Webinar Series: Can we Help ‘Solve’ Sepsis Together? Augmented Intelligence for Healthcare and Sepsis

Presenters:

Jeff Hersh, PhD, MD
Chief Medical Officer
GE Healthcare

Tom Zimmerman - Moderator
Director of Acute Care Commercial Marketing
GE Healthcare

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Sepsis Alliance Mission

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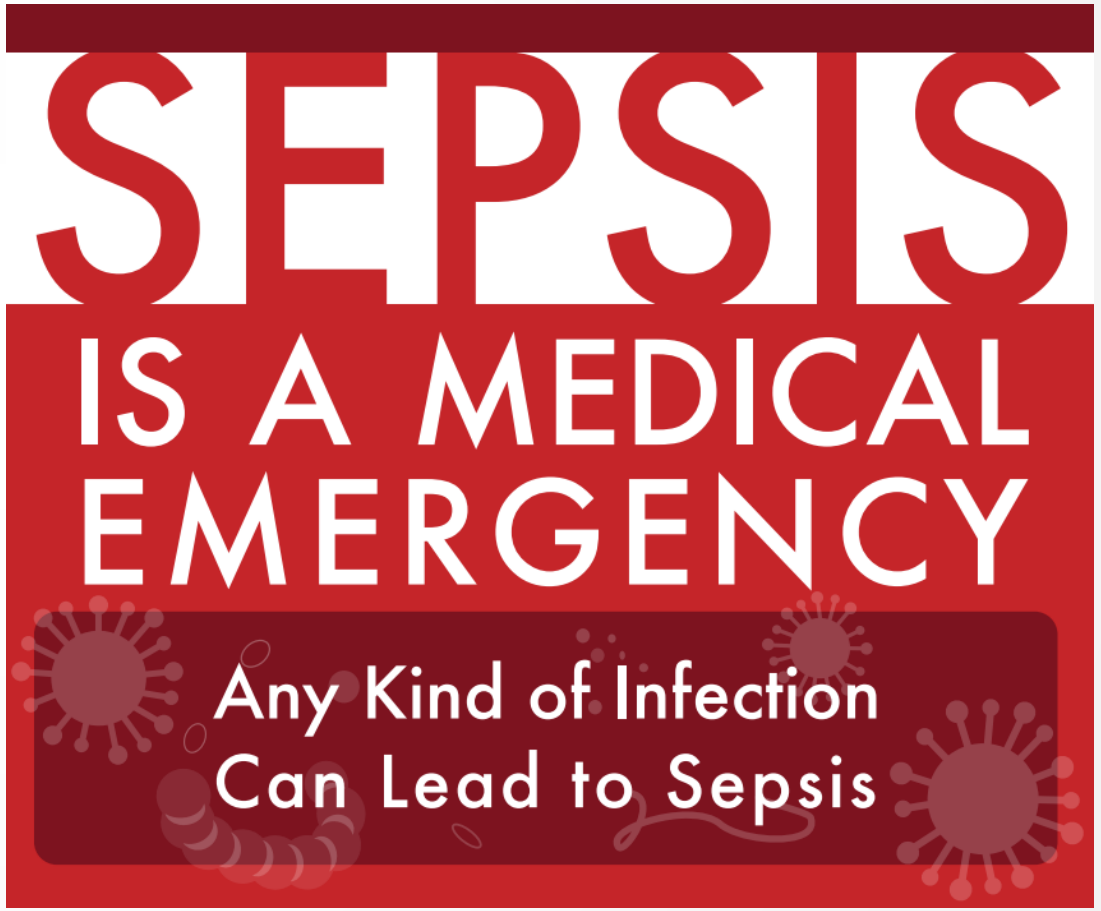
To save lives and reduce suffering by raising awareness of sepsis as a medical emergency

https://www.sepsis.org



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Presenter Biographies

Jeff Hersh, PhD, MD

Chief Medical Officer

GE Healthcare

Tom Zimmerman

Director of Acute Care Commercial Marketing

GE Healthcare

- Board Certified in Internal Medicine, Pediatrics, Emergency Medicine and Disaster Medicine
- Previous faculty appointments at Harvard, University of Massachusetts, Tufts, Cornell, Dartmouth, Yale and others.
- Hundreds of publications and presentations, multiple patents (including one in AI), PI of dozens of studies.

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Can we help "solve" sepsis together?

Episode 3 of the Webinar Series

August 22, 2019

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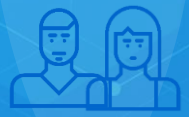
Comprehensive
Lab Testing

Complete view of patient



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Patient Imaging
& Monitoring

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tom.zimmerman@ge.com

Today's Speakers

- **Jeff Hersh,** MD, PhD, Chief Medical Officer
  Chief Medical Officer, GE Healthcare

  Board Certified in Internal Medicine, Pediatrics, Emergency Medicine and Disaster Medicine. Previous faculty appointments at Harvard, University of Massachusetts, Tufts, Cornell, Dartmouth, Yale and others. Hundreds of publications and presentations, multiple patents (including one in AI), PI of dozens of studies.

- **Tom Zimmerman -** Moderator
  Director of Acute Care Commercial Marketing
  GE Healthcare

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Interactive Augmented Intelligence for Healthcare…and Sepsis

- The potential impact of AI on future best practices for medical care and the treatment of sepsis
- Defining bottom up and top down approach to AI
- The benefits of a “digital twin” in differential diagnosis

Live chat Q & A with Dr. Hersh

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Does your enterprise have a digital sepsis alert notification?

a) Yes, already instituted and widely adopted
b) Yes, instituted but not widely adopted
c) Planned or piloted, but not yet launched across our enterprise
d) Not yet planned for our enterprise

System-generated sepsis alerts?

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Are these notifications connected to AI for both execution and analytics?

a) No, we simply use pre-defined threshold triggers
b) Yes, there is AI decision-making on multiple variables, but limited analytics
c) Yes, we have both AI-driven notifications and analytics for later review
d) We have neither at this time but are considering for future use

AI and Analytics?

Live Chat with Dr. Hersh

Please submit your questions online!

We'll pause to answer the first batch in just a few minutes….

