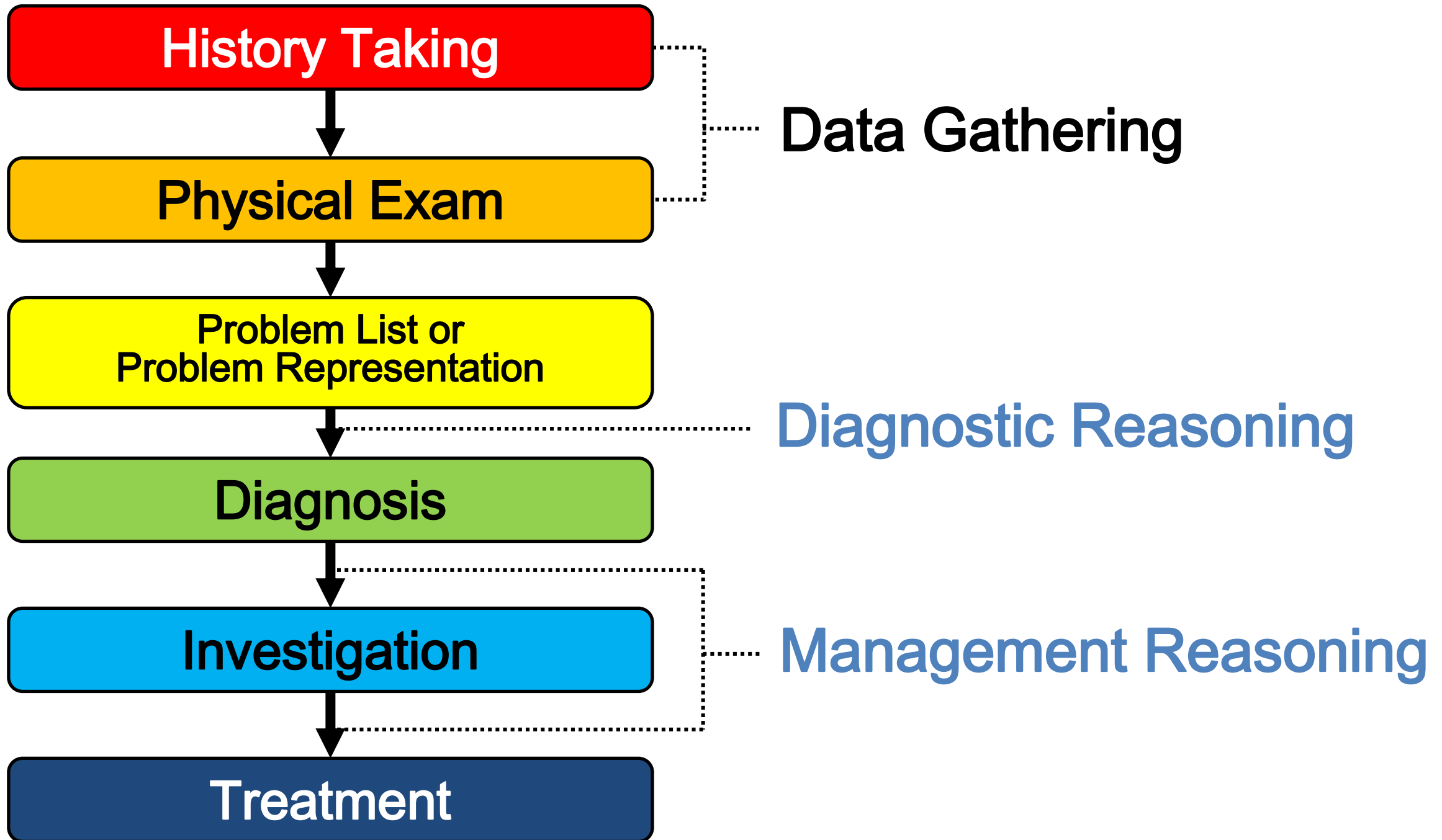


Unfolding Clinical Reasoning

Supot Pongprasobchai, MD

Department of Medicine, Siriraj Hospital

LINE ID: supotpong



Topics

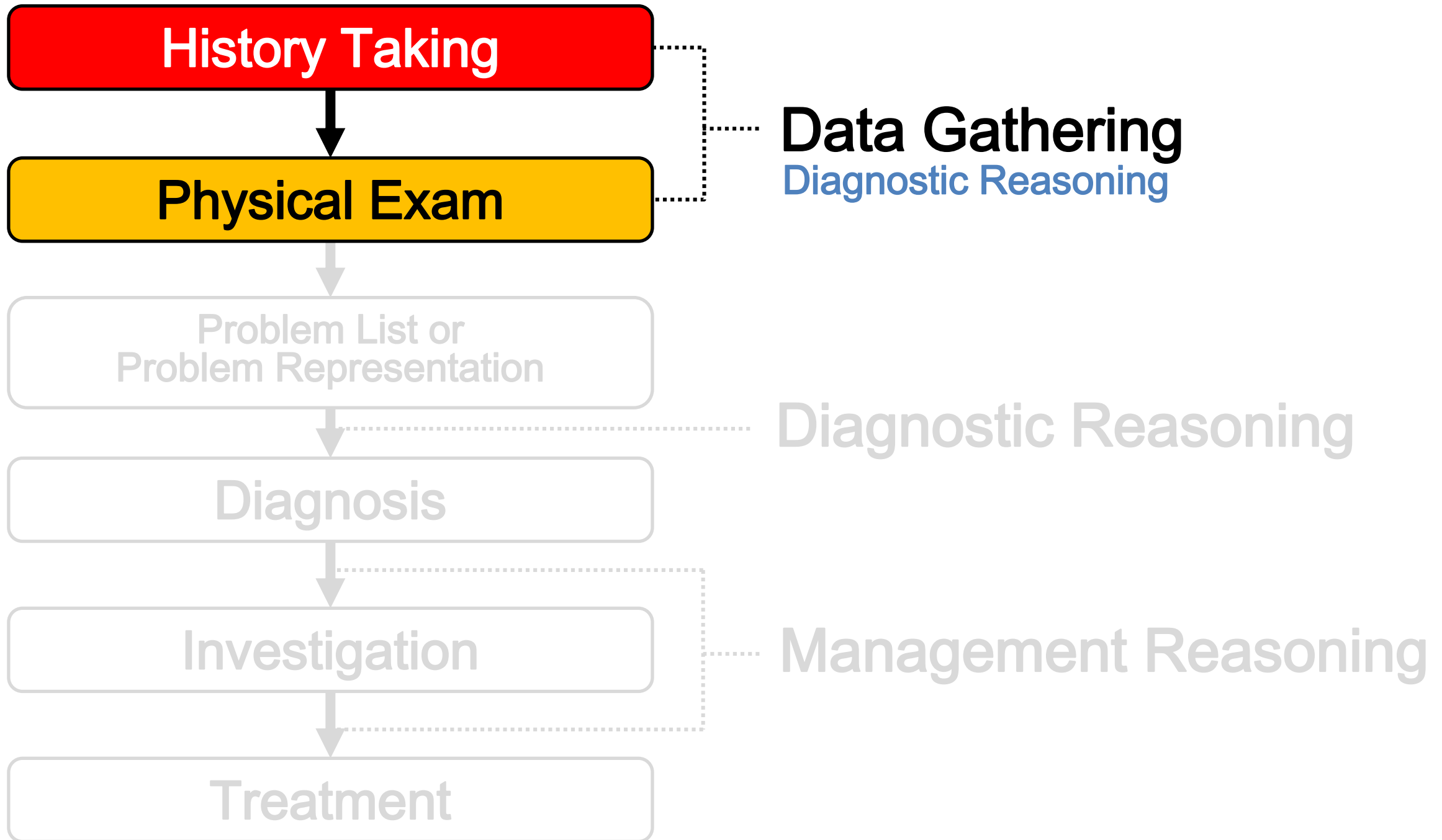


- I. CR in data gathering**
- II. Problem list (PL) & Problem representation (PR)**
- III. Diagnostic reasoning (DR)**
- IV. Management reasoning (MR)**

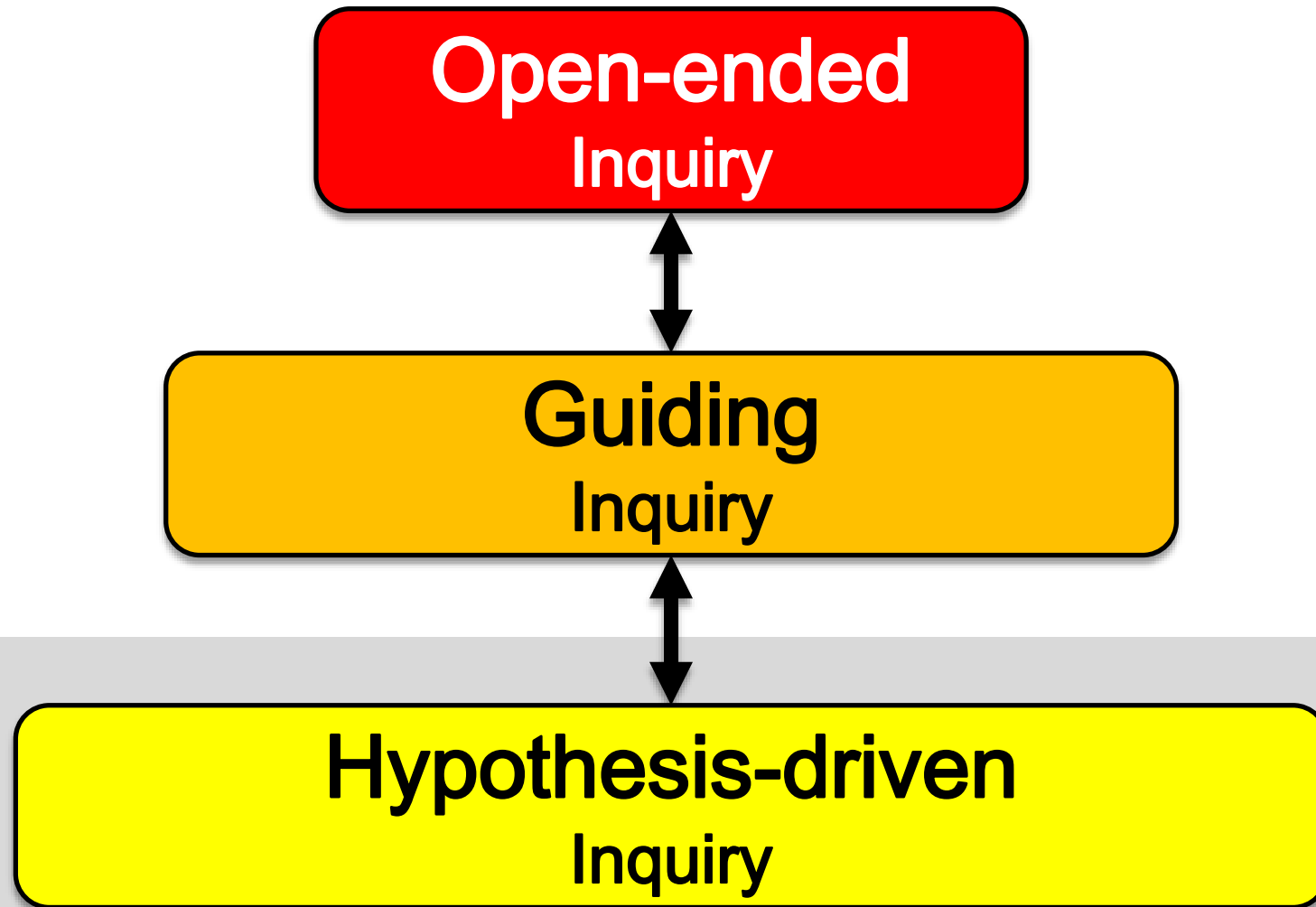


I

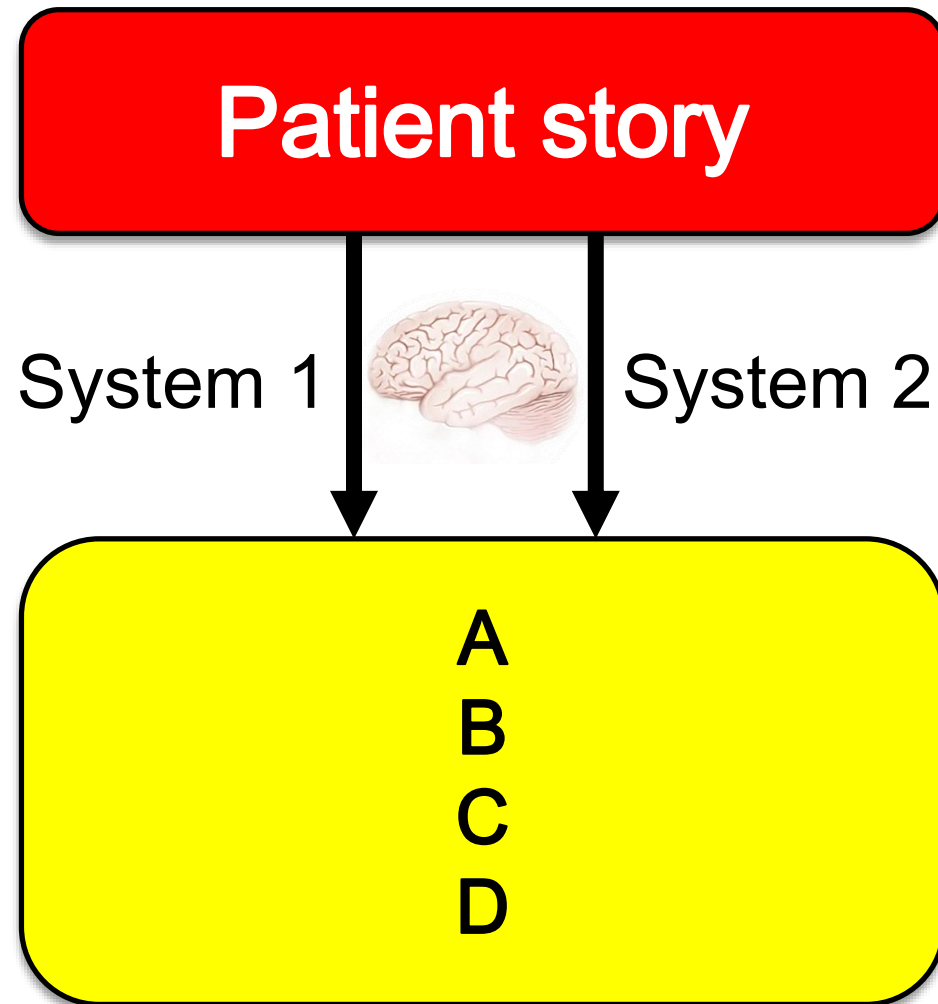
CR in Data Gathering



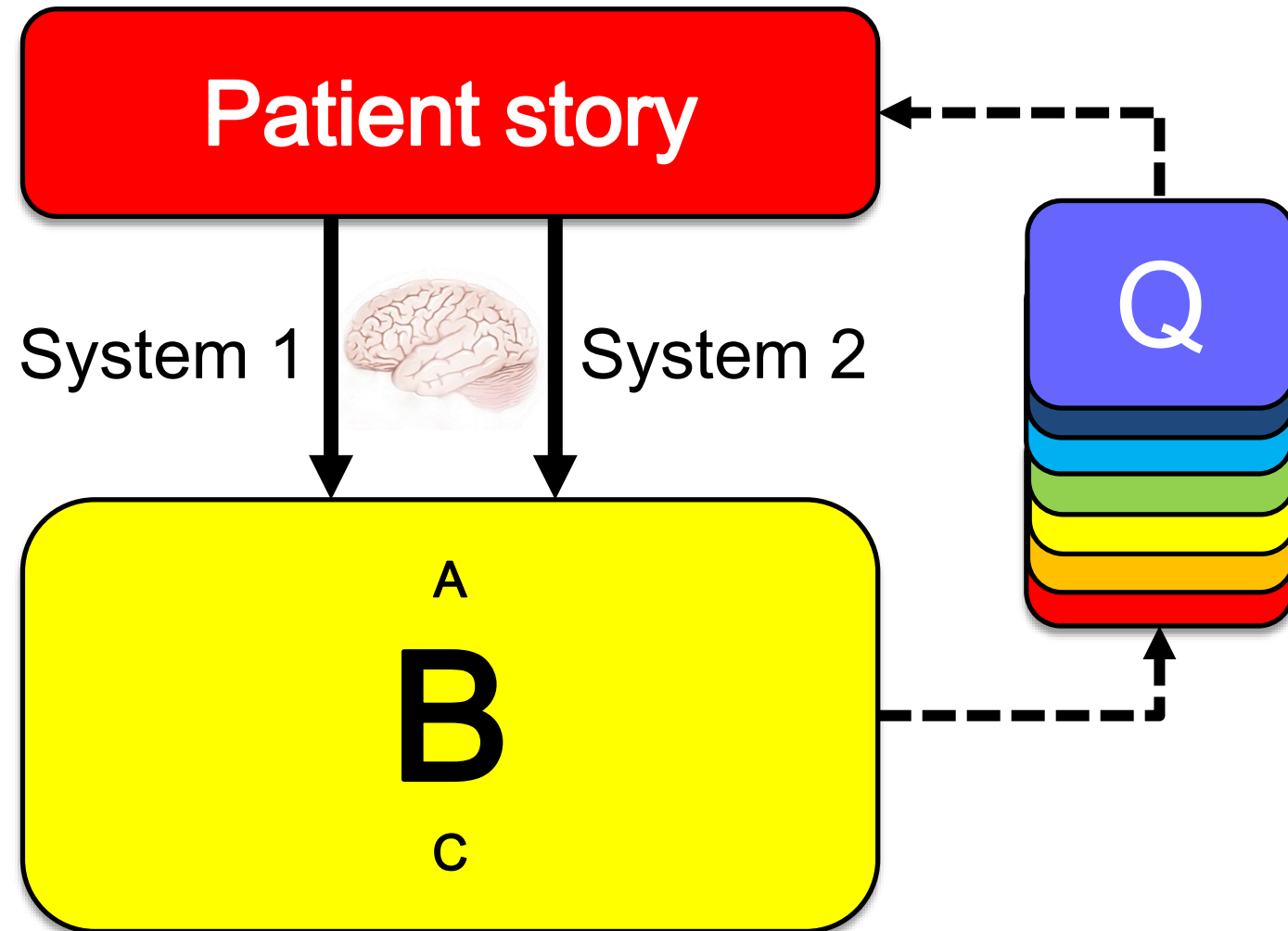
1) History Taking



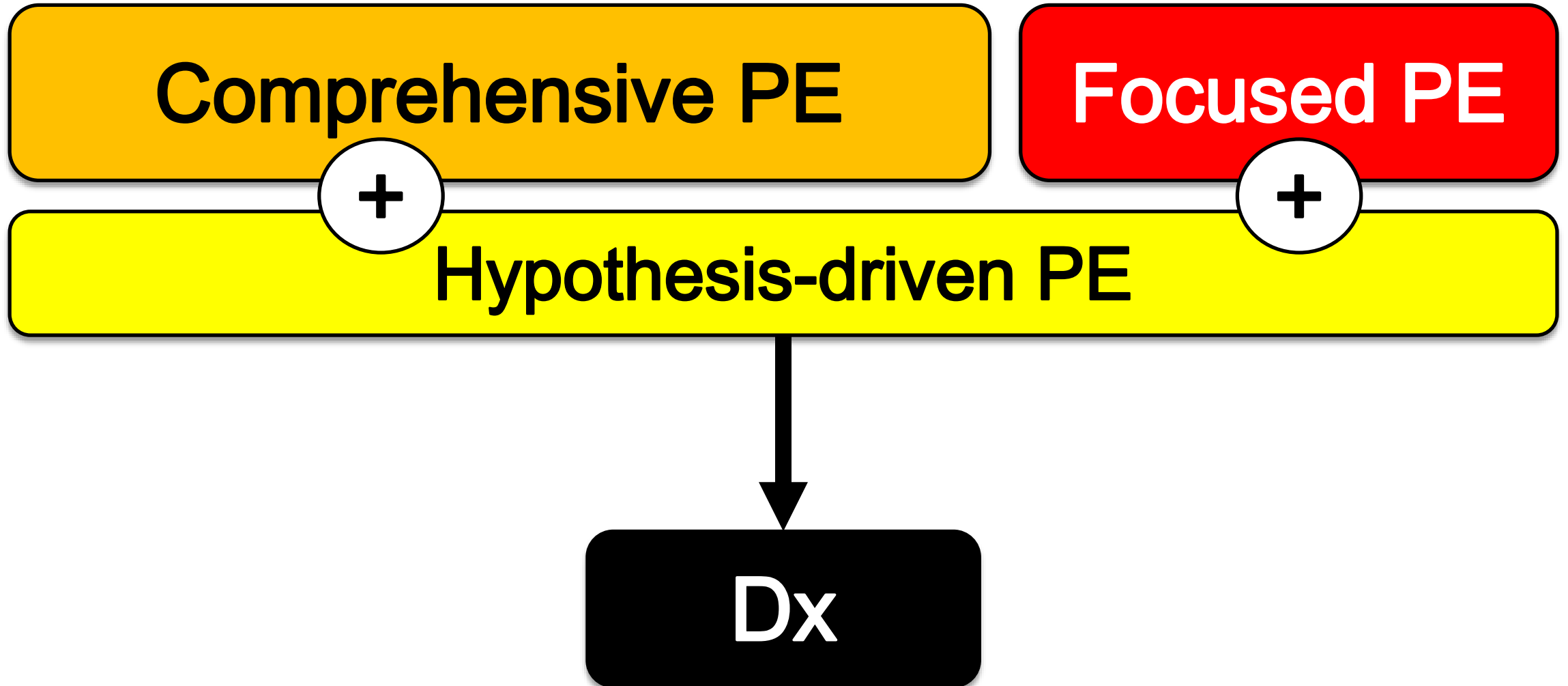
Hypothesis-driven Inquiry



Hypothesis-driven Inquiry



2) Physical Examination (PE)