The Complimentary Roles of Bottom-Up and Top-Down Approaches

Interactive Augmented Intelligence For Sepsis

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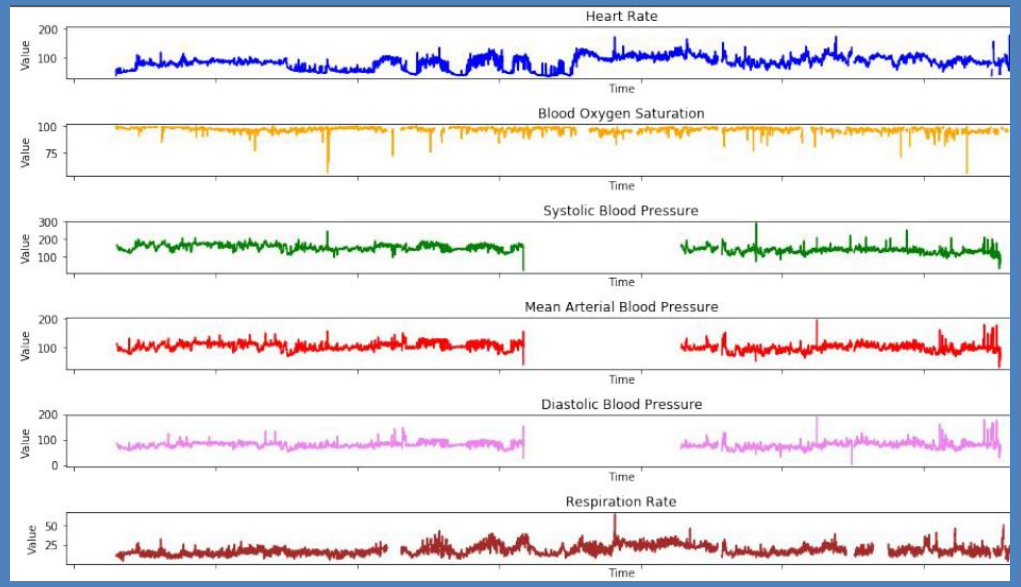
Bottom-Up Approaches:

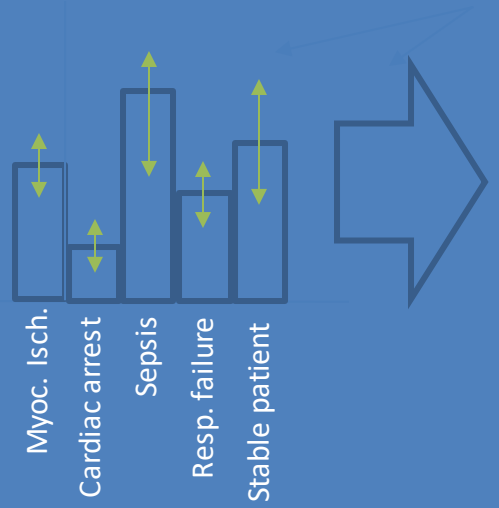
- Use standardized data and data streams
- Utilize large sets of patient data to identify associations
- Automatic methods scale easily with increasing data
  - The more data the better

An Example:
Predicting Risk Scores From Continuous Data

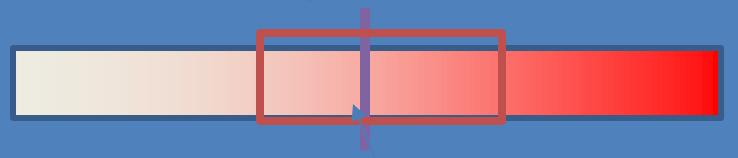
Input data



Probability



Risk score



Confidence interval

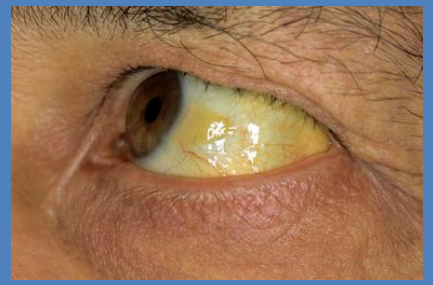
Bottom-Up Has Limitations

- Looking at large data sets is not enough:
  - Very large number of variables may limit interpretation of even a huge data set
  - Not all the relevant data may be captured, much data that is captured is not relevant, and the validity/quality/accessibility of available data may be limited
  - Association is not causation, and differentiating these is often key in developing an appropriate care plan, hence relevance of individual data points from a clinical/physiological perspective must be addressed
  - The data needs to be evaluated in context to be properly interpreted, and the entire context to do so may not be available

Two 35-year-old females present to the ED (both with occasional headaches since childhood):

- With a laceration and incidentally a heart rate = 48

- With worsening yellow eyes



How can bottom-up know when something is important or when it is background noise?

Machine learning cannot be just spaghetti sticking to the wall….we need to toss the right pasta:

- Scurvy noted to develop during long sea voyages in 1600's:
  - 1734 'anti-scorbutic' fresh vegetables per Dr. Bachstrom
  - Vitamin C discovered 1930's by Albert Szent-Gyorgyi

- Tomatoes are thought to be poisonous by French and N. Europeans
  - From South America of the 'deadly' nightshade family

How does bottom-up know what data may be relevant, and how it is relevant? How can we differentiate association from causation?

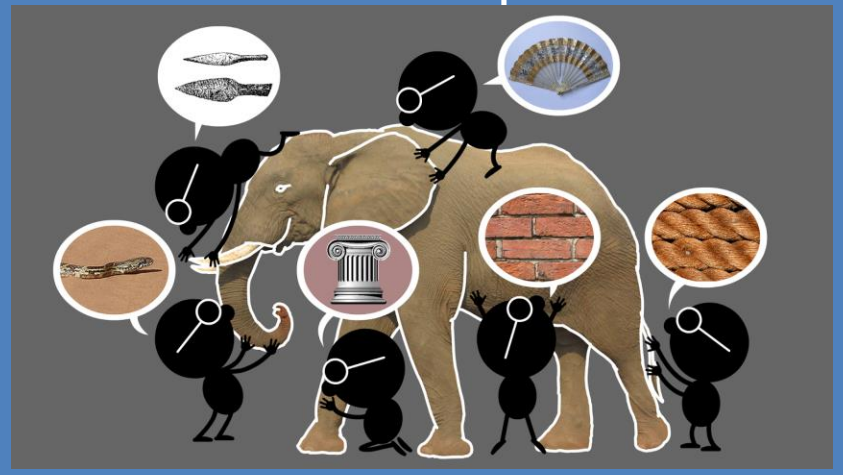
Isolated data may tell a misleading story

- Oxygen saturation is 99%. Is that good?
  - Breathing 10 times per minute on room air
  - Agonal breathing 26 times per minute on 100% oxygen
- Blood pressure 88/58
  - Pregnant woman with baseline 90/60
  - Hypertensive patient after a major traumatic accident
- Heart rate 160
  - Newborn who is pink, afebrile, active and feeding well
  - 54 year old complaining of palpitations

How can bottom-up individualize interpretation and place them in appropriate context?

Moving Beyond Bottom-Up Limitations

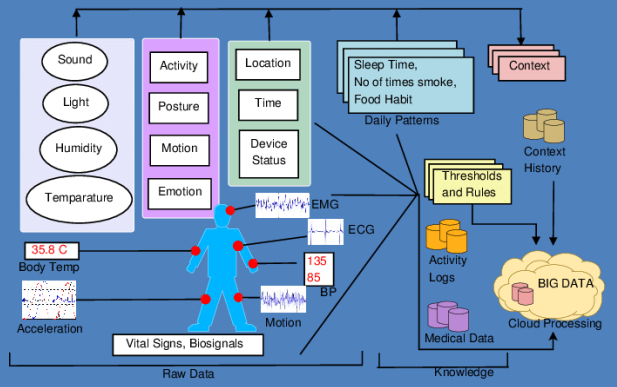
- We need to address:
  - When is something relevant/associated/causative/other?
  - How do we know what to consider in the data set, and is it available to evaluate?
  - How can we interpret individual data points in context to help them make sense?
  - Other



Top-down approaches can be utilized to address these issues

Top-Down Approaches:

- Use knowledge that already exists: guidelines, differential diagnosis and understandings of physiology
- Have the potential to utilize causation and not just association
- May allow personalization by putting evaluation in an appropriate clinical context



Some Guideline Examples (there are gazillions)

Canadian CT Head Rule

CT head is only required for minor head injury patients with any one of these findings:

High Risk (for Neurological Intervention)

1. GCS score < 15 at 2 hrs after injury
2. Suspected open or depressed skull fracture
3. Any sign of basal skull fracture*
4. Vomiting ≥ 2 episodes
5. Age ≥ 65 years

Medium Risk (for Brain Injury on CT)

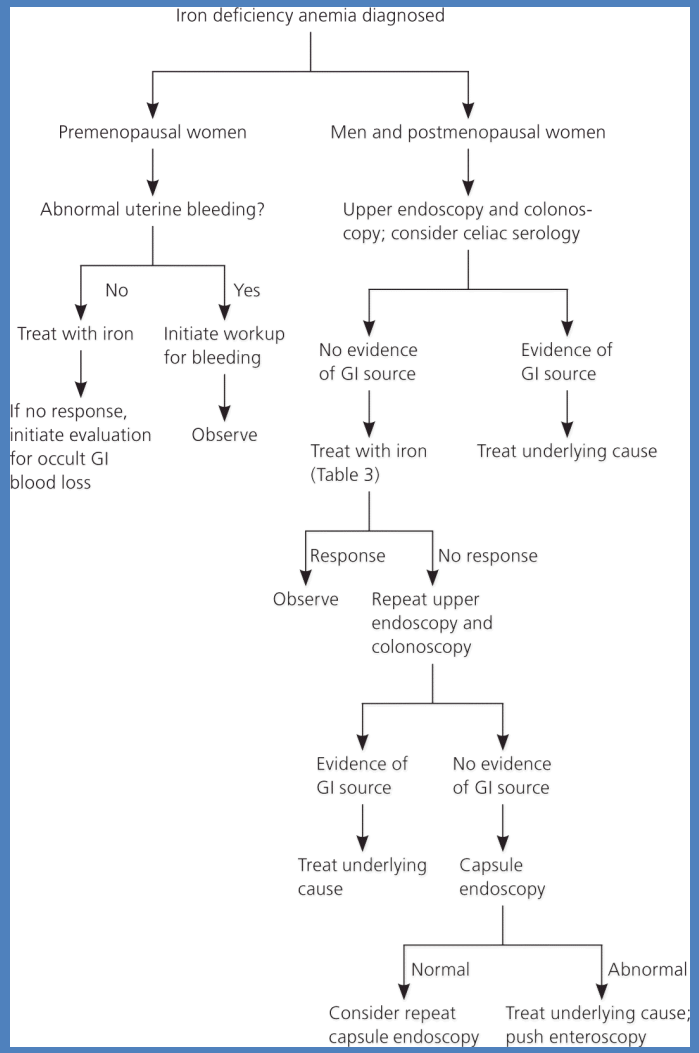
6. Amnesia before impact ≥ 30 min
7. Dangerous mechanism ** *(pedestrian, occupant ejected, fall from elevation)*

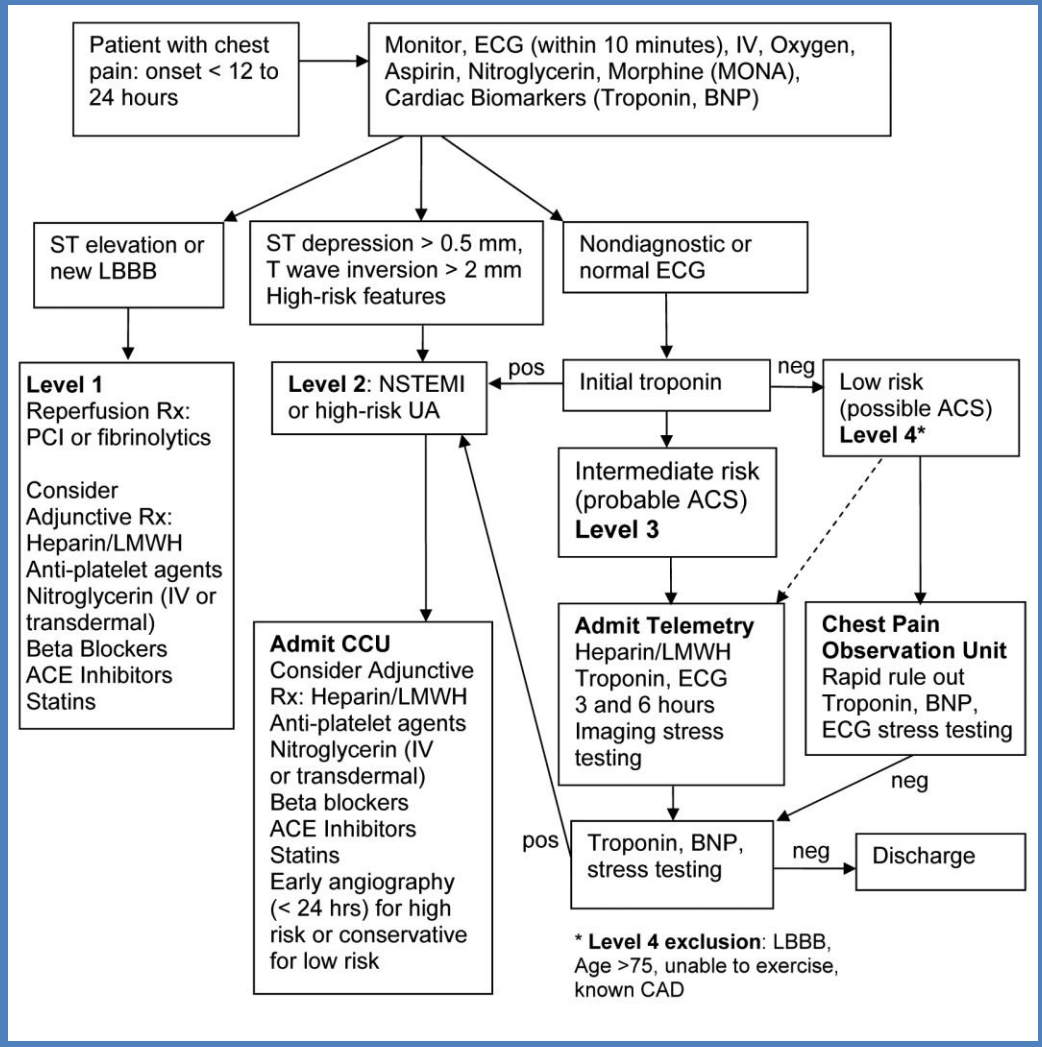
*Signs of Basal Skull Fracture
- hemotympanum, 'racoon' eyes, CSF otorrhea/ rhinorrhea, Battle's sign