Hypothesis-driven PE

*'You see
what you look for.
You recognize
what you know.'*

Irfan Mamoun, MD



Hypothesis-driven PE

Hypotheses
from Hx Taking

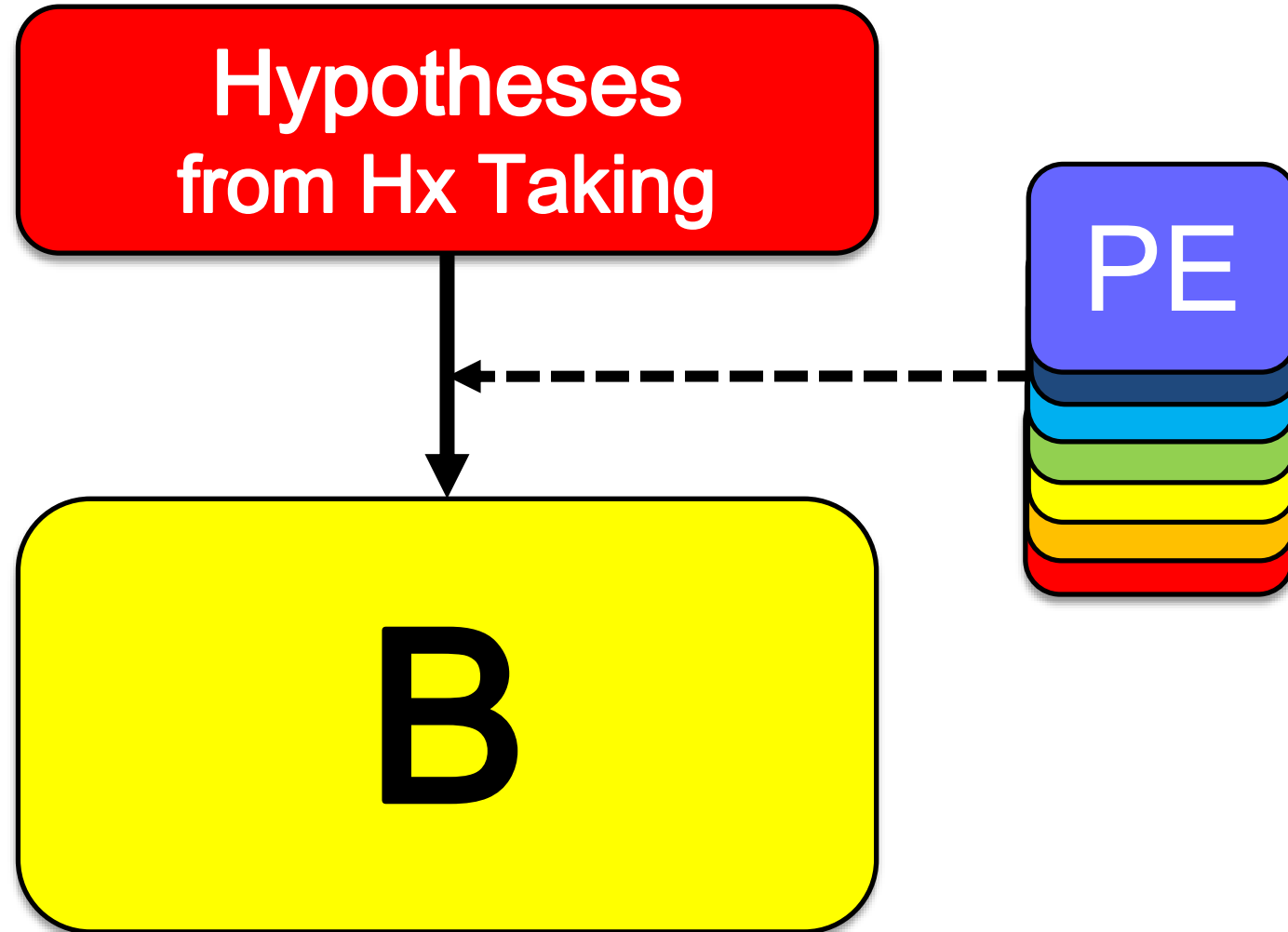
```
graph TD; A[Hypotheses from Hx Taking] --> B["A<br/>B<br/>C"]
```

A

B

C

Hypothesis-driven PE



Essential Knowledge for Hypothesis-driven Hx & PE

Disease X	Typical features	S	Sp
Hx	Symptom A	...	...
	Symptom B	...	...
	Symptom C	...	...
PE	Sign A	...	...
	Sign B	...	...
	Sign C	...	...

I. CR in Data Gathering

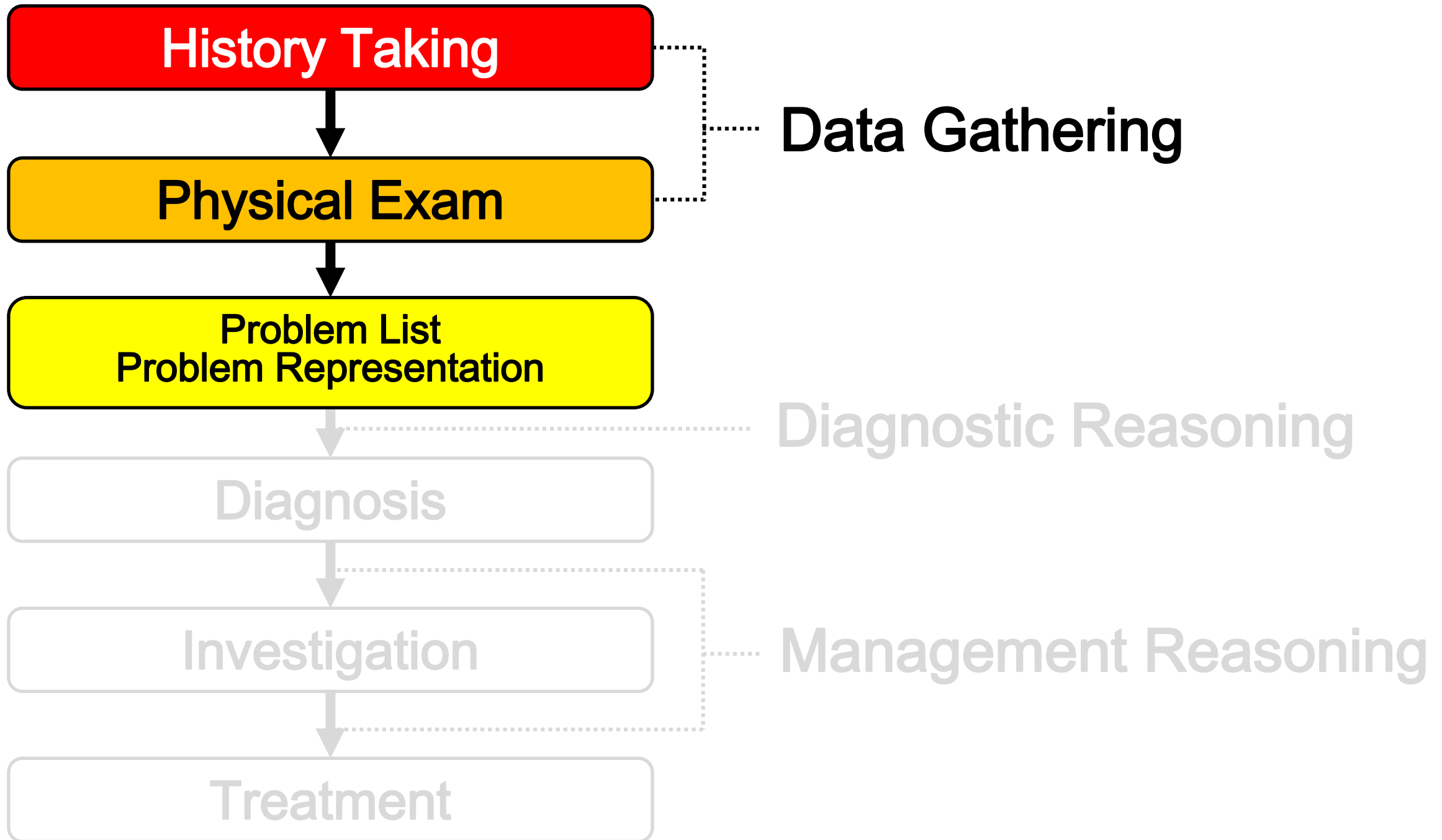
Conclusion

- Add hypothesis-driven inquiry during Hx taking
- Add hypothesis-driven PE on usual PE
- Knowledge of key symptoms & signs of each disease is essential (= illness scripts)



II

Problem List & Problem Representation



The First Introduction of Problem List

Vol. 278 No. 11

MEDICAL RECORDS THAT GUIDE AND TEACH—WEED

593

SPECIAL ARTICLE

MEDICAL RECORDS THAT GUIDE AND TEACH

LAWRENCE L. WEED, M.D.*

Problem List



Management Purpose

- **Medical terms**
 - Concise
 - Aggregated
- **No duration**
- **Sort by importance**

PROBLEM LIST

- #1 Rheumatic Heart Disease
 - a. Mitral insufficiency
 - b. Atrial fibrillation
 - c. Compensated congestive failure TTB
 - d. Cardiac catheterization
 - e. Successful cardioversion
- #2 Presumed SBE
- #3 Mild Diabetes Mellitus – adult onset
- #4 Repeated pulmonary embolism
- #5 Post. Inferior Vena Cava Ligation
- #6 Allergic dermatitis
- #7 Arthralgia
- #8 Family problems

Problem List

Management Purpose

- Medical terms
 - Concise
 - Aggregated
- No duration
- Sort by importance

Diagnostic Purpose

Context
Clinical
Chronology

Problem List

Management Purpose

- Medical terms
 - Concise
 - Aggregated
- No duration
- Sort by importance

Diagnostic Purpose

- Medical terms
 - Concise
 - Aggregated
 - Informative (SQ)*
- Have duration*
- Sort by chronology*
- Have context*

Informative = Semantic Qualifiers (SQ)

Acute – Chronic

Sudden – Insidious

Intermittent – Continuous

Mild – Severe

Unilateral – Bilateral

Mono – Poly

Chronology & Sorting

By Importance

- Respiratory failure 1 h
- Dyspnea 2 d
- High grade fever 3 d
- Productive cough 1 wk

By Chronology

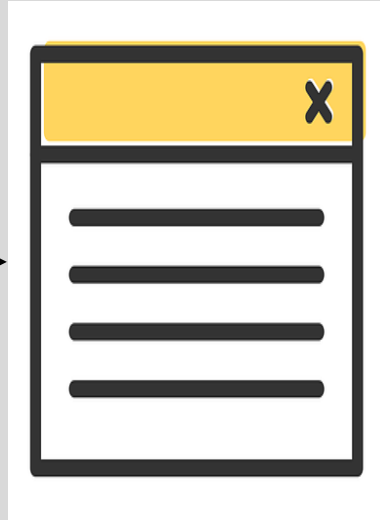
- Productive cough 1 wk
- High grade fever 3 d
- Dyspnea 2 d
- Respiratory failure 1 h

Problem List (PL)

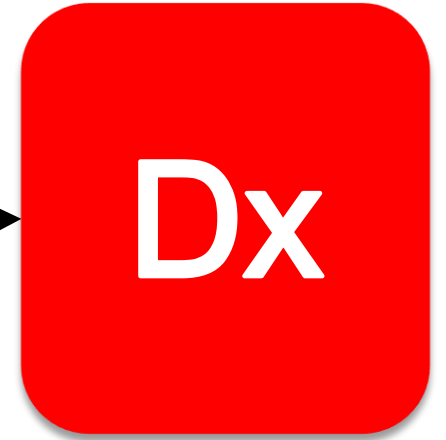
1. Recurrent acute monoarthritis right knee
1 year
2. Hyperuricemia
3. HT and DLP



Hx, PE



PL

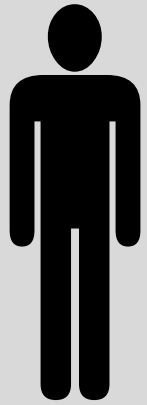




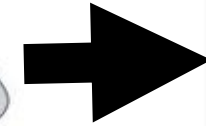
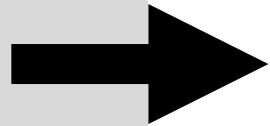
'Mental Abstraction'



Hx, PE



PR



Problem Representation (PR)

'1-Liner' or 'Summary Statement'

Context

'A middle-aged man with HT and DLP presents with recurrent acute monoarthritis of right knee for 1 y and hyperuricemia'

Clinical

Chronology

Early *Problem Representation* Makes Dx More Accurate

Chang RW. *Acad Med* 1998;73:S109-11

RCT

Use *Problem Representation* Makes Dx Faster

Braun LT. *Med Educ* 2017;51:1118–26






Articulating '*Problem Representation*'

Bowen JL. *NEJM* 2006;355:2217-25

Cooper N. *Med Teach* 2021;43:152-9

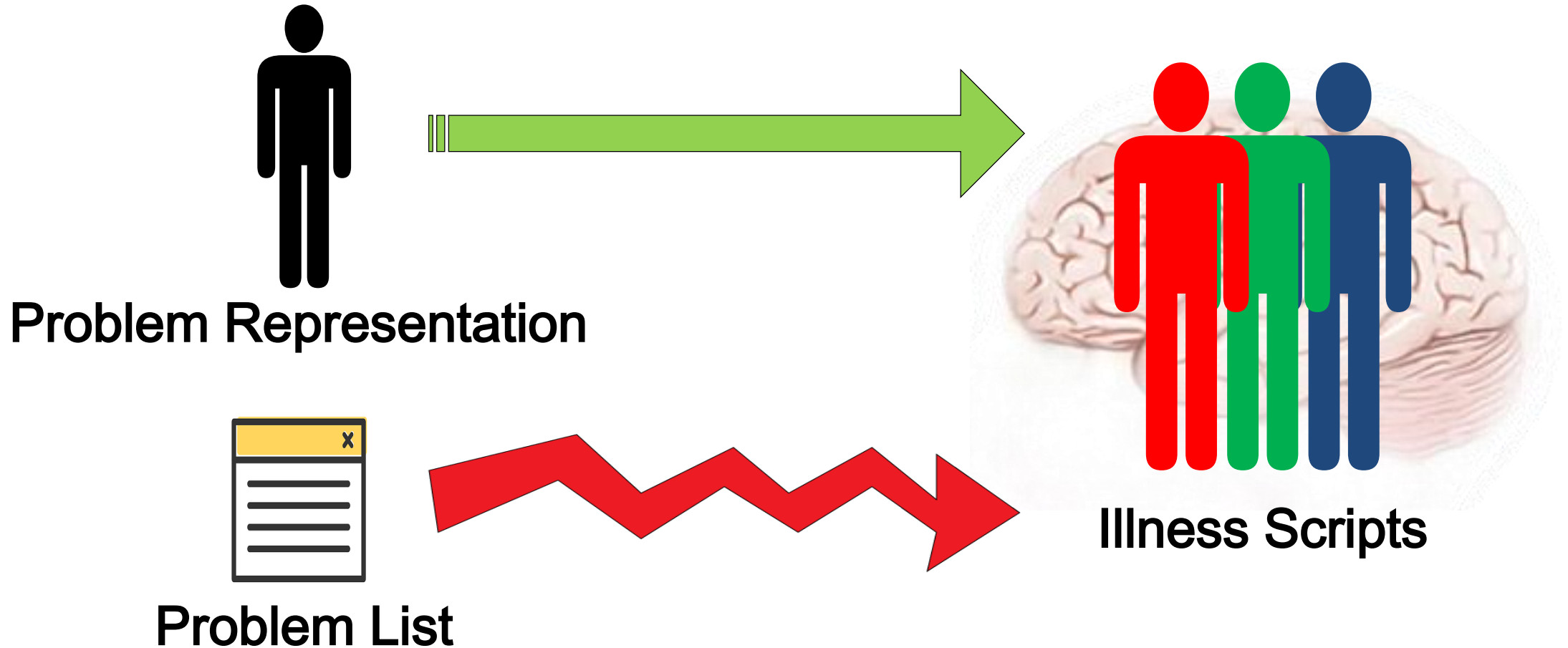
Penner JC. *J Gen Intern Med* 2023;38:3041-6

Characteristics differentiating problem representation synthesis between novices and experts

Casey N. McQuade MD, MS¹   | Michael G. Simonson MD, MS¹  |
Julia Lister MD^{2,3} | Andrew P. J. Olson MD^{2,3}  | Laura Zwaan PhD⁴  |
Scott D. Rothenberger PhD¹ | Eliana Bonifacino MD, MS¹

- Experts include **fewer co-morbidities** than novices
- PR with **3C** = 5x more accurate Dx
- PR with **SQ** = 5x more accurate Dx

PR May be Better than PL for Dx



‘Hybrid’ Problem List

Add PR to PL

A 40-YO man with HT and DLP presents with

- 1. Recurrent acute monoarthritis of right knee 1 y**
- 2. Hyperuricemia**

'Hybrid' Problem List

Add PR to PL

Context

A 40-YO man with HT and DLP presented with

1. Recurrent acute monoarthritis of right knee
2. Hyperuricemia

1 y

Clinical

Chronology

Art of Context

A 60-year-old man with stage IV-NSCLC, DM, HT, DLP, BPH, C-spondylosis, ...

- Appropriate information in context: improves Dx accuracy
- Salient distracting features (SDF): worsens Dx accuracy
- Sequence of information: earlier impacts more

II. Problem List / Problem Representation

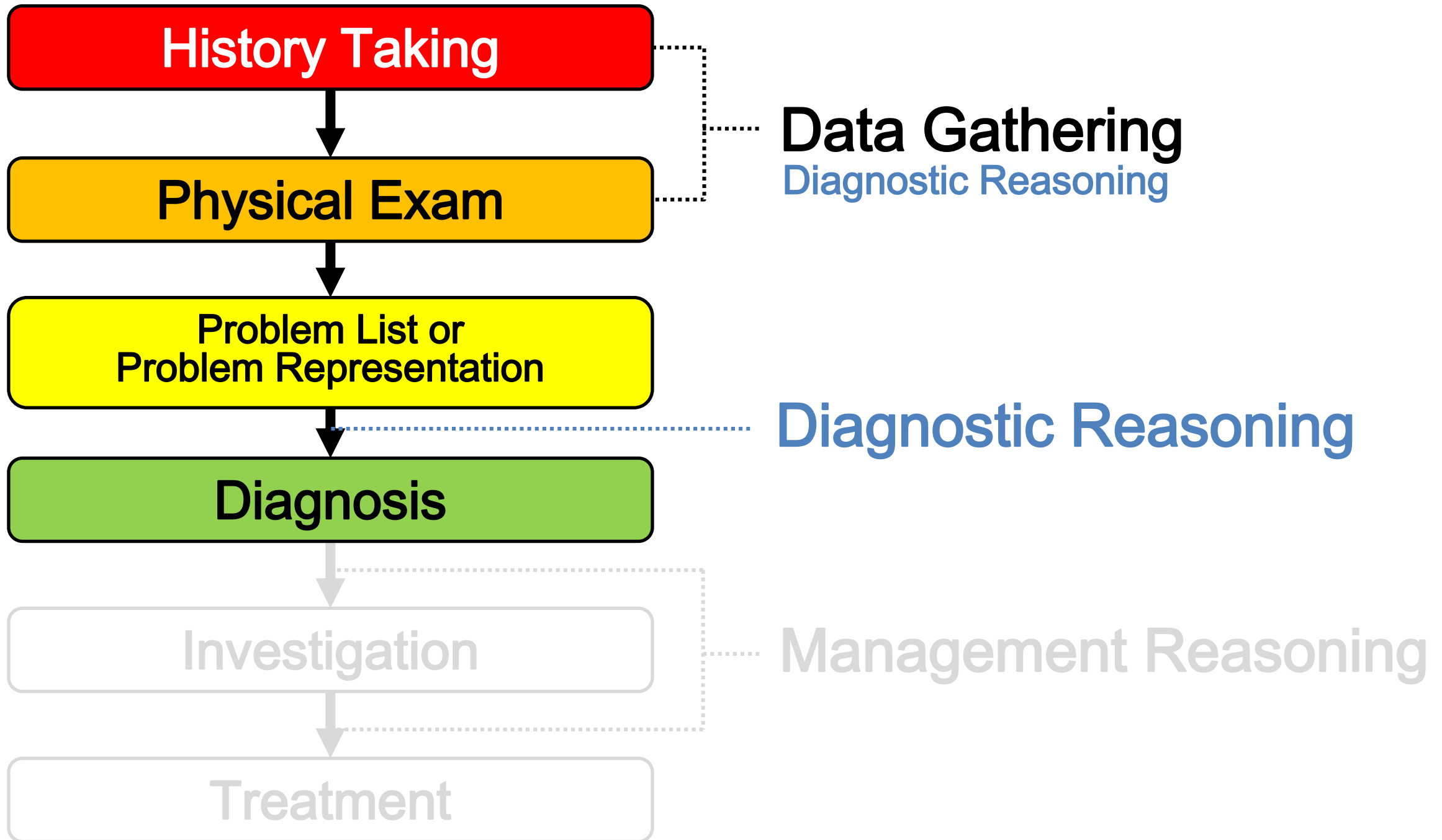
Conclusion

- Always formulate **PR** or **PL** or **hybrid PL**
- Good PL/PR must have **Context**, **Clinical**, **Chronology (3C)**
- Good PL/PR must have **SQ**
- For Dx, PR may be **better** than PL



III

Diagnostic Reasoning





‘Dual Process Theory’

Problem list / Problem representation

```
graph TD; A[Problem list / Problem representation] --> B[System 1 reasoning<br/>(non-analytic, intuitive, pattern recognition,<br/>forward, fast thinking)]; A --> C[System 2 reasoning<br/>(analytic, hypothetico-deductive,<br/>backward, slow thinking)]; B --> D((Illness scripts)); D -.->|>1| E[Elstein]; D -->|1| F[Diagnosis]; C --> E; C --> G[Eddy & Clanton]; E --> F; G --> F;
```

System 1 reasoning

(non-analytic, intuitive, pattern recognition,
forward, fast thinking)

System 2 reasoning

(analytic, hypothetico-deductive,
backward, slow thinking)

**Illness
scripts**

>1

Elstein

**Eddy &
Clanton**

1

Diagnosis

Problem list / Problem representation

System 1 reasoning

(non-analytic, intuitive, pattern recognition,
forward, fast thinking)

System 2 reasoning

(analytic, hypothetico-deductive,
backward, slow thinking)

Illness
scripts

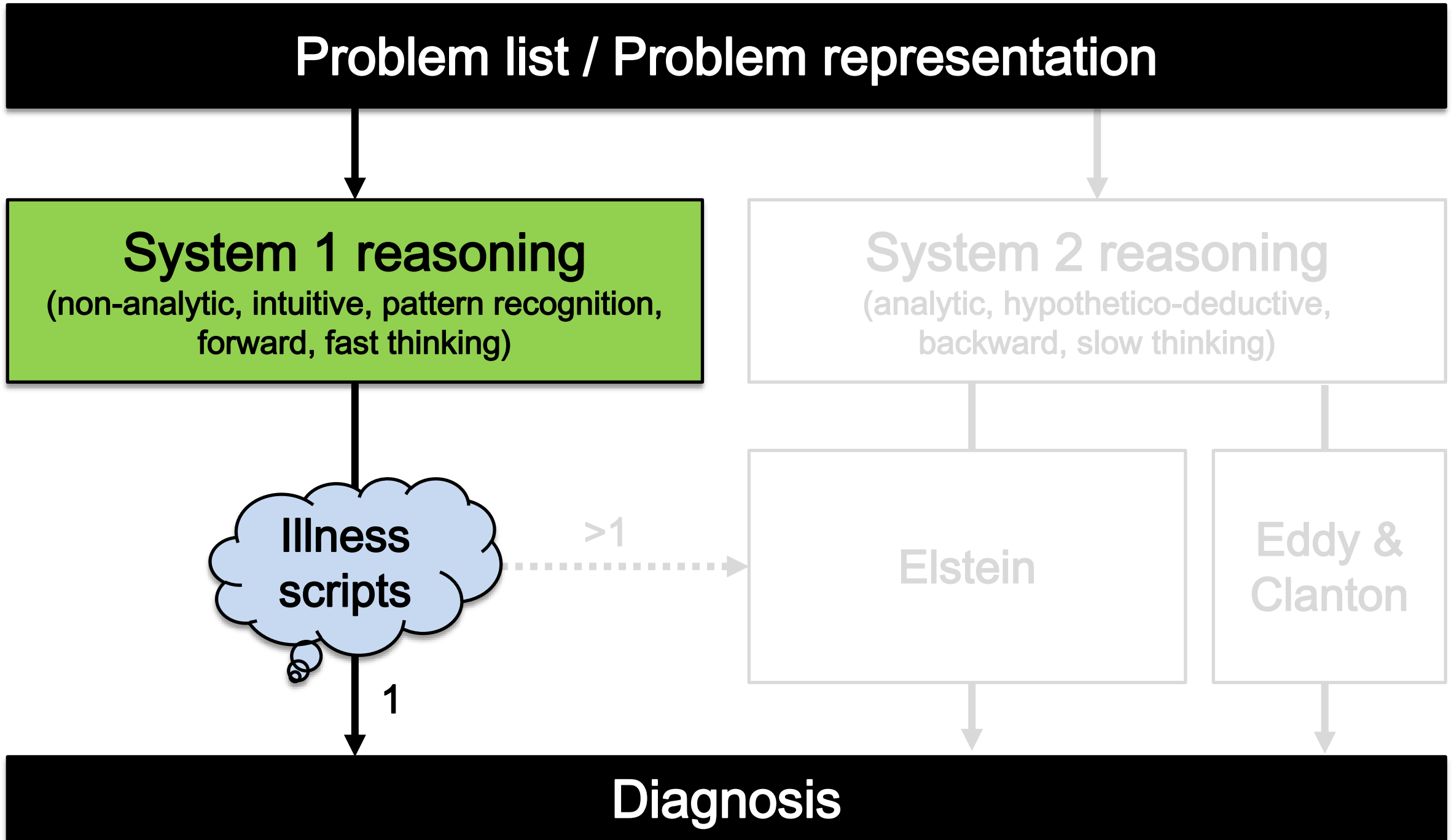
>1

Elstein

Eddy &
Clanton

1

Diagnosis



System 1 Reasoning

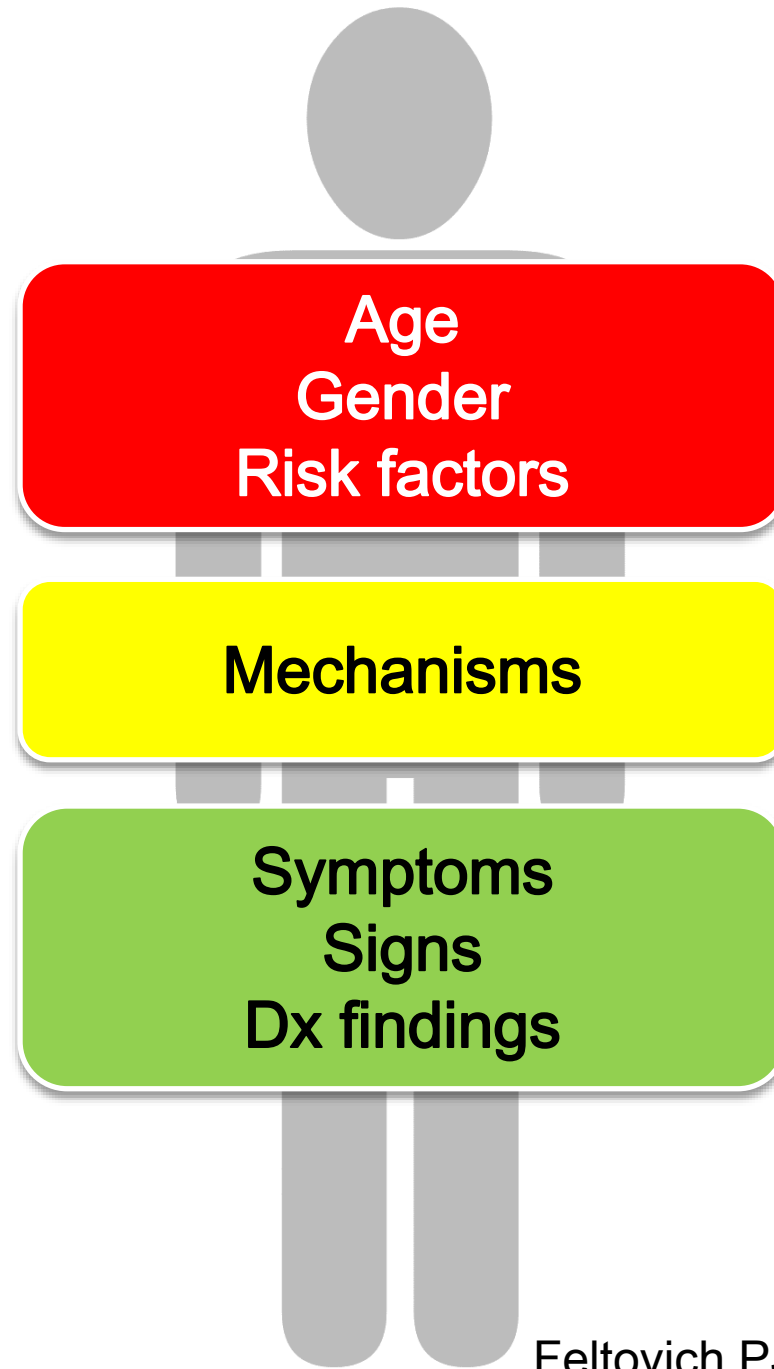
Fever, cough, running nose	URI
Unilateral temporal headache, aura, N-V	Migraine
Dyspnea, orthopnea, edema, crepitation	CHF
Pollakiuria, dysuria, turbid urine	Cystitis
Fever, headache, stiff neck	Meningitis



Illness Scripts

Illness Script

Template



Illness Script

Acute Cholecystitis

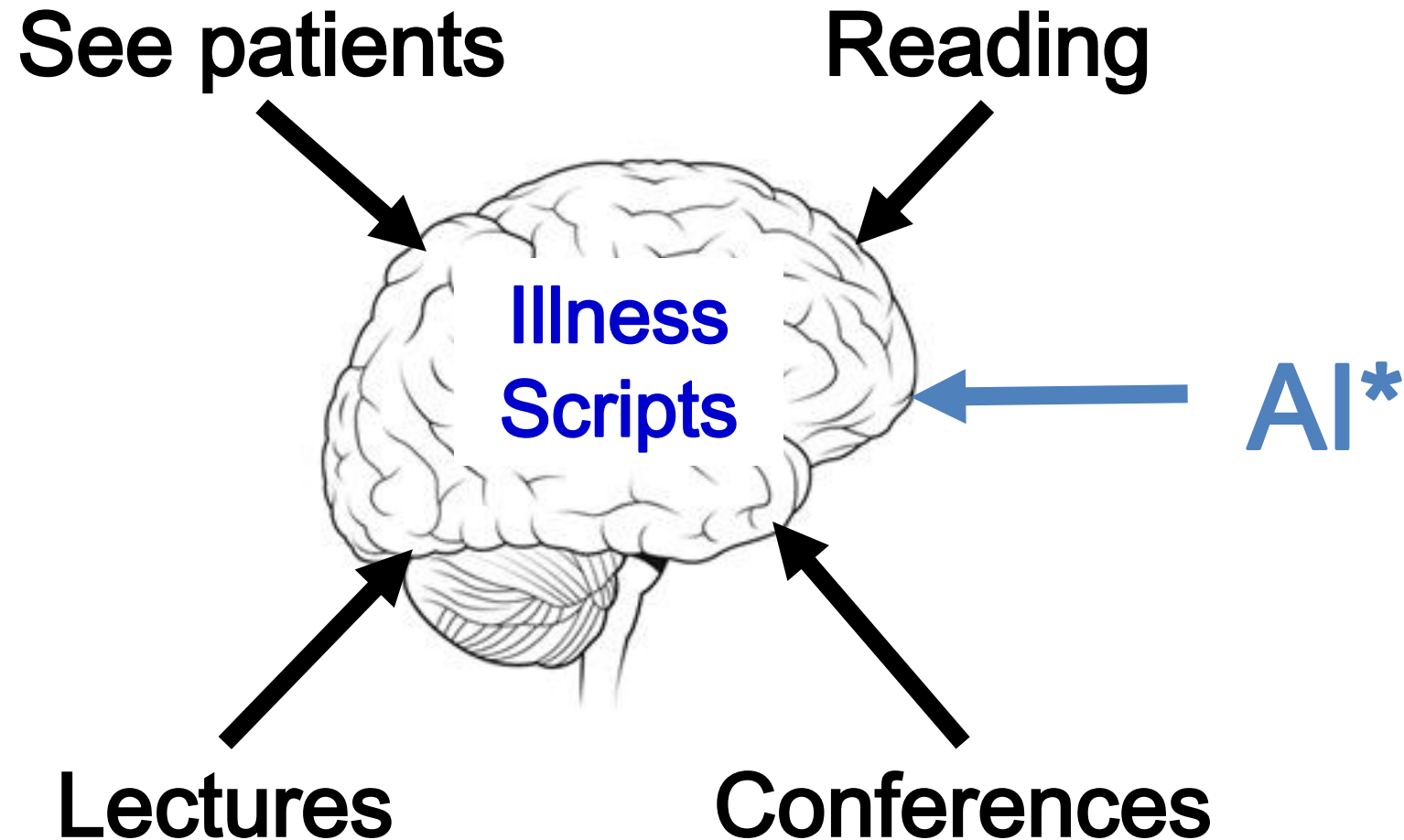


F > M,
middle to old age

Cystic duct obstruction,
GB distension,
inflammation,
2° bacterial infection

Epigastric pain >6 h,
RUQ tenderness,
fever, sepsis,
Murphy's sign (80%),
Jaundice (<5%)

Where Do Illness Scripts Come from?



ChatGPT for Illness Scripts

Subarachnoid Haemorrhage

[Pathophysiology] Bleeding into subarachnoid space, often due to ruptured aneurysm or arteriovenous malformation.

[Epidemiology] Risk factors: Age (50-60), Hypertension, Smoking, Excessive alcohol, Family history.

[Time course] Acute: seconds to minutes, Rapid onset, severe headache ("worst headache of life").

[Symptoms and signs] Sudden severe headache, Neck stiffness, Photophobia, Vomiting, Seizures, Focal neurologic signs.

[Diagnostics] Non-contrast CT head, Lumbar puncture if CT negative, Cerebral angiography for source identification.

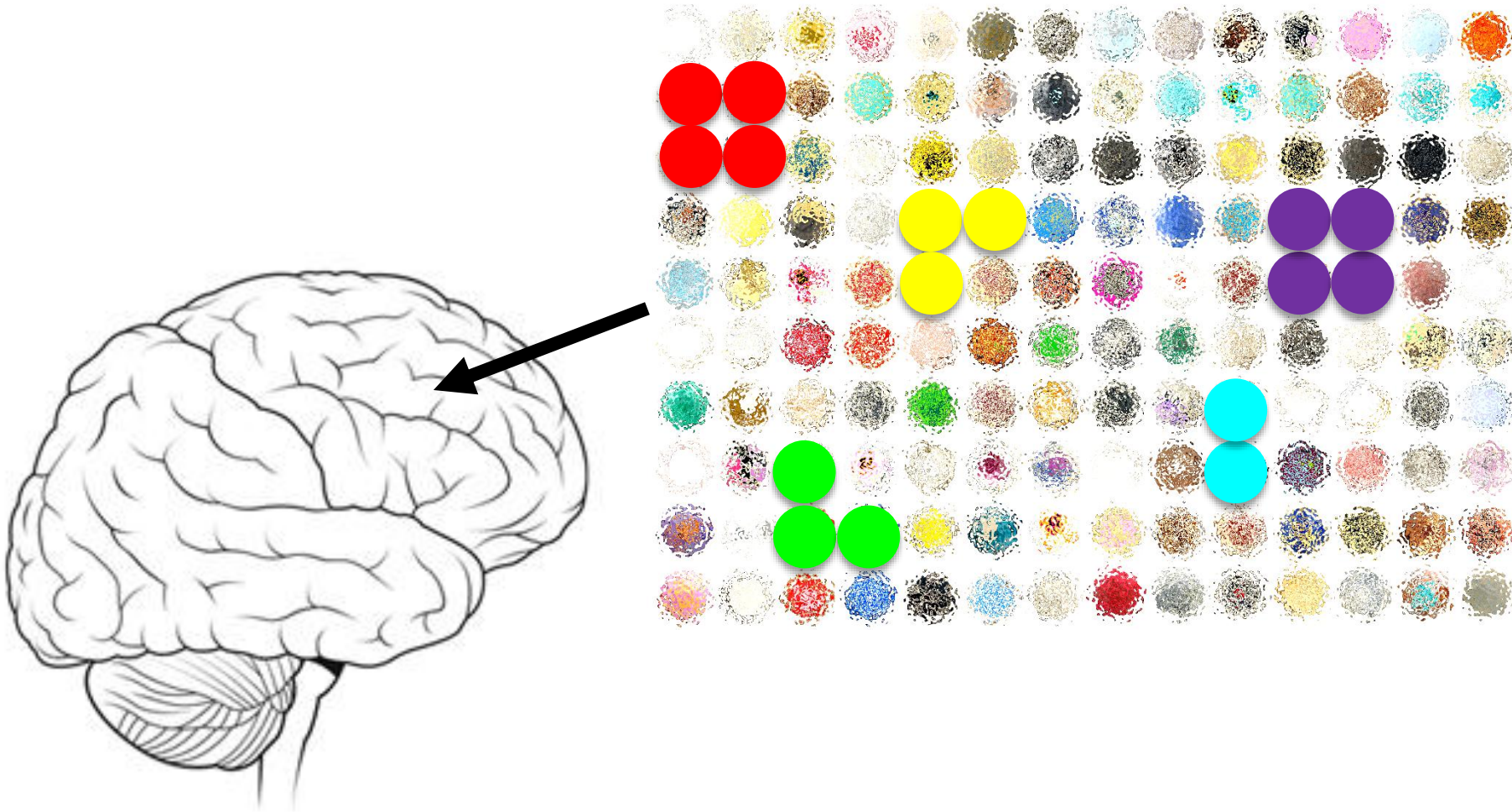
[Treatment] Immediate neurosurgical consult, Control blood pressure, Aneurysm repair, Analgesia, Nimodipine to prevent vasospasm.