** Dangerous Mechanism
- pedestrian struck by vehicle
- occupant ejected from motor vehicle
- fall from elevation ≥ 3 feet or 5 stairs

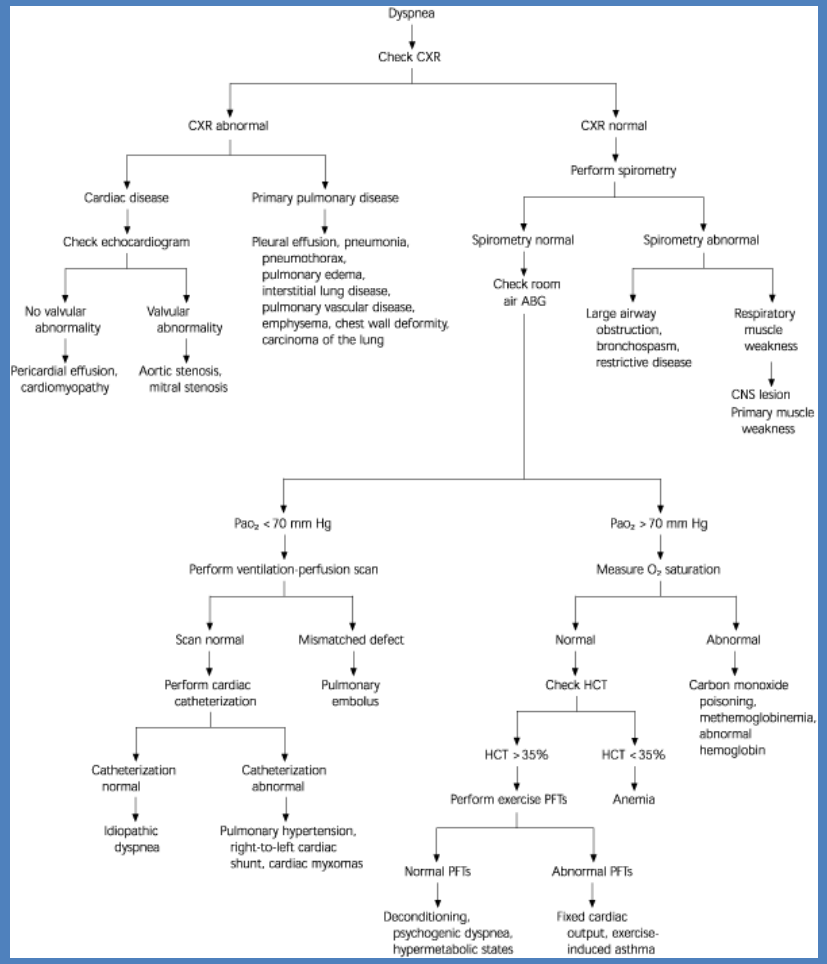
Rule Not Applicable If:
- Non-trauma cases
- GCS < 13
- Age < 16 years
- Coumadin or bleeding disorder
- Obvious open skull fracture

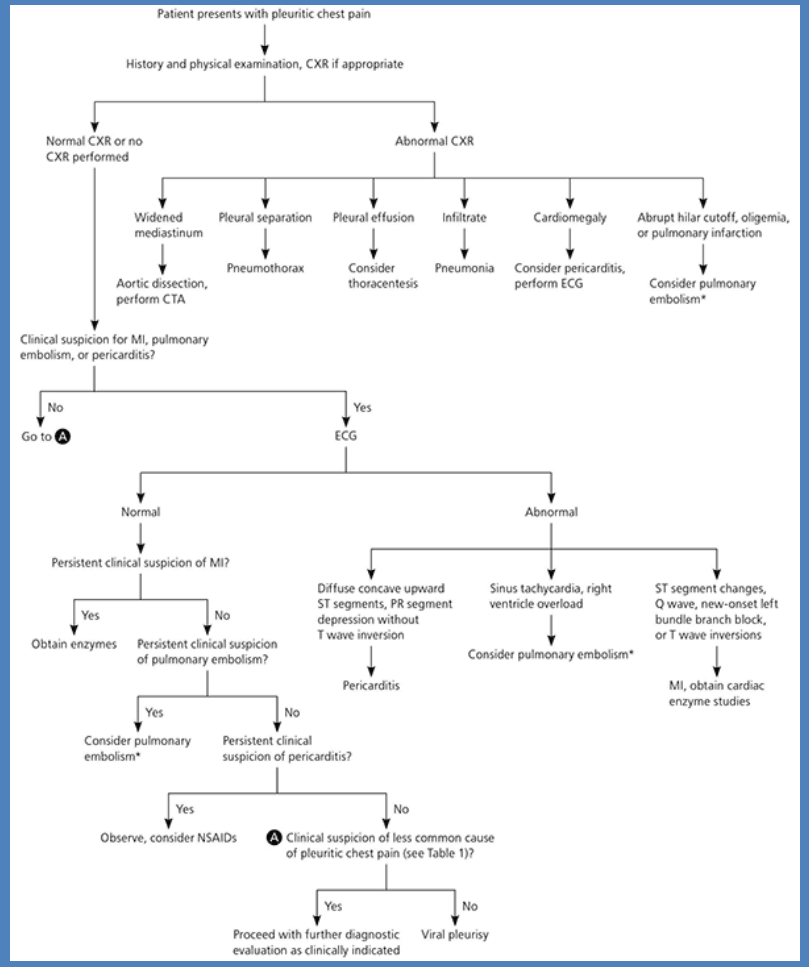
Stiell IG, et al. The Canadian CT Head Rule for Patients with Minor Head Injury. Lancet 2001;357:1391-96.

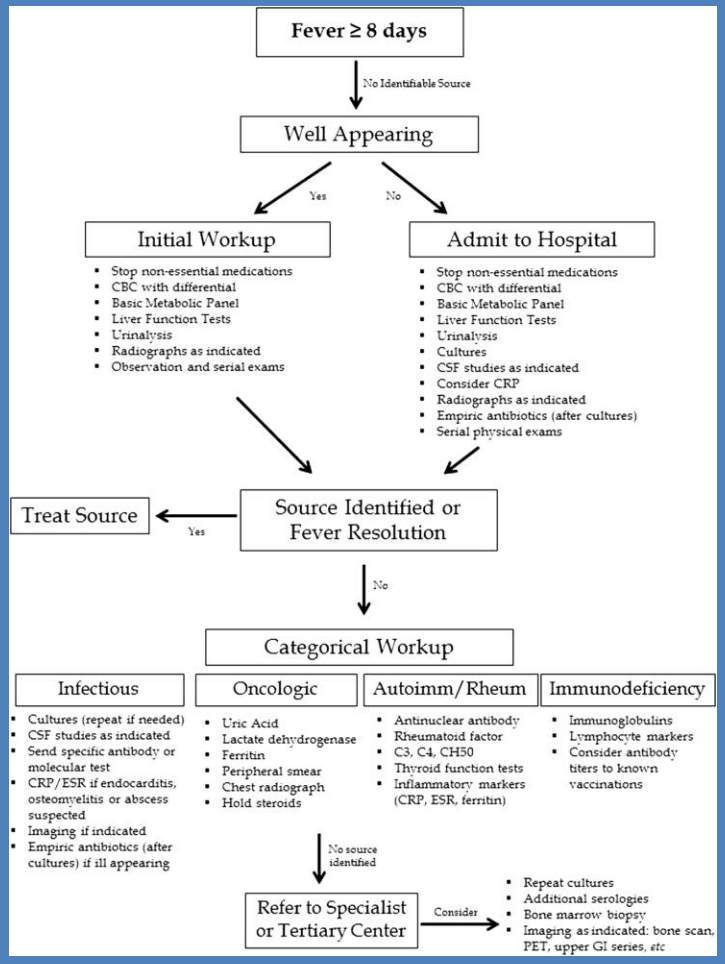




Some Differential Diagnosis Examples (there are gazillions)

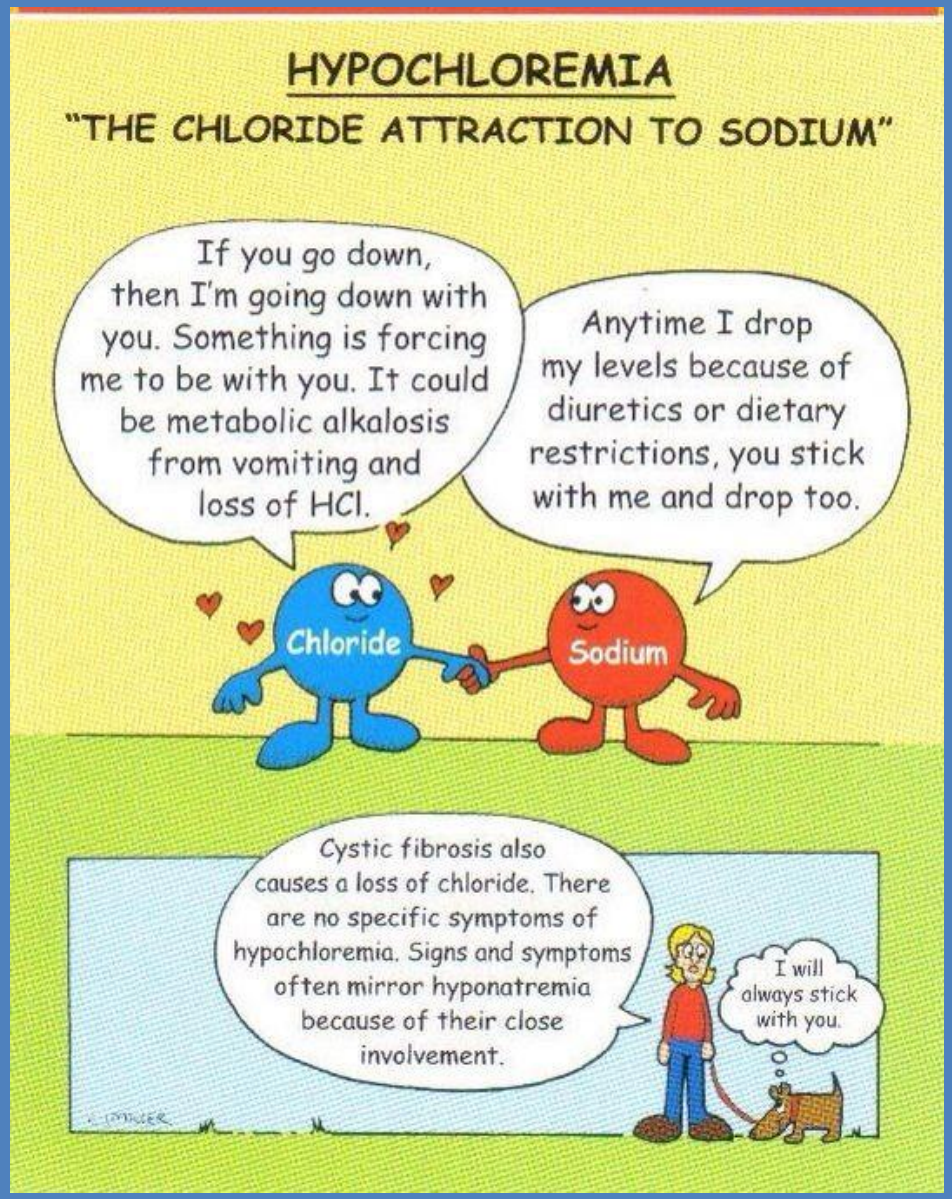






Some Context Examples (there are gazillions)

Low TSH <0.1	Normal TSH 0.1 - 2	High TSH > 2
↓	↓	↓
Consider (over-active thyroid) Hyperthyroidism or Secondary or Tertiary Hypothyroidism	Make Presumptive Diagnosis on Clinical Grounds & Basal Temperatures Hypothyroidism	Consider (under-active thyroid) Hypothyroidism
↓	↓	↓
To Confirm Diagnosis Check FT4 & TT4 TPOAb & TgAb	To Confirm Diagnosis Check FT4 & TT4 FT3 & TT3 TPOAb & TgAb (rT3)	To Confirm Diagnosis Check FT4 & TT4 TPOAb & TgAb (rT3)
↓	↓	↓
If Raised Levels and / or Antibodies Present	If T4 & T3 at Lower End of Range Consider Diagnosis Confirmed (rT3 may be raised) and / or Antibodies Present	If T4 & T3 Low (rT3 may be raised) and / or Antibodies Present
↓	↓	↓
Hyperthyroidism	(if in normal range diagnosis may be made on clinical grounds) **Hypothyroidism**	**Hypothyroidism**