'Chunks' of Illness Scripts



Triggering of Illness Scripts

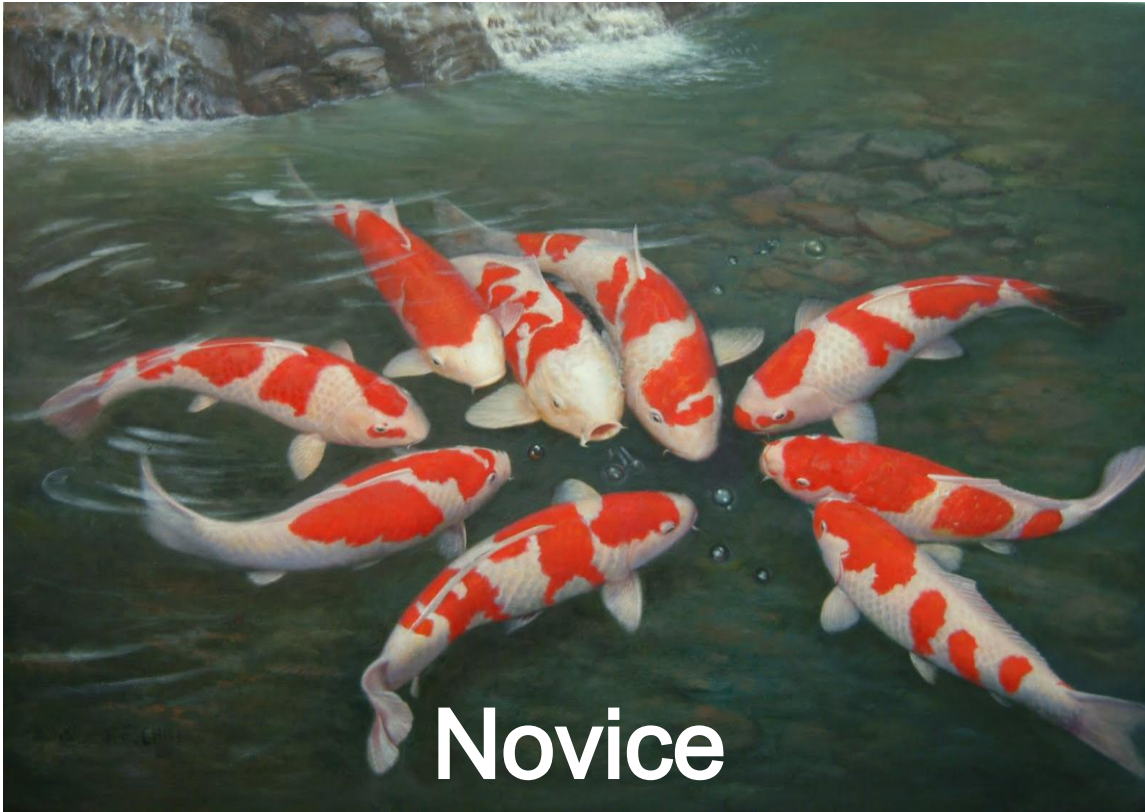
'Fever with RUQ Pain'



How to Develop and Improve Illness Scripts

- See patients (as many as possible)
- Read textbooks, attend lectures, join case discussion, search AI

Exemplars Make Expertise



How to Develop and Improve Illness Scripts

- See patients (as many as possible)
- Read textbooks, attend lectures, join case discussion, search AI
- Self-reflection



Disease 'X'

Age
Gender
Risk factors

Mechanisms

Symptoms
Signs
Ix findings



Illness Scripts Must be Precise!

How to Develop and Improve Illness Scripts

- See patients (as many as possible)
- Read textbooks, attend lectures, join case discussion, search AI
- Self-reflection
- Reason aloud
- Get feedback



Problem list / Problem representation

System 1 reasoning

(non-analytic, intuitive, pattern recognition,
forward, fast thinking)

System 2 reasoning

(analytic, hypothetico-deductive,
backward, slow thinking)

Illness
scripts

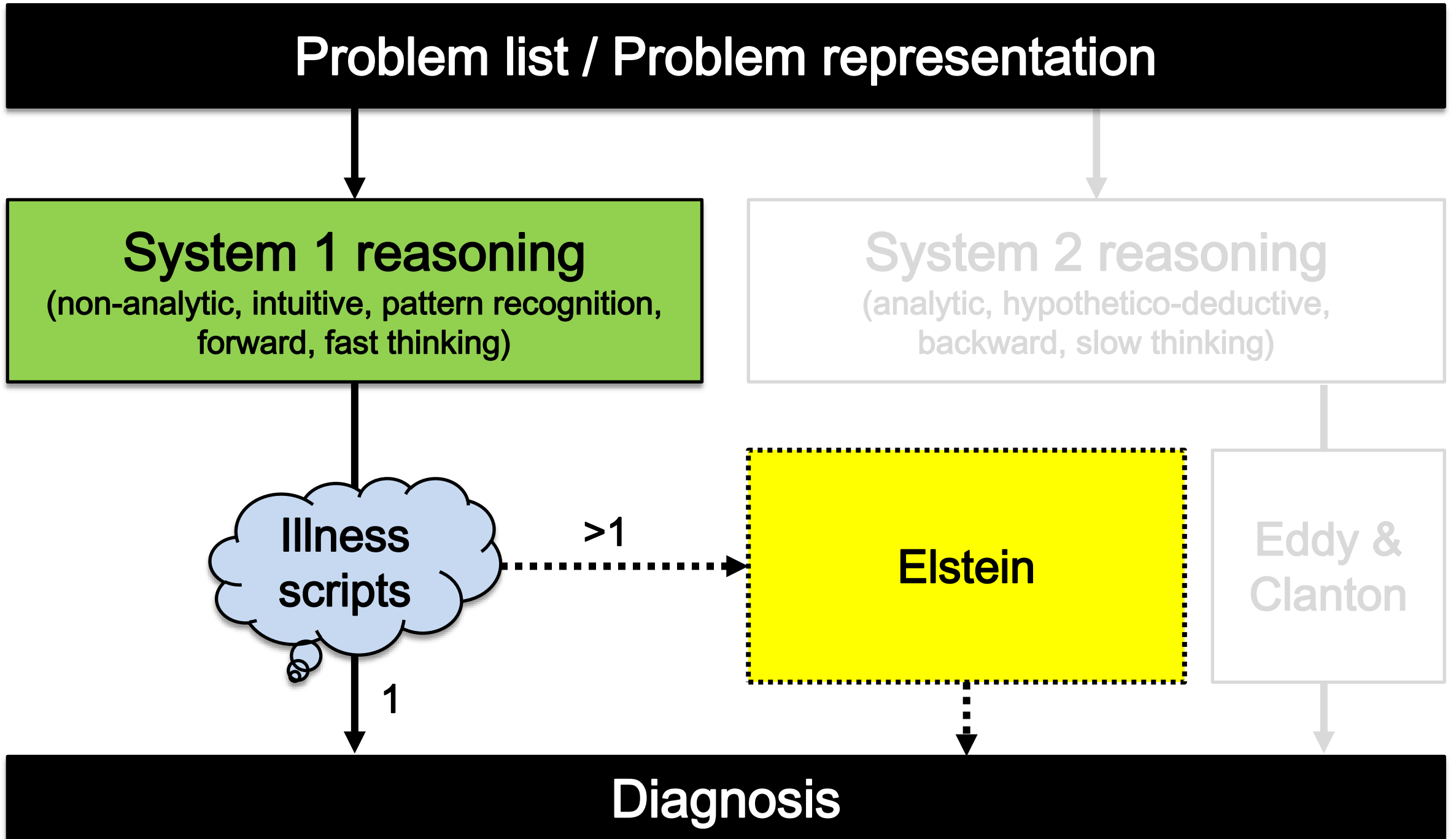
>1

Elstein

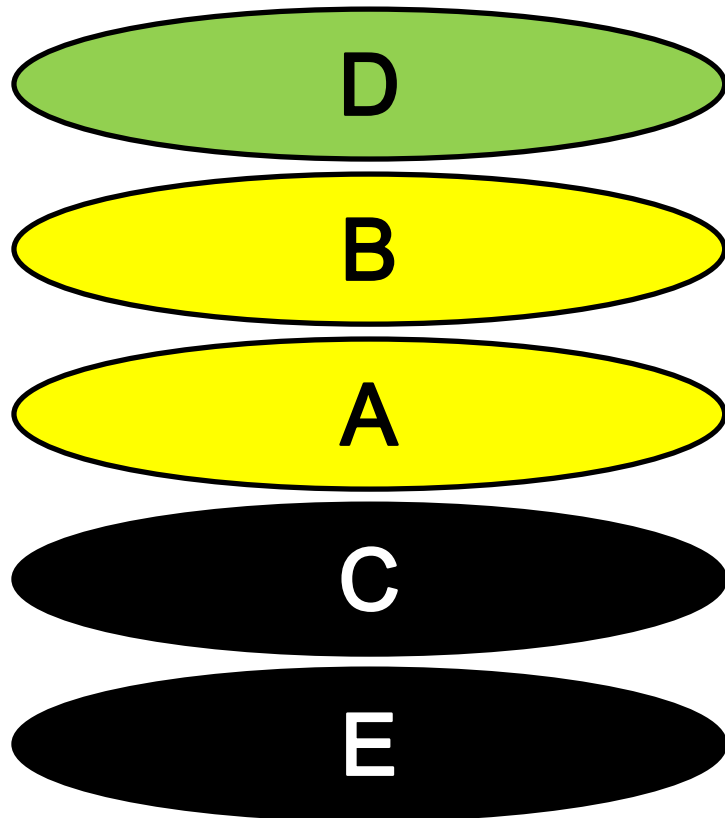
Eddy &
Clanton

1

Diagnosis

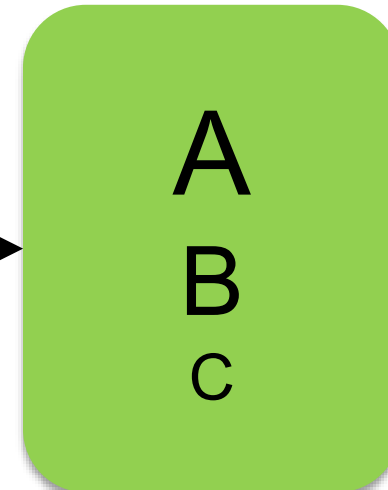
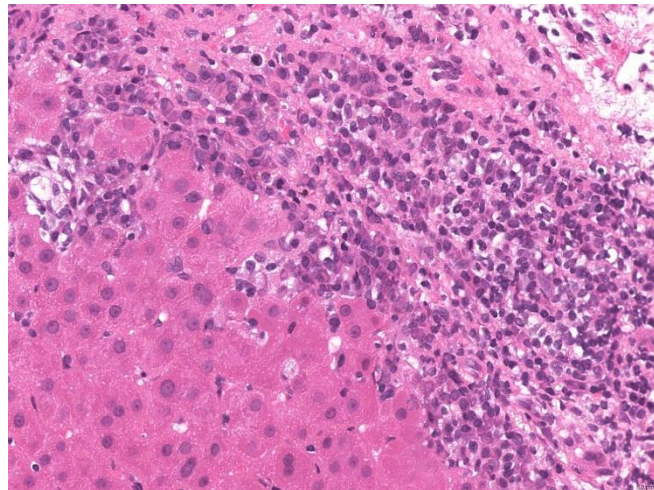
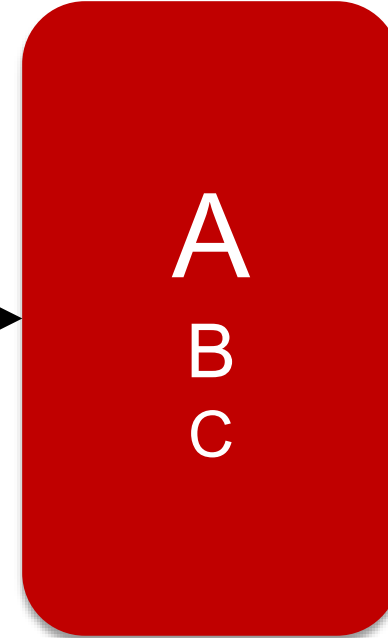


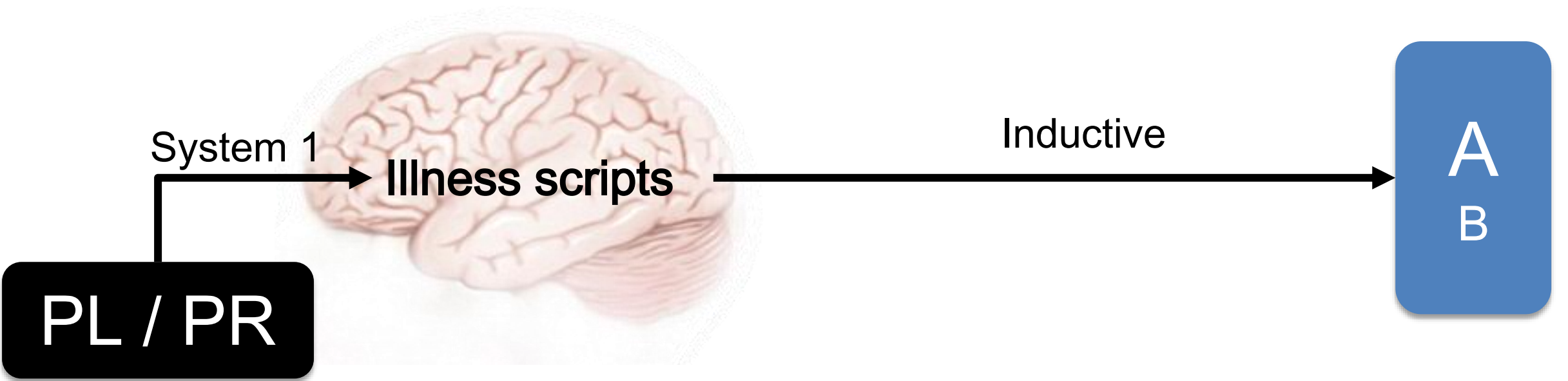
+ System 2 to System 1 Reasoning



<i>Support</i>	<i>Against</i>
+++++	-
++++	+
++++	+
++	+++
+	++++

Pattern Recognition = 'Visual' Illness Script





Dual Process Reasoning

	System 1	System 2
Nature	Inductive Forward	Deductive Backward
Effort	+	+++
Speed	+++	+
Experiences	+++	+
Biases	+++	+
Errors	++	+
Accuracy	+++	+++

Problem list / Problem representation

System 1 reasoning

(non-analytic, intuitive, pattern recognition,
fast thinking)

System 2 reasoning

(analytic, hypothetico-deductive,
backward, slow thinking)

Illness
scripts

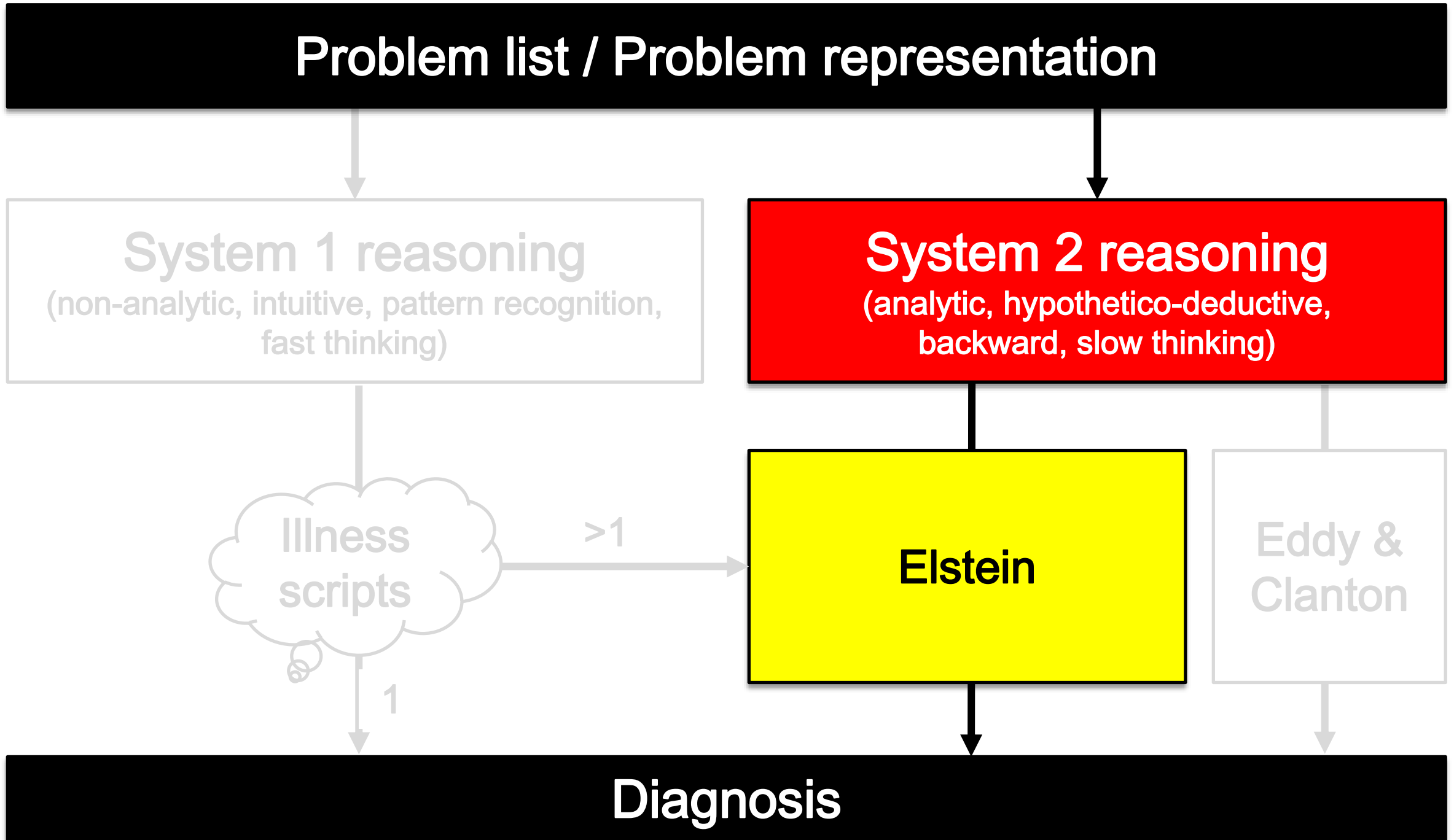
>1

Elstein

Eddy &
Clanton

1

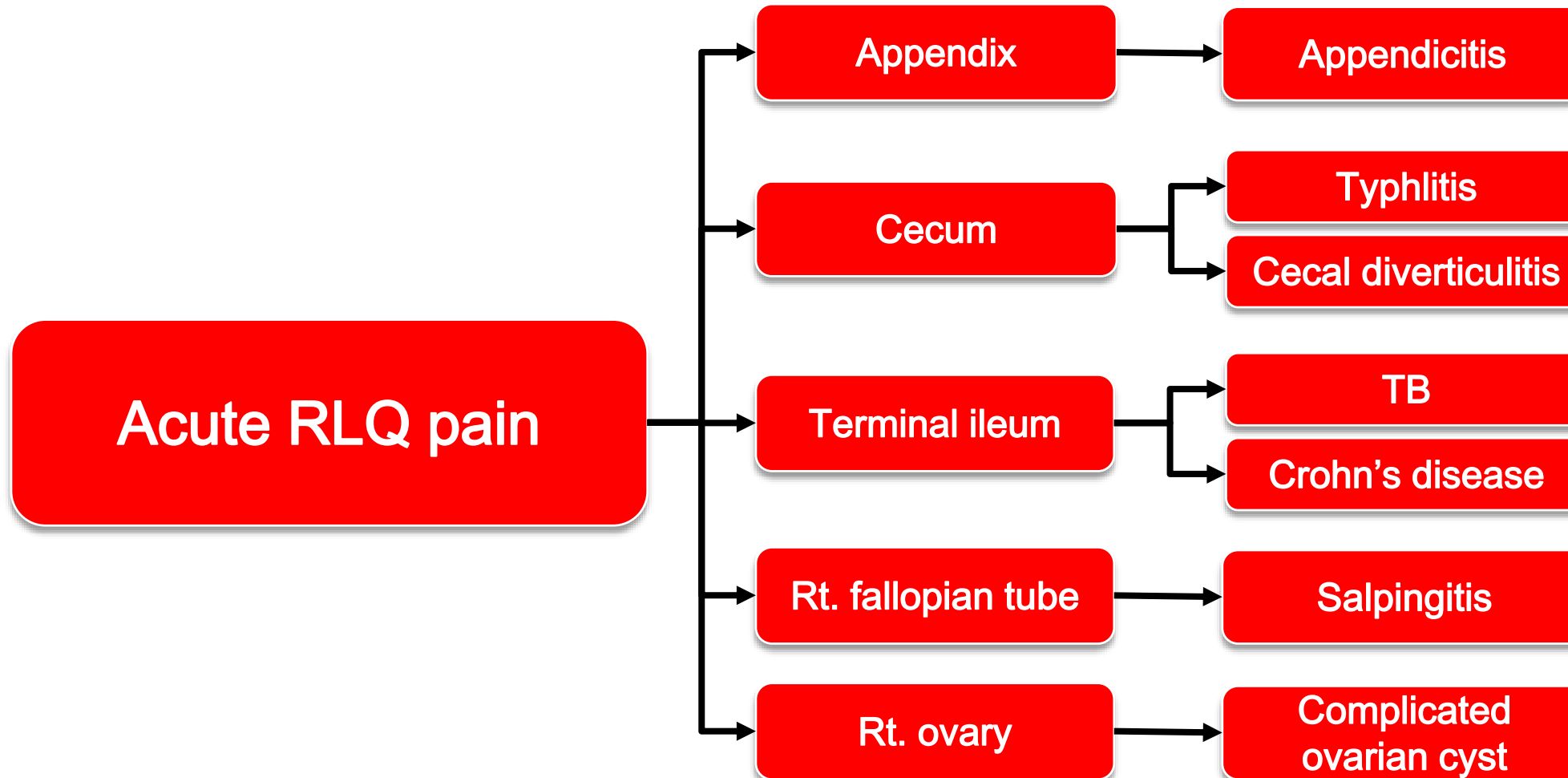
Diagnosis



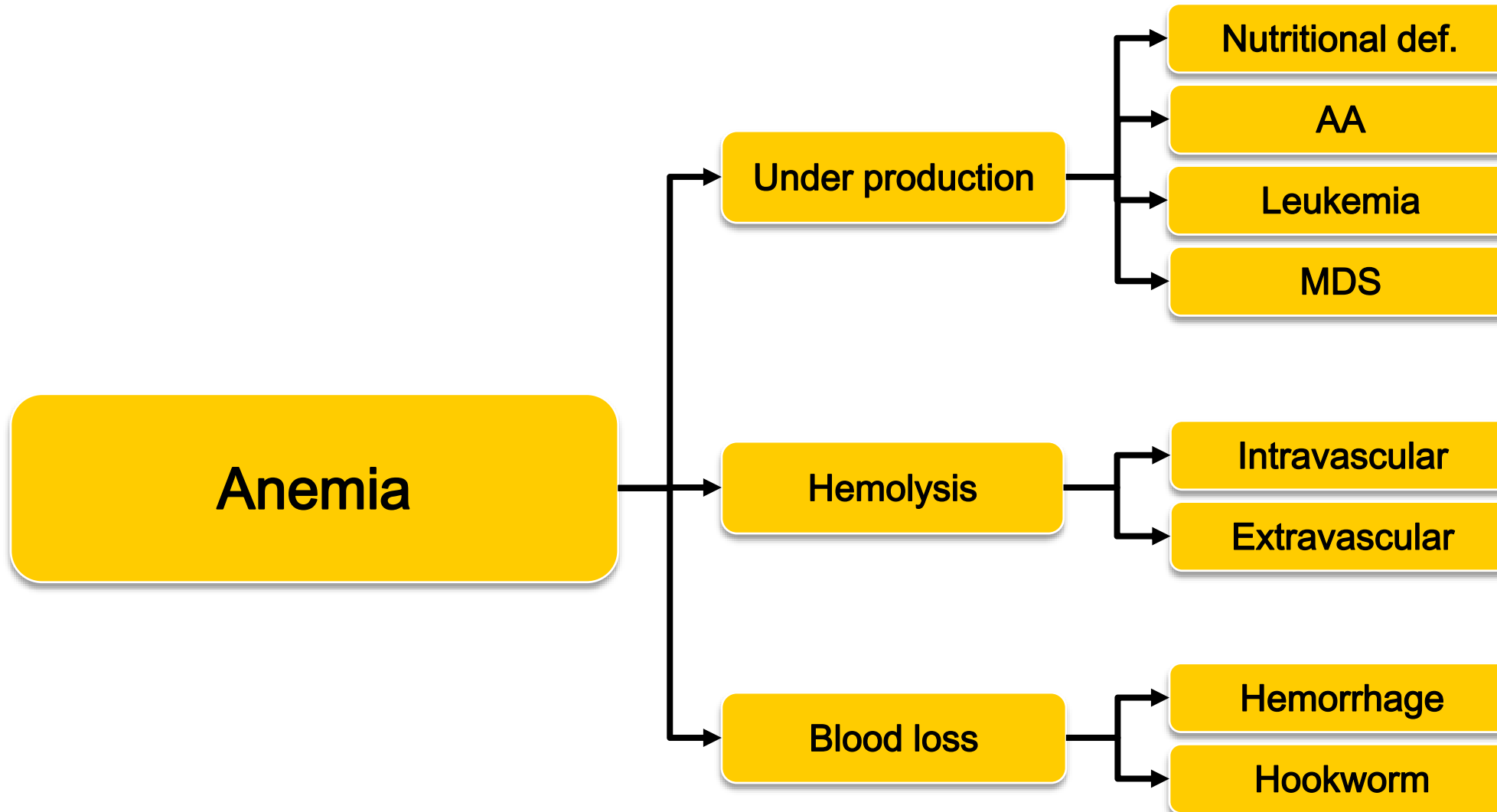
Elstein's System 2 Reasoning

1. Create hypotheses from the problems using appropriate schemes (*'hypothetico-'*)
 - Anatomical
 - Physiological
 - Pathological
 - Unspecified
2. Analyze each hypothesis for the possibility, deduce to the most likely Dx and DDx (*'-deductive'*)

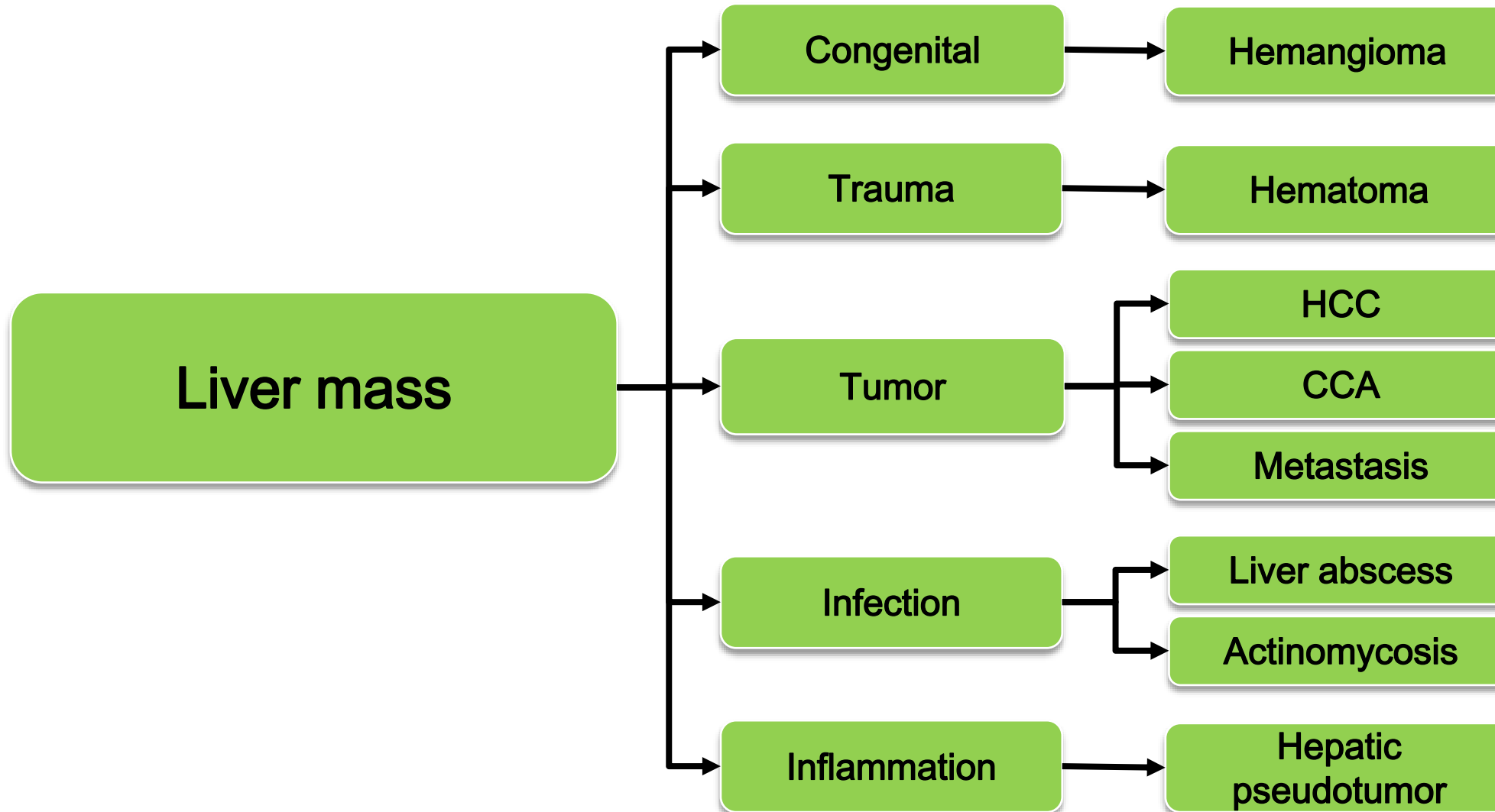
Anatomical Schemes



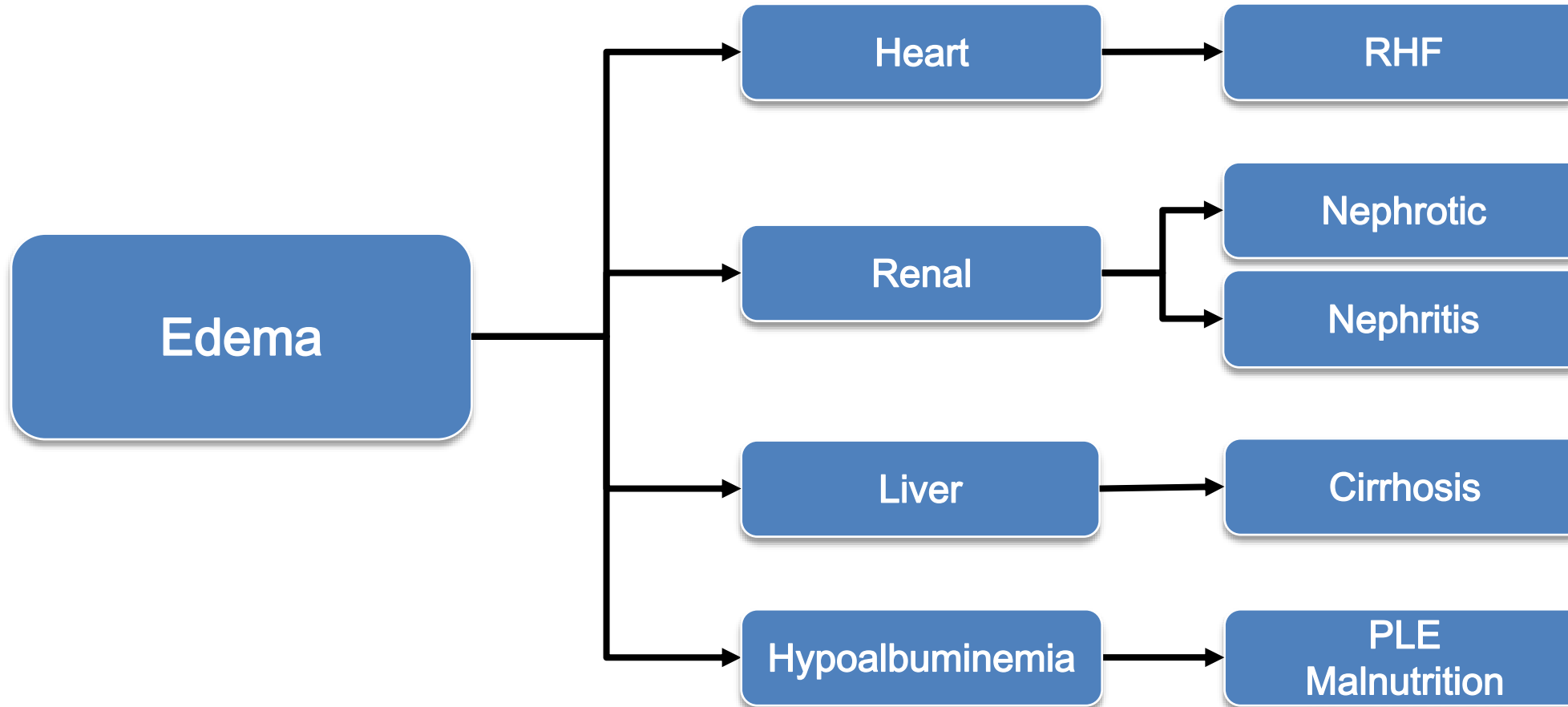
Physiological Schemes



Pathological Schemes



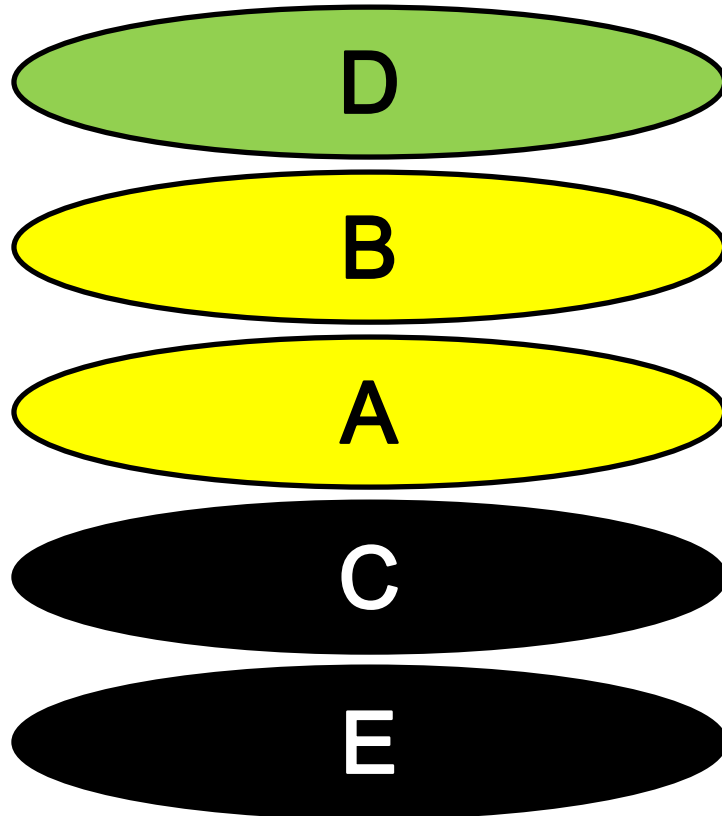
Unspecified (Mixed) Schemes



Elstein's System 2 Reasoning

1. Create hypotheses from the problems using appropriate schemes (*'hypothetico-'*)
 - Anatomical
 - Physiological
 - Pathological
 - Unspecified
2. Analyze each hypothesis for the possibility, deduce to the most likely Dx and DDx (*'-deductive'*)

Elstein's System 2 Reasoning



<i>Support</i>	<i>Against</i>
+++++	-
++++	+
++++	+
++	+++
+	++++

Problem list / Problem representation

System 1 reasoning

(non-analytic, intuitive, pattern recognition,
fast thinking)

System 2 reasoning

(analytic, hypothetico-deductive,
backward, slow thinking)

Illness
scripts

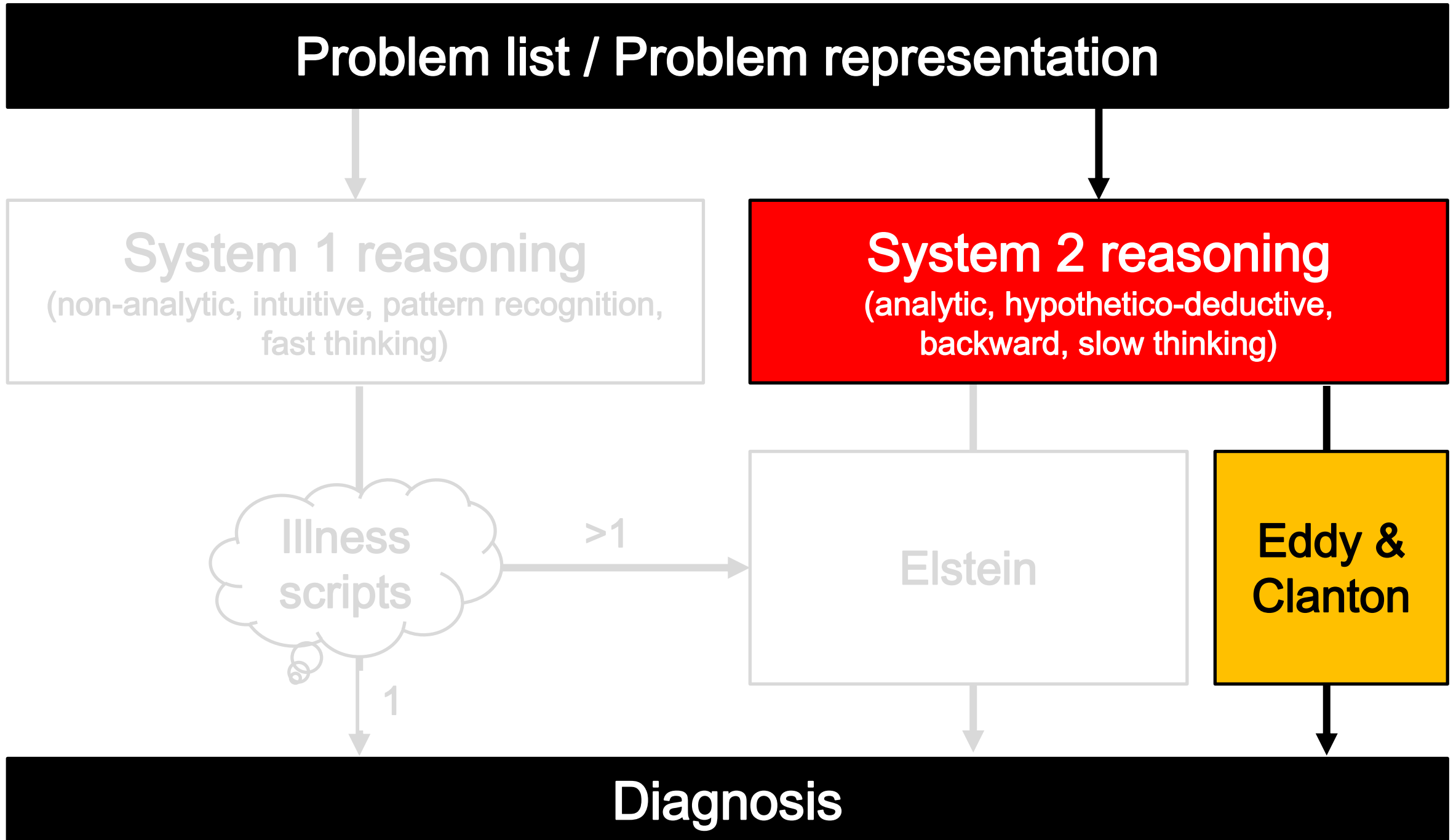
>1

Elstein

Eddy &
Clanton

1

Diagnosis



Too Many Problems!