A Bottom-Up Approach Can Be Used To Create a Top-Down Tool: National Early Warning Score (NEWS)

- System to standardize the assessment and response to acute illness
- Easy to use
- Fixed set of input parameters
- Does not adapt to patient context

Physiological Parameters	3	2	1	0	1	2	3
Respiration Rate (BPM)	≤8		9-11	12-20		21-24	≥25
Oxygen Saturations (%)	≤91	92-93	94-95	≥96			
Any Supplemental Oxygen		Yes		No			
Temperature (°C)	≤35		35.1-36.0	36.1-38.0	38.1-39.0	≥39.1	
Systolic Blood Pressure (mmHg)	≤90	19-100	101-110	111-219			≥220
Heart Rate (BPM)	≤40		41-50	51-90	91-110	111-130	≥131
Level of Consciousness				A			V, P or U

An Executable Approach:

Interactive Augmented Intelligence (IAI)

1) “Digital twin” to help generate a differential diagnosis and surveil for the onset of a complication/condition
2) Force rank the potential diagnoses: consider likelihood and clinical criteria (?is it life threatening and treatable?)
3) Use guidelines to help identify a possible care plan (tests, treatments, consults, etc.)
4) IAI: discusses with the clinician in real time
5) Initiate the plan (personalized medicine)
6) Surveil for progress (force rank type/manner of clinician-centric personalized data display)
7) Repeat this loop, looking at changes and evaluating new info
8) Converge on the definitive diagnosis and care plan
9) Use machine learning to refine and improve

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Application of IAI to Sepsis

“Digital twin” to help identify patients at risk for sepsis

Bottom-up approach, informed by top-down:
This helps identify factors to differentiate cohorts

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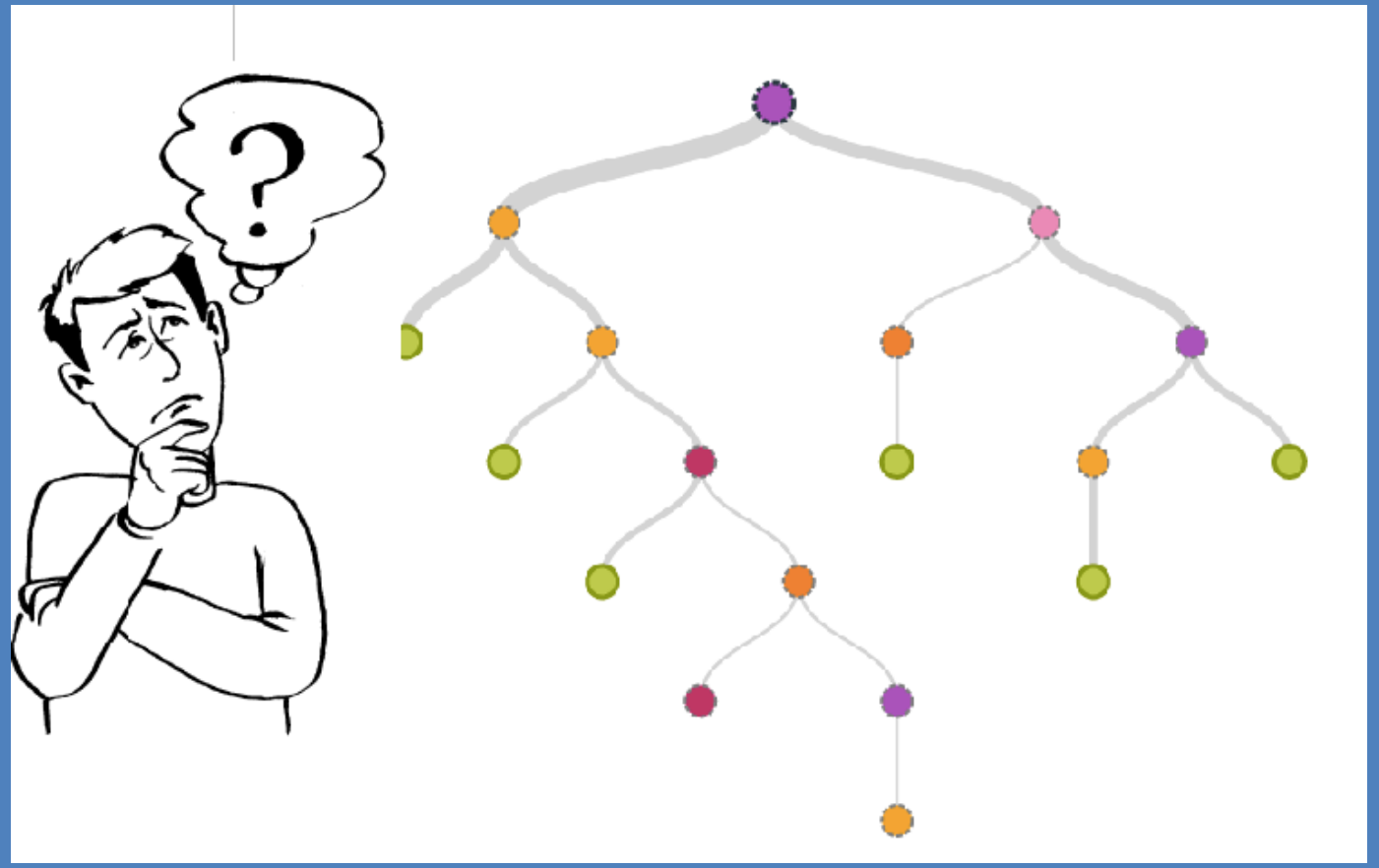
Force rank other potential diagnoses

Top-down, likely enhanced by some bottom-up:
This helps identify confounding diagnoses

Use guidelines to help identify possible next steps (further tests, Rx's, consults, etc.)



Top-down, likely enhanced by some bottom-up:
Bottom-up can help make the evaluation and Rx more efficient

Discuss the possibility of sepsis with the clinician

This is key! It is the method to maintain clinician ‘gut feeling’
And other intangibles….