1. Pedal edema ...
2. Periorbital edema ...
3. Heavy proteinuria
4. Heart failure ...
5. Cardiomegaly
6. Chronic watery diarrhea ...
7. Hepatomegaly
8. Elevated ALP

'Eddy & Clanton' System 2 Reasoning

THE ART OF DIAGNOSIS

Solving the Clinicopathological Exercise

DAVID M. EDDY, M.D., PH.D., AND CHARLES H. CLANTON, M.D.

1. Aggregate the findings
2. Select a pivot
3. Generate a cause list (using *Elstein's*)
4. Prune the list
5. Select the diagnosis (roll)

Findings

1. Pedal edema
2. Periorbital edema
3. Heavy proteinuria
4. Heart failure
5. Cardiomegaly
6. Chronic diarrhea
7. Hepatomegaly
8. Elevated ALP

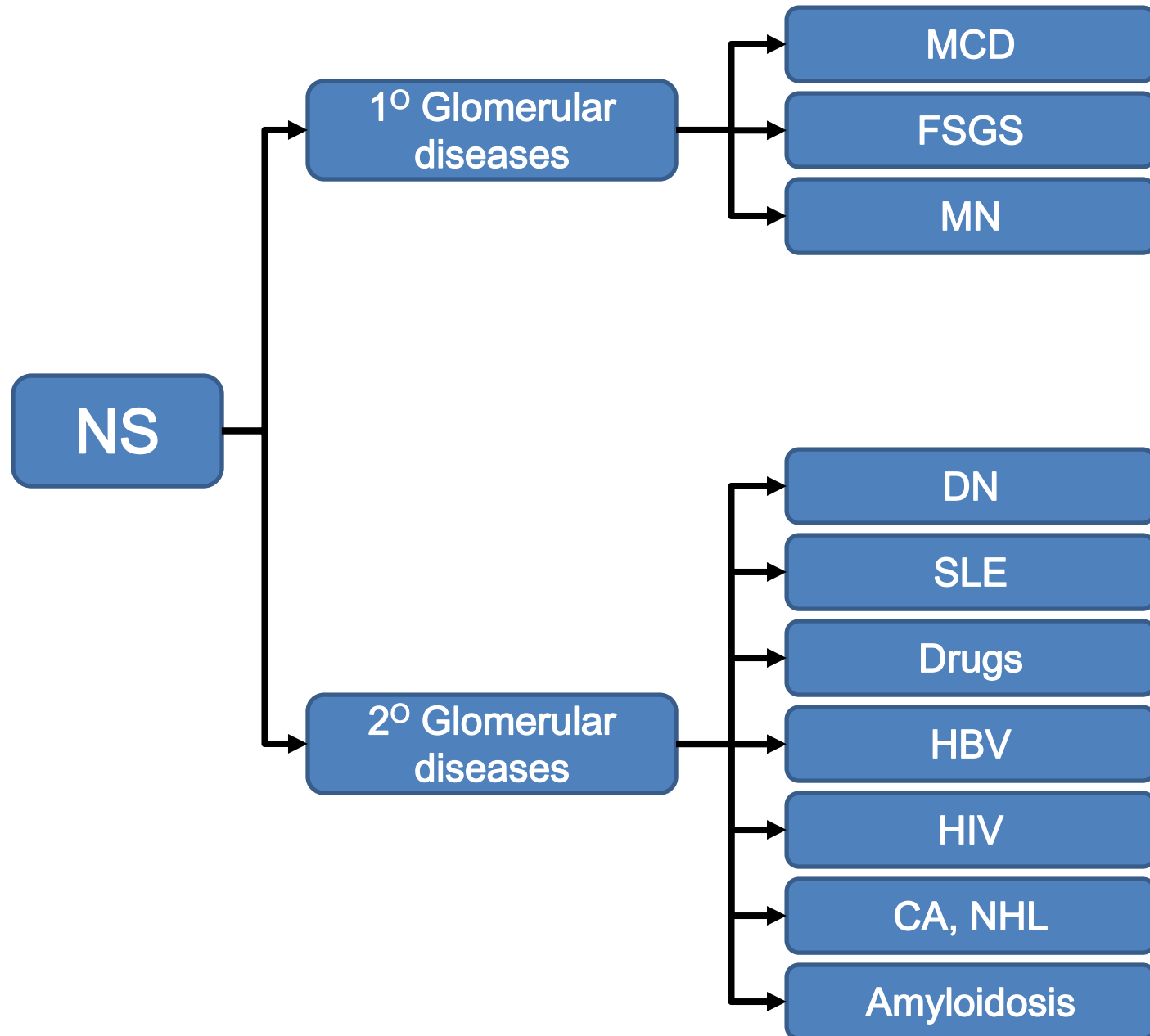


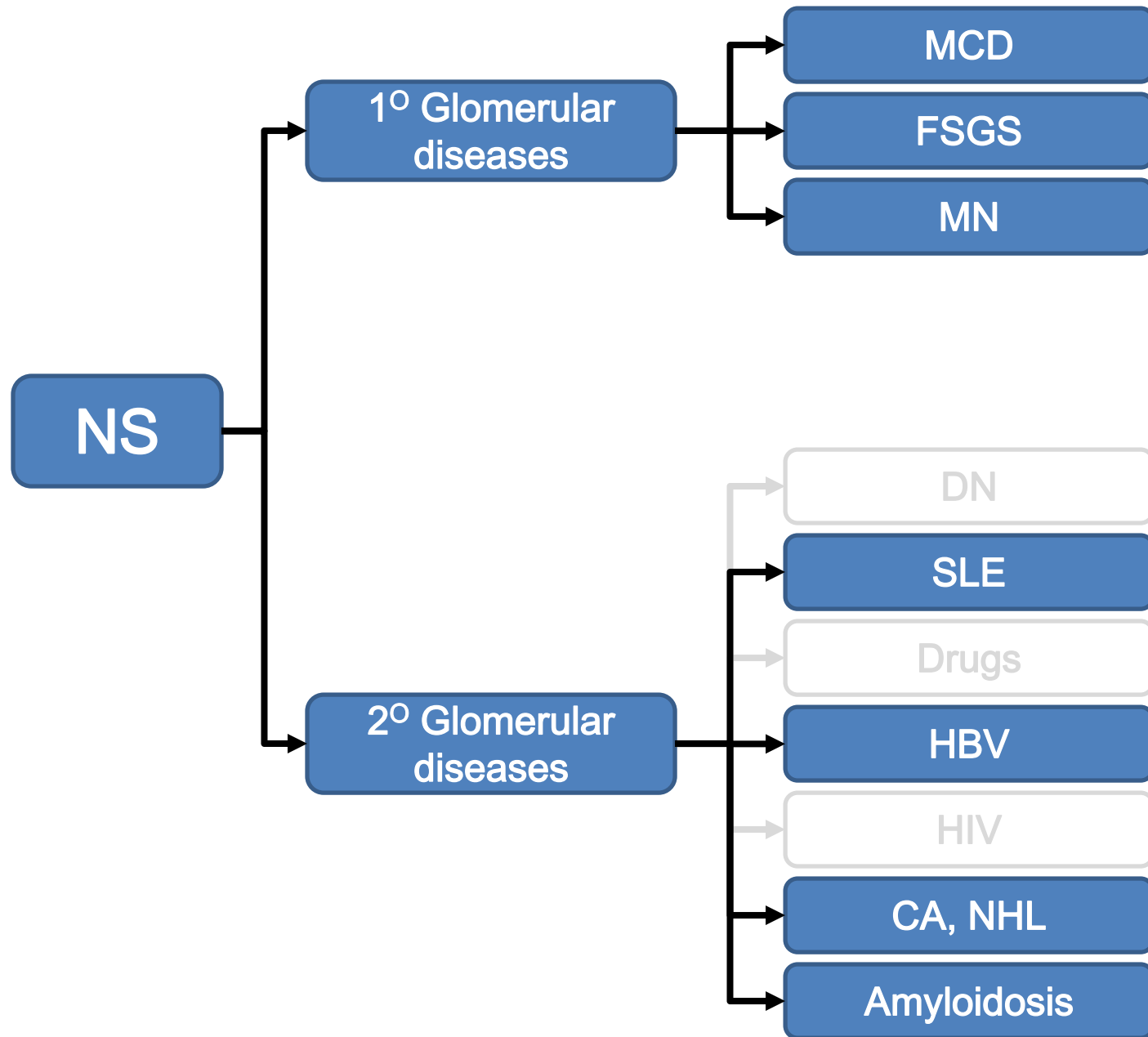
Aggregated

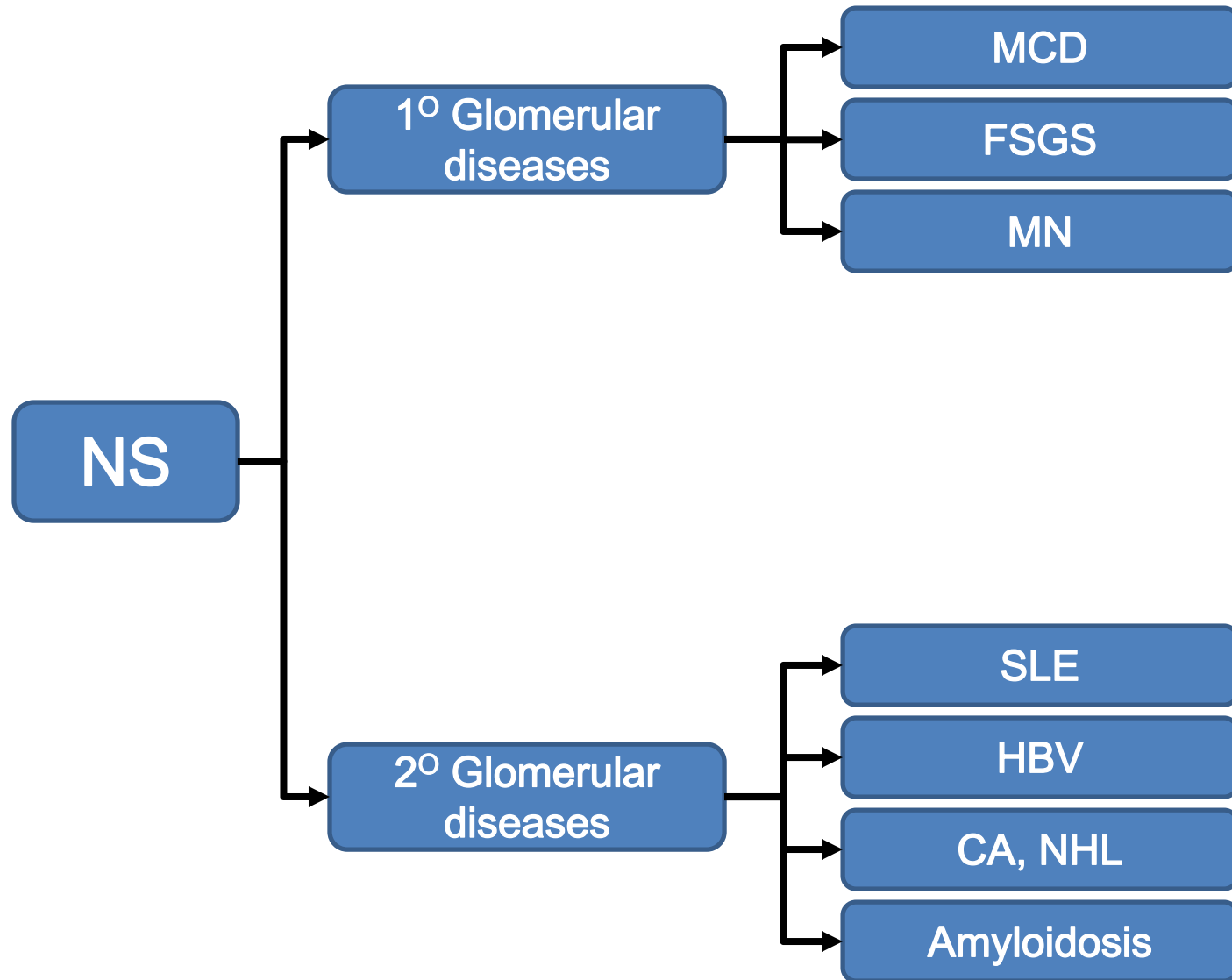
1. Pedal, periorbital edema, heavy proteinuria
2. Heart failure and cardiomegaly
3. Chronic watery diarrhea
4. Hepatomegaly and elevated ALP

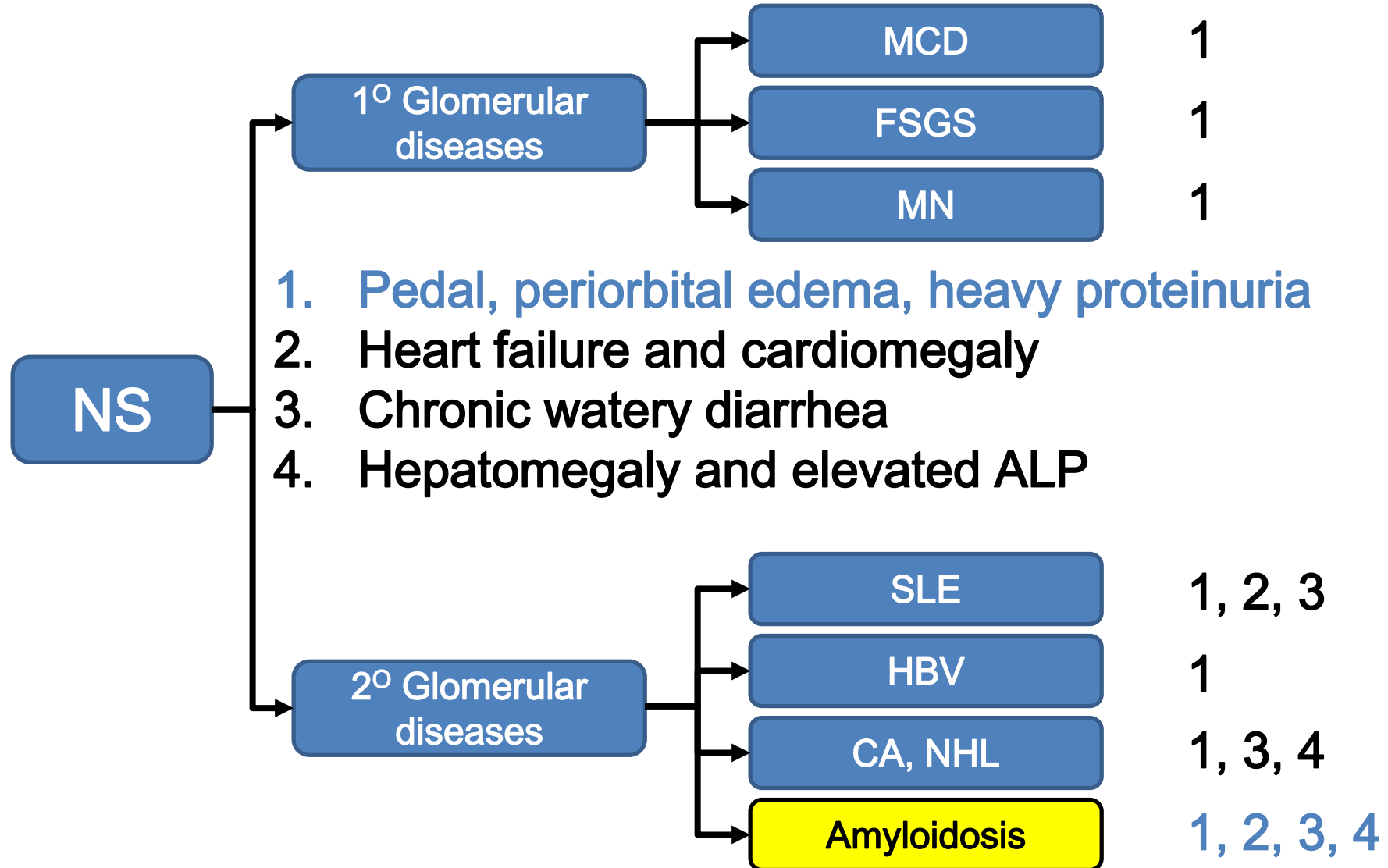
Select a Pivot

1. Pedal, periorbital edema, heavy proteinuria
2. Heart failure and cardiomegaly
3. Chronic watery diarrhea
4. Hepatomegaly and elevated ALP



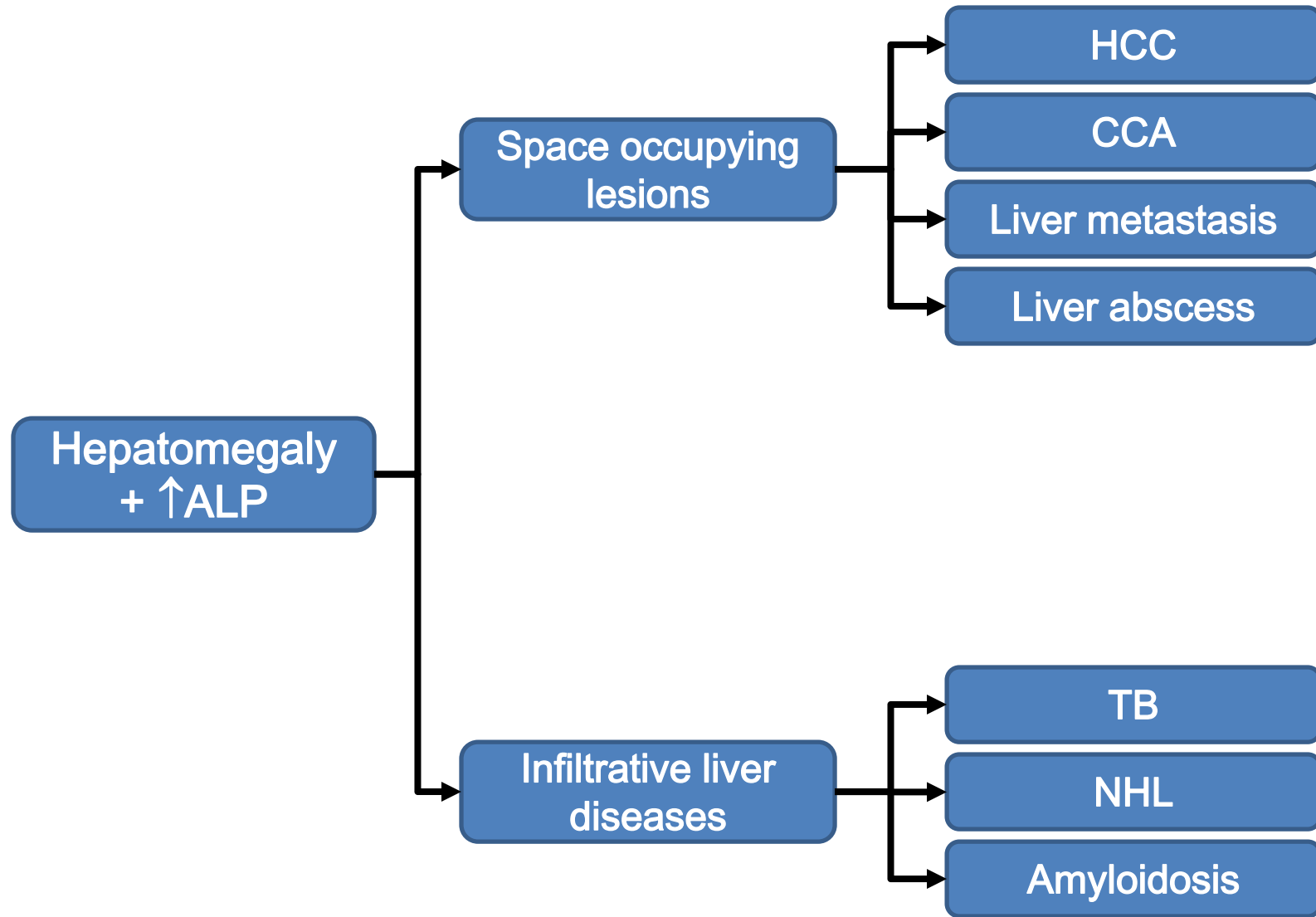


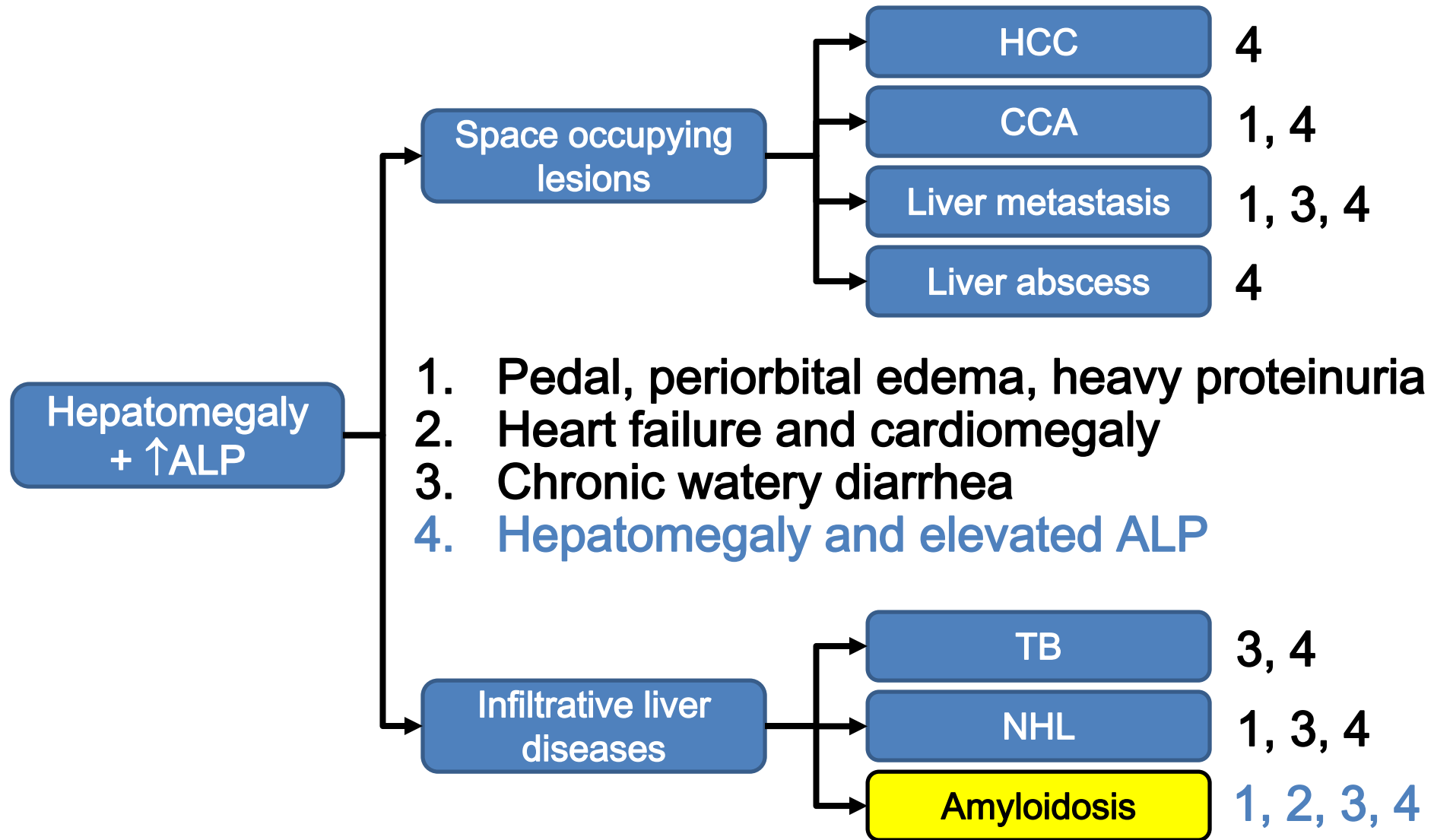


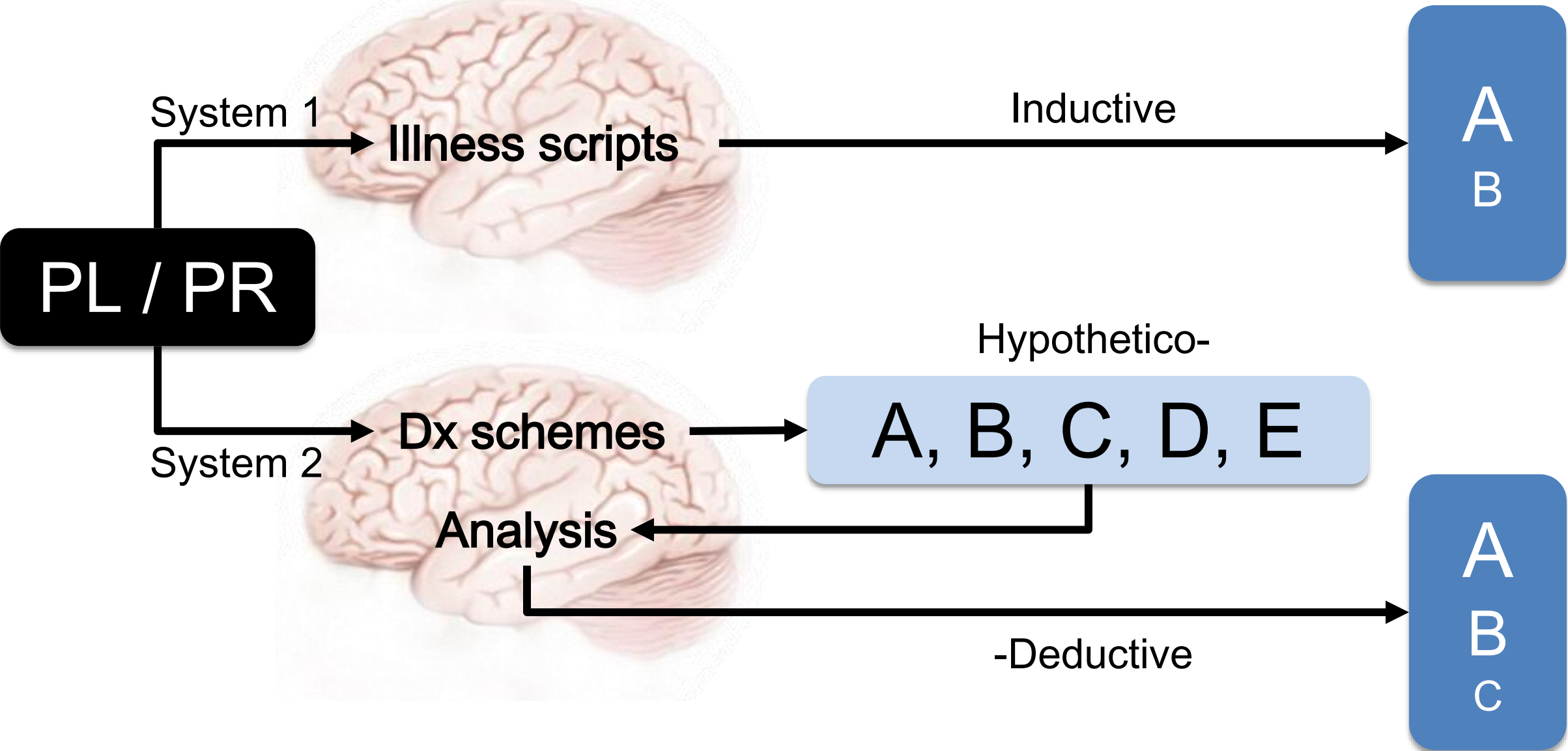


Using any Pivot Results in the Same

1. Pedal, periorbital edema, heavy proteinuria
2. Heart failure and cardiomegaly
3. Chronic watery diarrhea
4. Hepatomegaly and elevated ALP





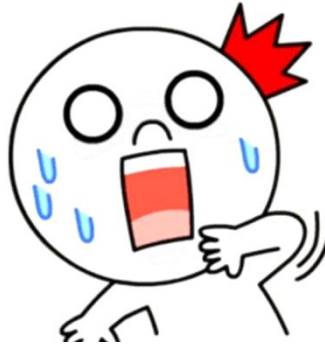


Dual Process Reasoning

	System 1	System 2
Nature	Inductive Forward	Deductive Backward
Effort	+	+++
Speed	+++	+
Experiences	+++	+
Biases	+++	+
Errors	++	+
Accuracy	+++	+++

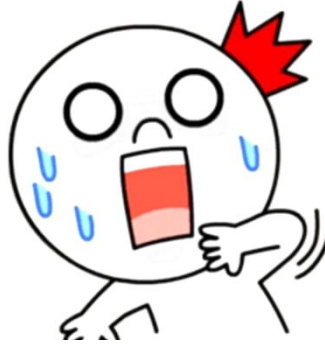
Dual Process Reasoning

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Effort	+	+++
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Biases	+++	+
Errors	++	+
Accuracy	+++	+++



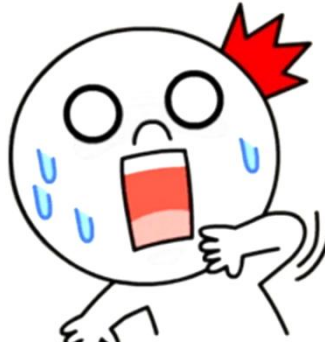
***“System 1 causes errors
and System 2 fails to detect and correct”***

Daniel Kahneman



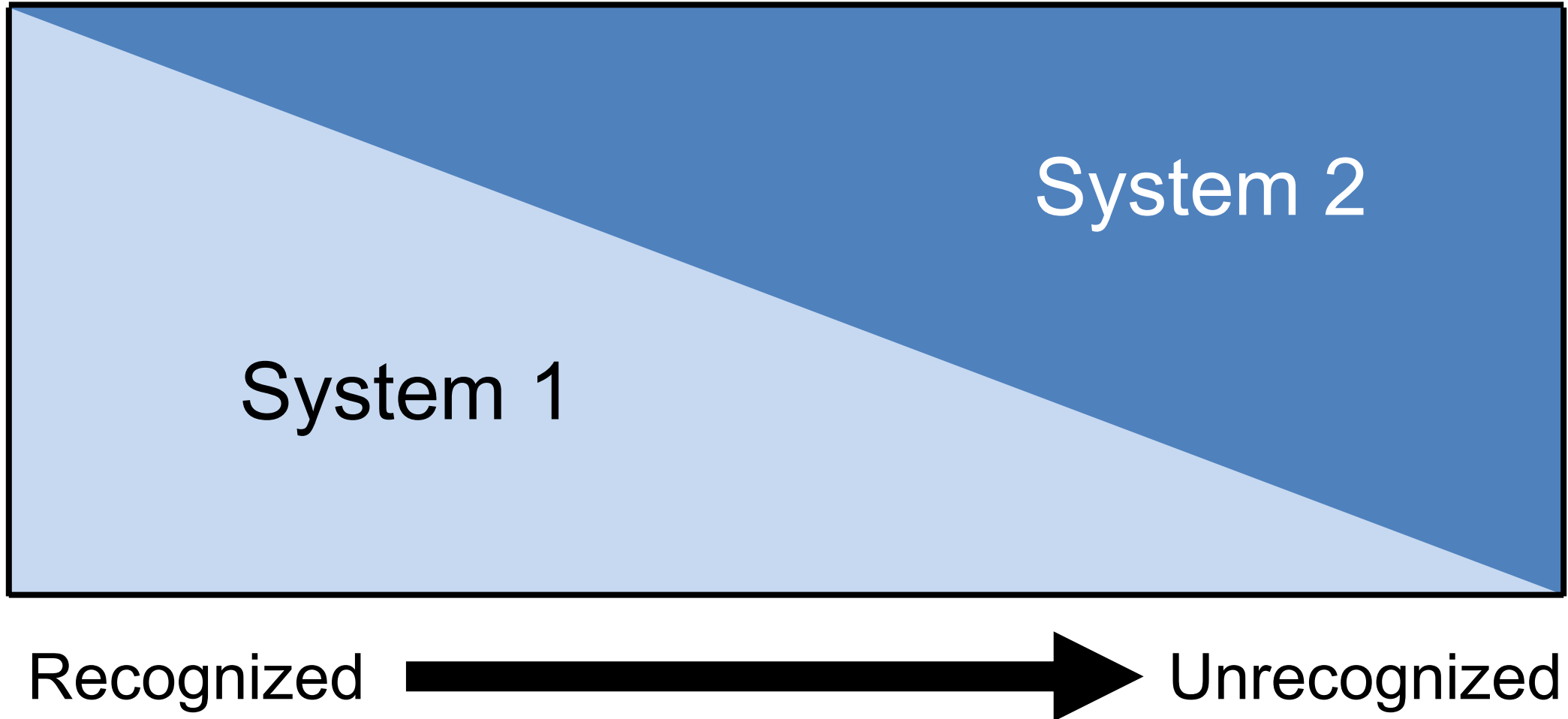
***“System 1 should not be advocated
among medical students for fear of
potential grim consequence”***

Coderre S. *Med Educ* 2003;37:695-703

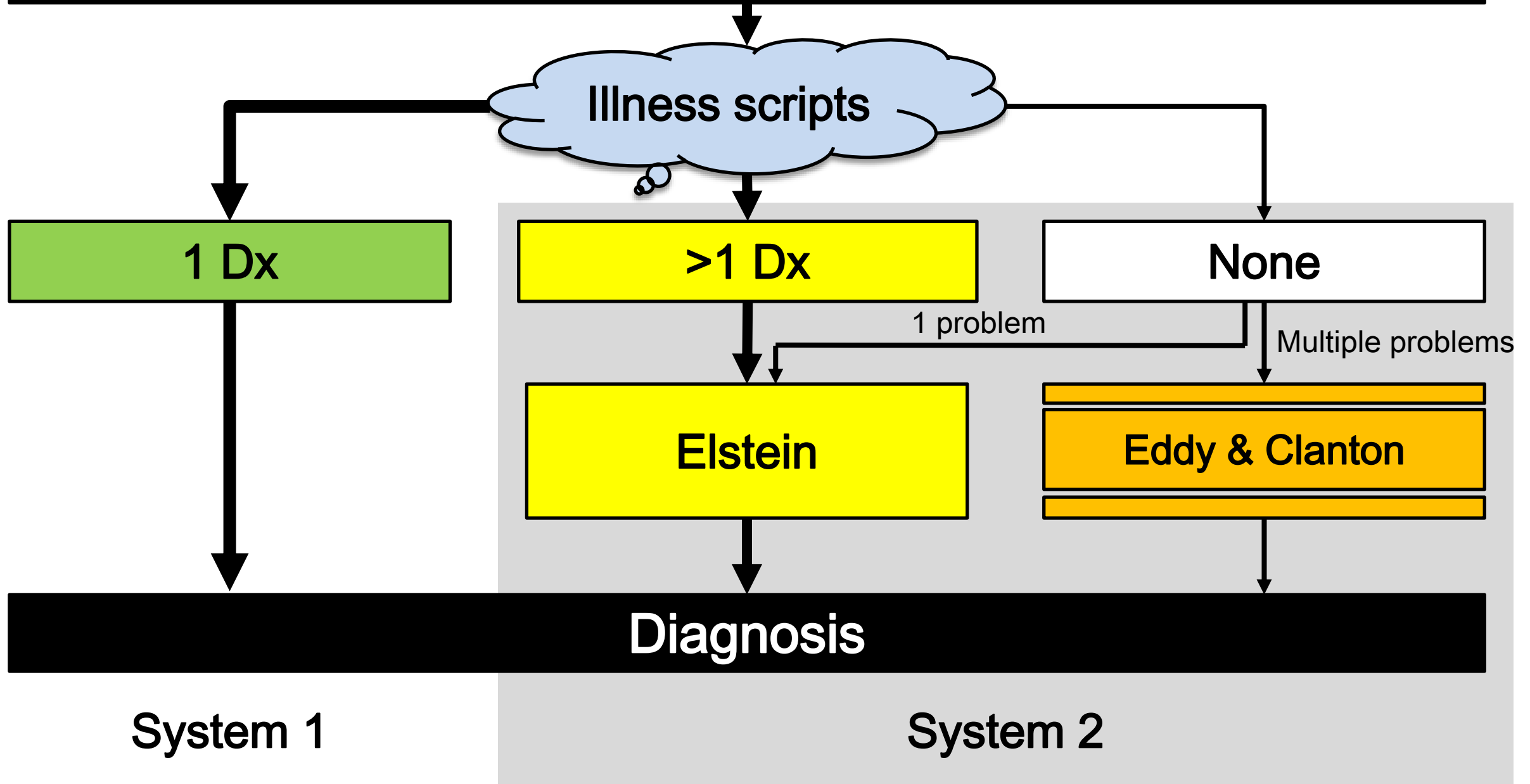


“System 1 is **default and inevitable** process from novices to experts”