Initiate the plan (personalized medicine)

Personalized care is a very key goal for the future of Healthcare delivery

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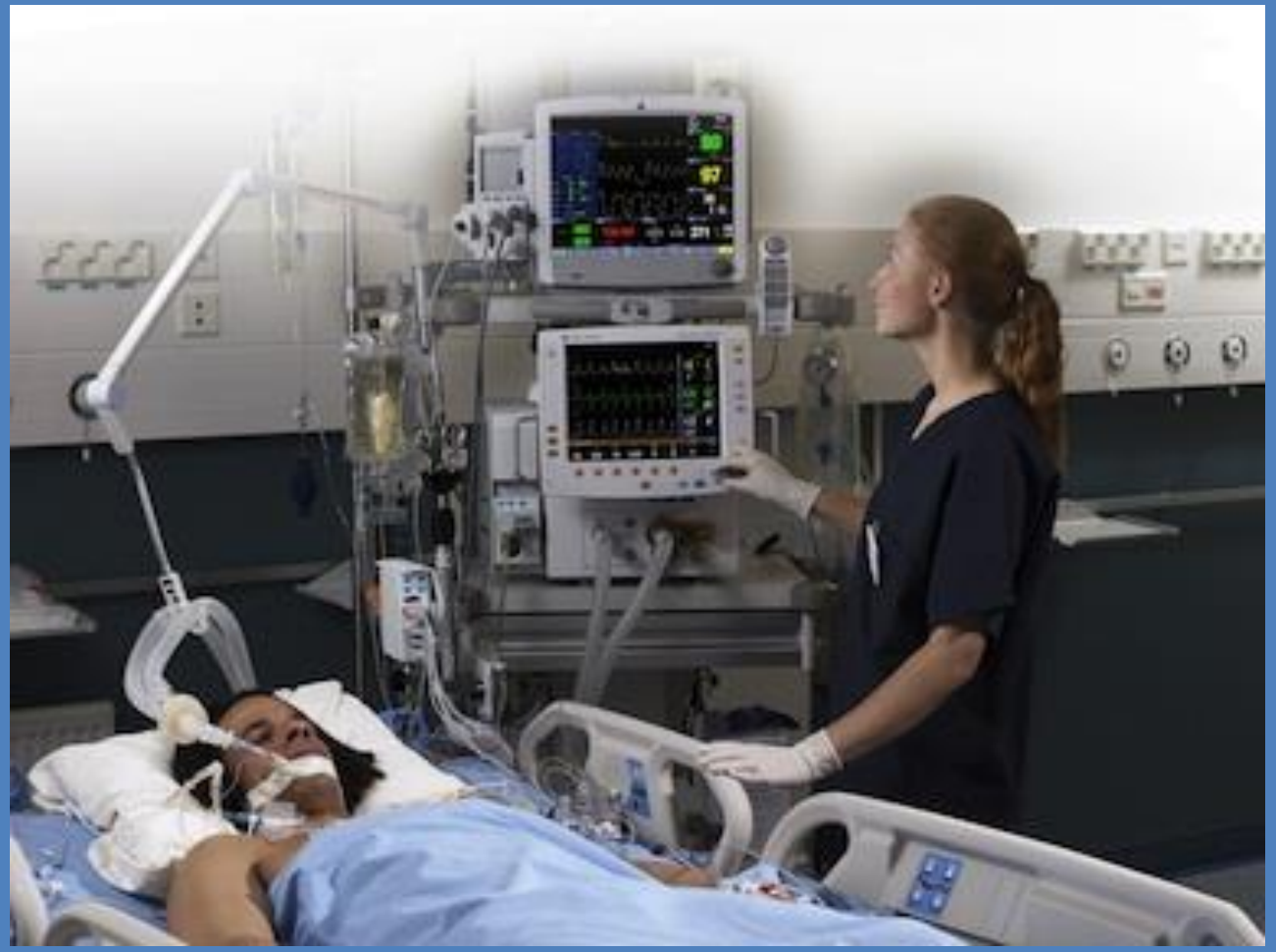
Surveil for progress (specifically identifying key parameters to monitor for the septic patient)



Bottom-up informed by top-down to look for indications of issues:
Very similar to digital twin step in concept

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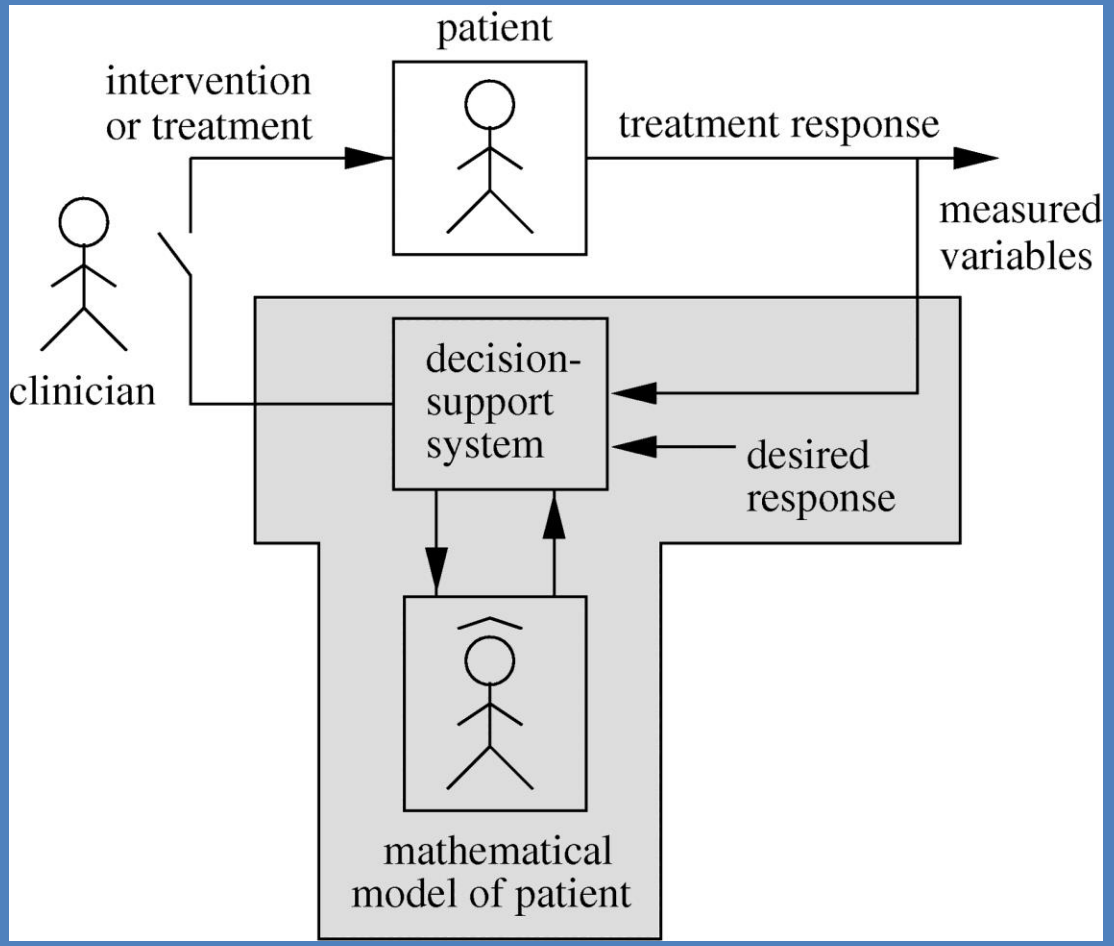
Repeat this loop, looking at changes and evaluating new info: does the care plan need to be modified?



Bottom-up and top-down as in prior steps

Converge on the definitive care plan

IAI drives action and execution

Use a bottom-up approach (machine learning) to refine and improve all phases of this approach

Bottom-up, strongly leveraging machine learning

Why IAI?

- Interactive:
  - Not a black box, instead it is a ‘curbside consult’
    - Increases acceptance, adoption and utilization
  - Puts the evaluation in the appropriate clinical context

- Augmented
  - Supports clinical care, not trying to replace the clinician (‘gut feeling’, patient-clinician interaction, etc., stay intact)
  - Combines bottom-up and top-down

- Intelligence
  - Manage data (clinician wants what they want/need, when they want/need it), including smart data presentation
  - Has potential to improve consistency and efficiency

Questions?

Live Chat with Dr. Hersh

Please submit your questions online!

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Next: September 18th series edition
"Can we help 'solve' sepsis together?"

Dr. Eric Gluck, Swedish Covenant Hospital
"Biomarkers: We just need to be better listeners"

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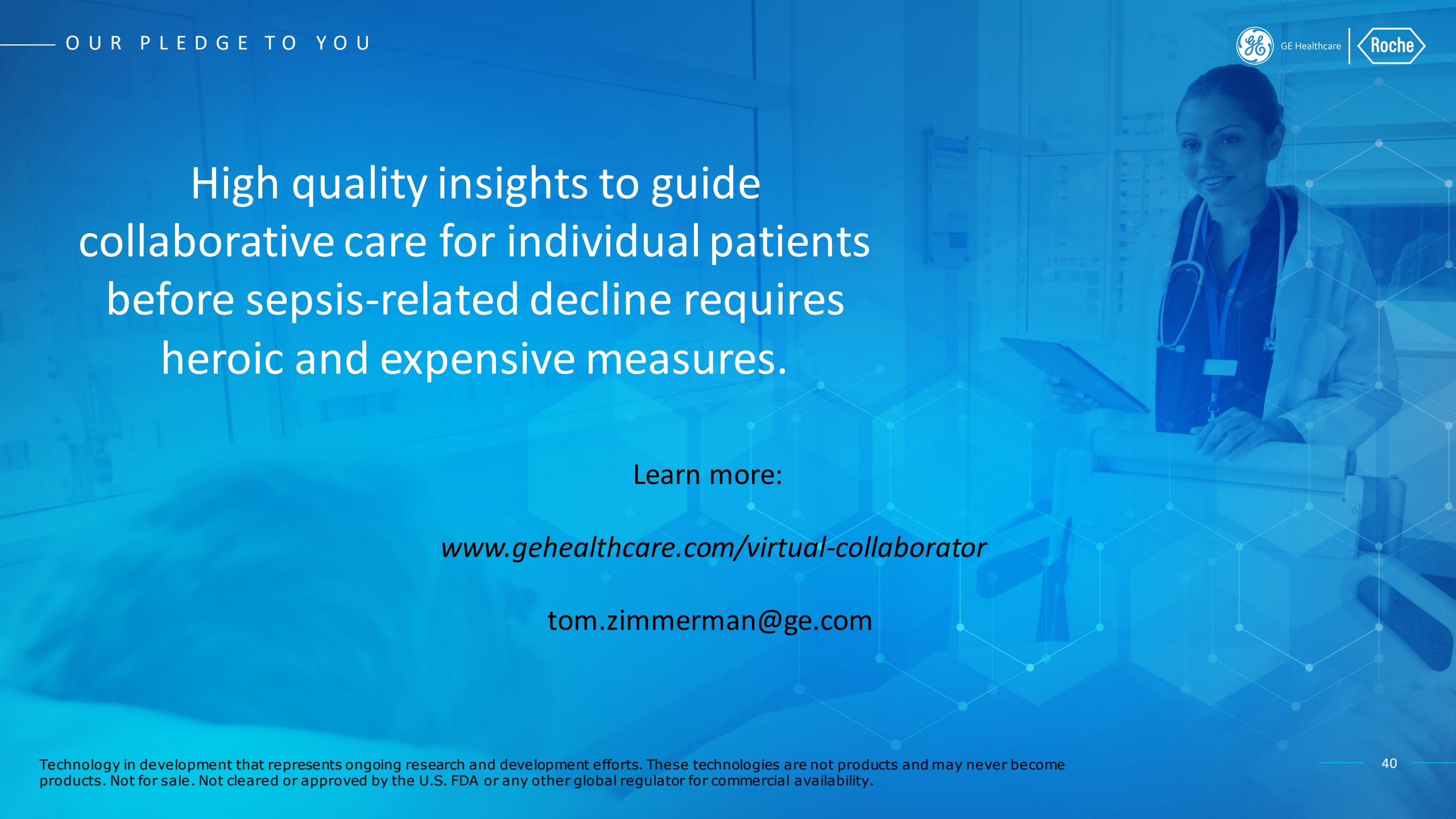

High quality insights to guide collaborative care for individual patients before sepsis-related decline requires heroic and expensive measures.

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September 18th edition
"Can we help 'solve' sepsis together?"

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"Biomarkers: We just need to be better listeners"

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Thank you!

Sepsis Awareness Month

SEPSIS ALLIANCE

- Launched in 2011 by Sepsis Alliance
- State designations
- Community events
- Sepsis Superhero™ Challenge
- Toolkits for healthcare providers
  - ➢Printable Posters and Infographics
  - ➢Digital and Social Media tools
  - ➢Ideas to get involved
  - ➢Template messaging

2019 SEPTEMBER SEPSIS SAY SEPSIS SAVE LIVES

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Sepsis Heroes

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- Annual celebration of sepsis leadership across the country
- September 12, 2019
- Marquee New York City

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Sepsis Coordinator Network Webinar

SEPSIS ALLIANCE

Sepsis: Common, Lethal, and Unrecognized

August 27 at 2-3 pm ET

Speaker:

Angel O. Coz, MD, FCCP

Associate Professor of Medicine

University of Kentucky

Register at SepsisCoordinatorNetwork.org

Founding Sponsor: Edwards

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GE Sponsored Innovation Webinar

SEPSIS ALLIANCE

Series: Can We Help 'Solve' Sepsis Together?

"Biomarkers: We just need to be better listeners"

September 18 at 2-2:45 pm ET

Register at SepsisWebinar.org

Speaker:

Dr. Eric Gluck

Swedish Covenant Hospital

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Sepsis: Across the Continuum of Care Webinar

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The Blind Spot of Antibiotic Stewardship: Antibiotic Overuse at Discharge

September 24 at 2-3 pm ET

Register at SepsisWebinar.org

Speaker:

Valerie Vaughn, MD, MSc

Assistant Professor

University of Michigan Medical School

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