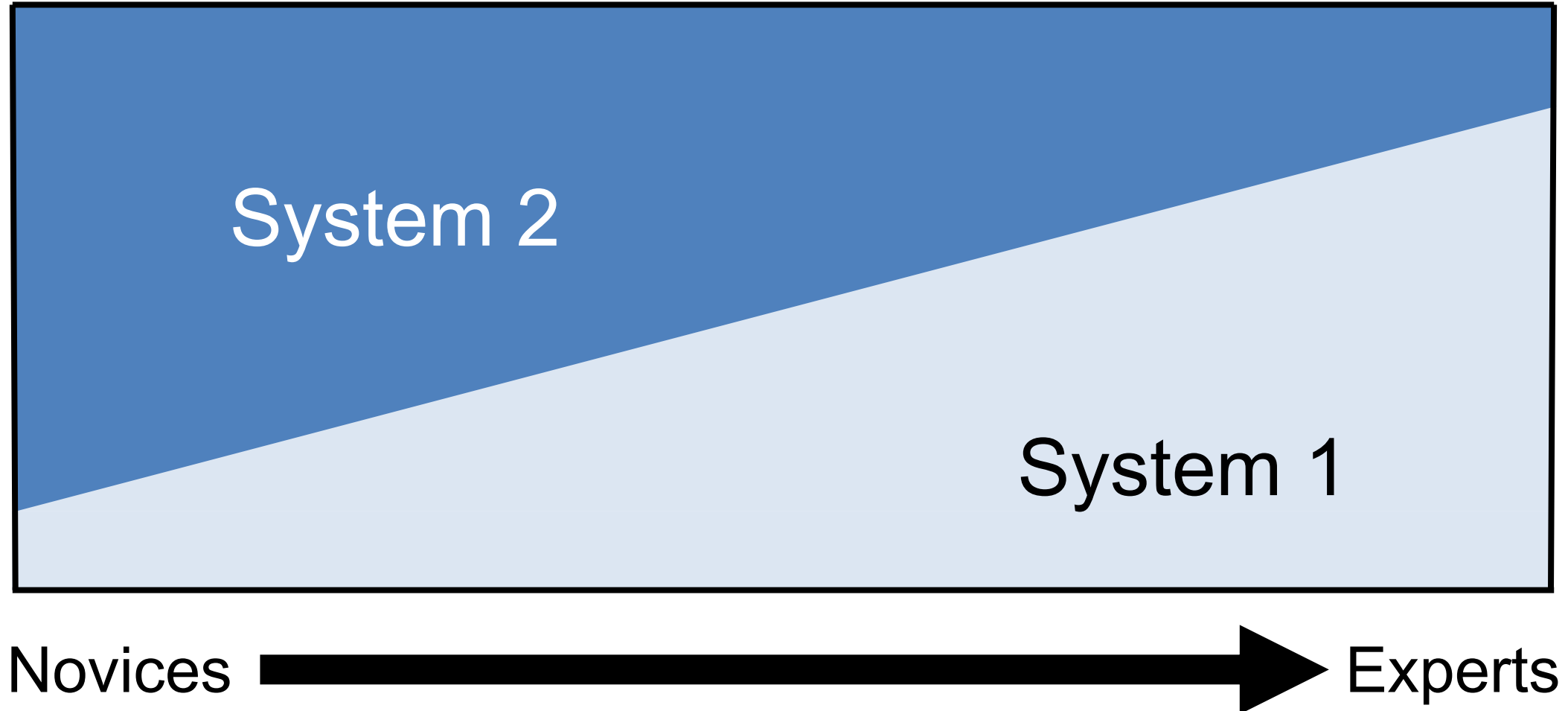
Content Specificity



Problem list / Problem representation



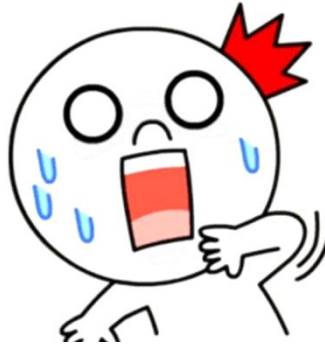
Level of Expertise



Urgency



Urgent  Non-urgent



***“Force learners to ‘slow down’ (= system 2)
or to ‘go fastest’ (= system 1)
do not improve or worsen Dx accuracy’***

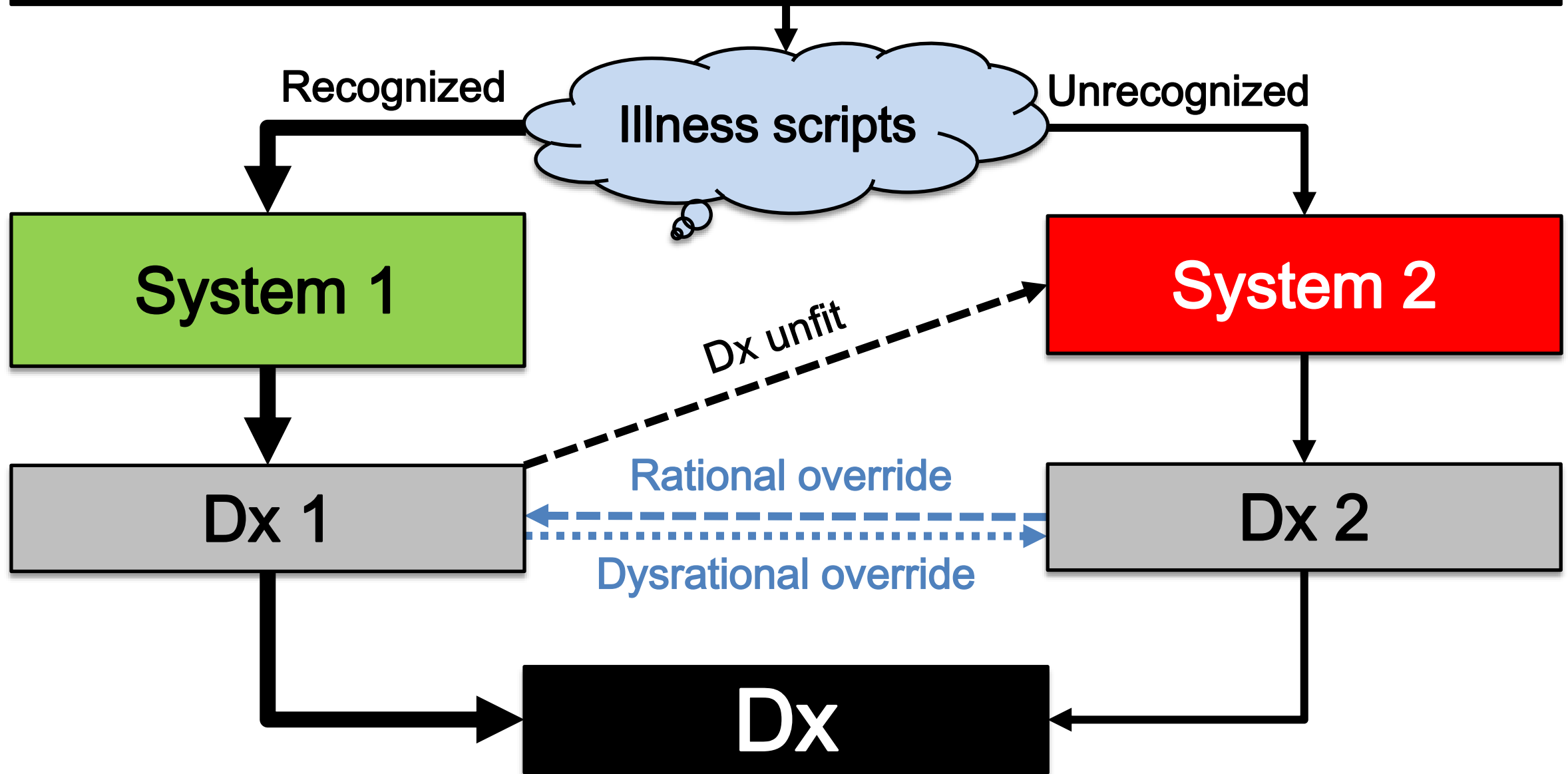
Norman G. *J Eval Clin Pract* 2024;1-9



***“Routine combined using of System 1 & 2
does not gain more accuracy than using
either one alone”***

Norman G. *J Eval Clin Pract* 2024;1-9

Problem list / Problem representation





***“We should be keen in
all the 3 Dx reasoning”***

Other Common Rules of Diagnosis



1. If it looks like a duck, swims like a duck, and quacks like a duck, then it **probably *is* a duck.**

Other Common Rules of Diagnosis



2. Occam's razors

- **Diagnostic parsimony**
"One condition explains all problems"
- **Common things being common**
"If you hear hoof beats, don't think zebra"

Other Common Rules of Diagnosis



3. Hickam's dictum

"A man can have as many diseases as he damn well pleases"

Other Common Rules of Diagnosis

4. **Multiple common diseases** are more likely than 1 rare disease
5. An **atypical common disease** is more likely than a typical rare disease



*‘Medicine is
a Science of Uncertainty
and an Art of Probability’*

Sir William Osler

III. Diagnostic Reasoning

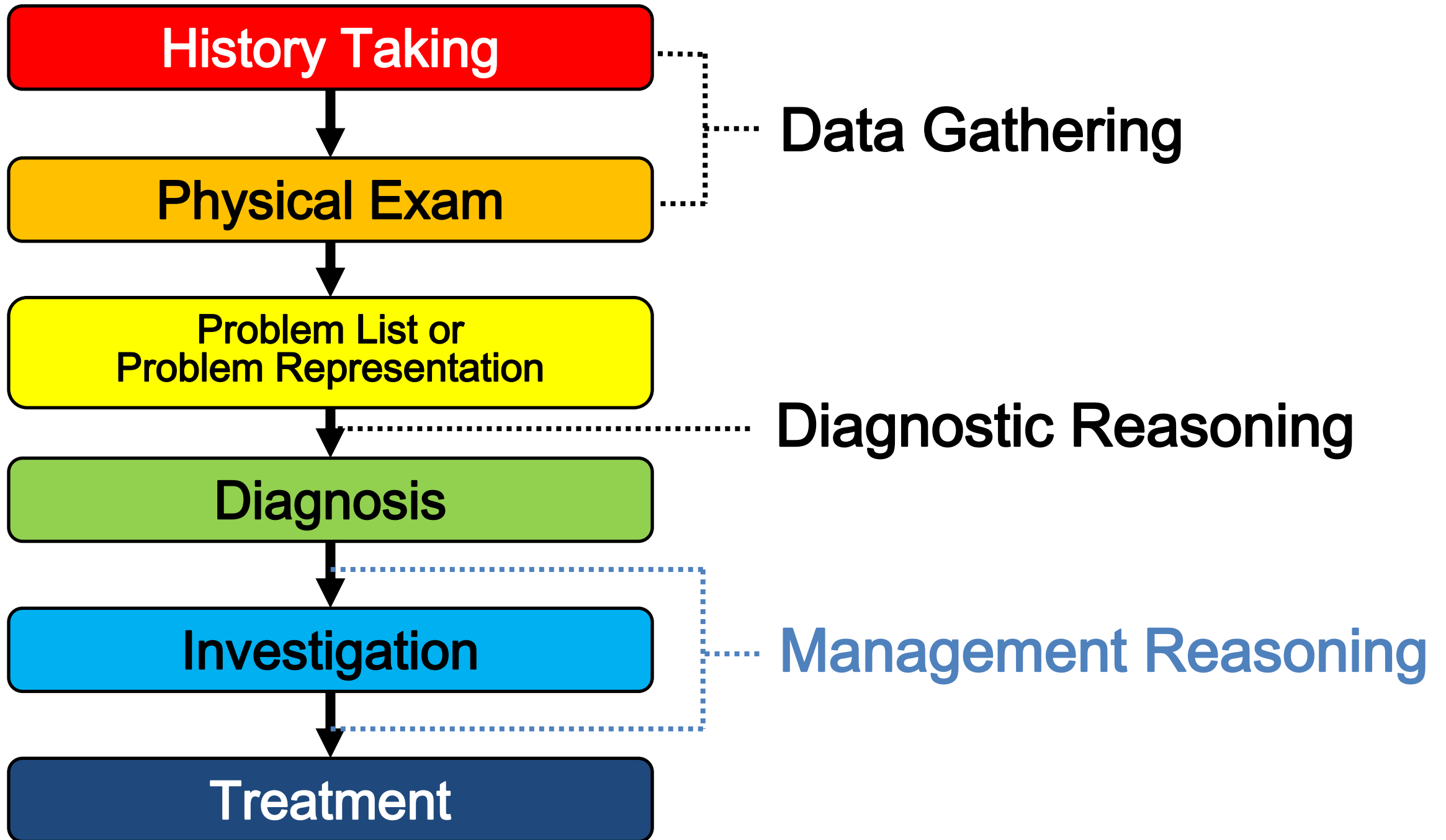
Conclusion

- **Illness scripts are treasures, must be**
 - Built intentionally (with template)
 - Collected deliberately
 - Crafted frequently (by feedback)
- **Both system 1 and system 2 reasoning are effective, essential and every doctor should be keen**
- **Aware of the 5 common rules of Dx**

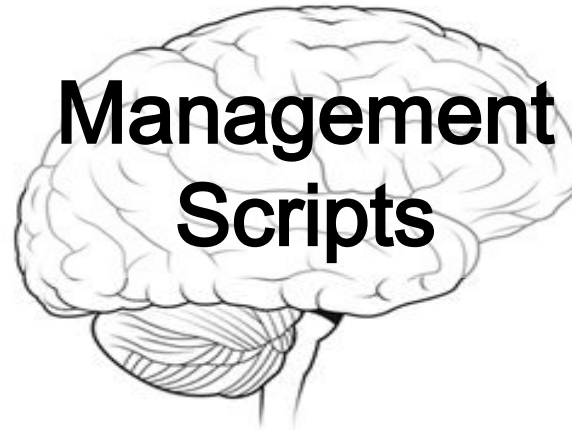


IV

Management Reasoning



Provisional Dx / DDx



Labs

Imaging

Procedures

Consultations

Medications

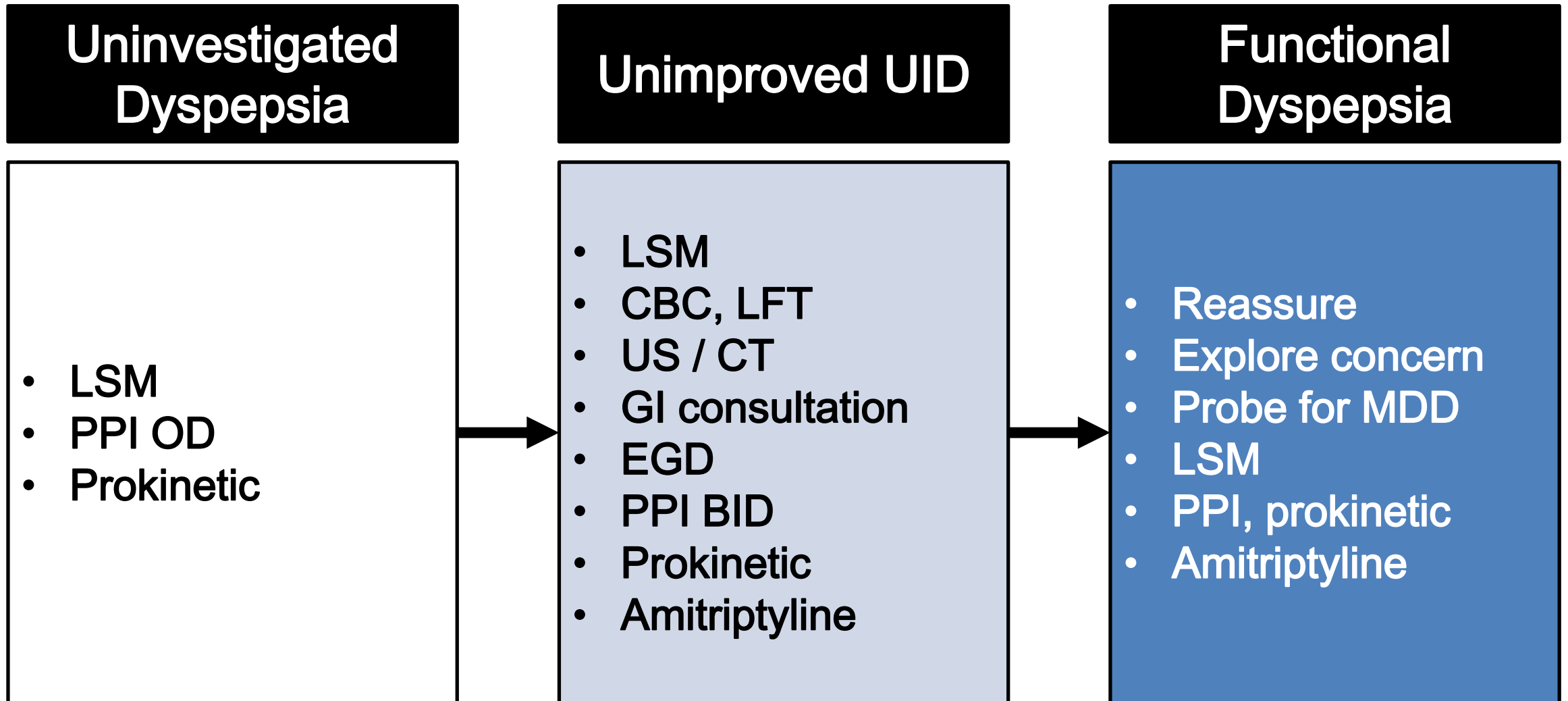
Monitoring

Management Scripts

Template

Management Scripts

'Dyspepsia'



Provisional Dx / DDx



Knowledge of the disease

Knowledge of the process

**Management
Scripts**

Knowledge of the patient

Past experiences

**‘Different Doctors,
Different Management’**

Provisional Dx / DDx



System 1

(Reflective)

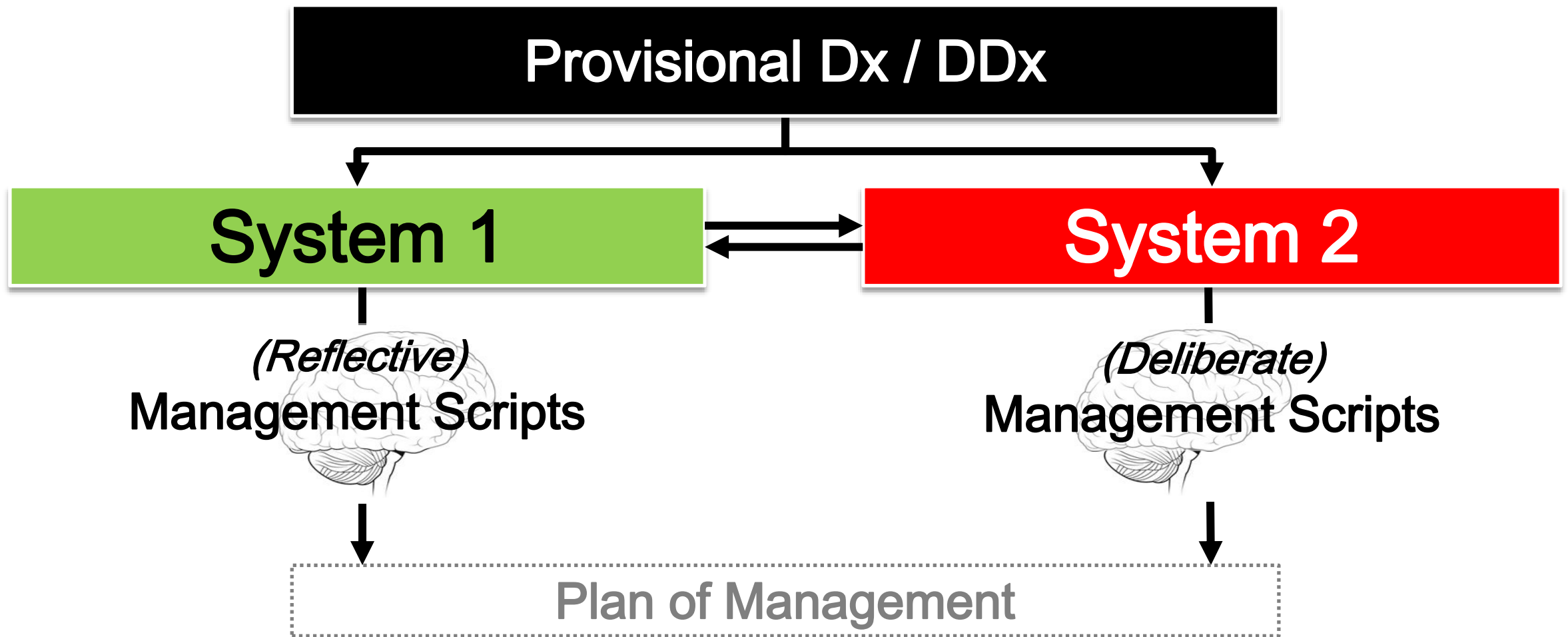


System 2

(Deliberate)



- Thorough thinking
- Rationale
- Thresholds



Provisional Dx / DDx

System 1

System 2

(Reflective)
Management Scripts

(Deliberate)
Management Scripts

Educating Patient

Shared Decision Making

Managing

Monitoring & Adjusting Rx

IV. Management Reasoning

Conclusion

- **Management scripts are also treasure, must be**
 - Developed (using template)
 - Collected
 - Crafted (by peers & self-reflection)
- **Triggering and choosing appropriate management scripts by system 1 (reflective) or 2 (deliberate)**
- **Educating Pt is essential**
- **Shared decision making is the heart of all**