Of Horses, Zebras & Chameleons:
Diagnostic Reasoning in EM

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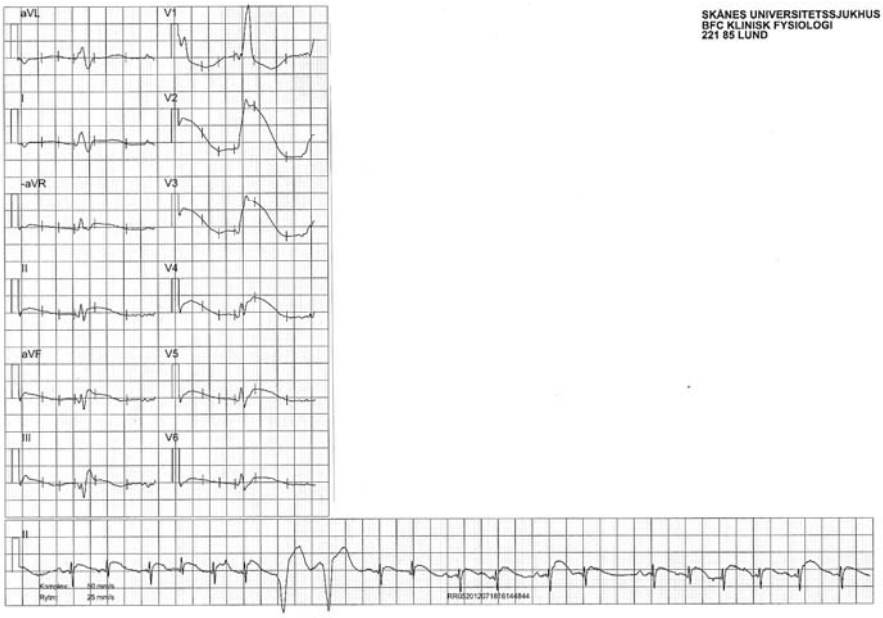

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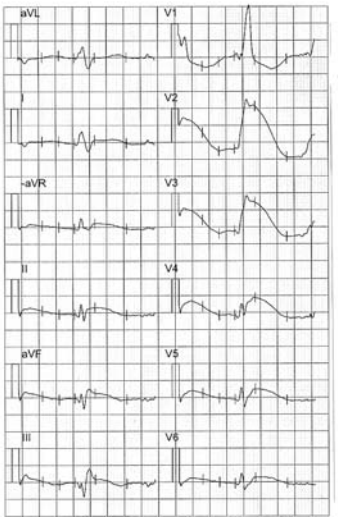

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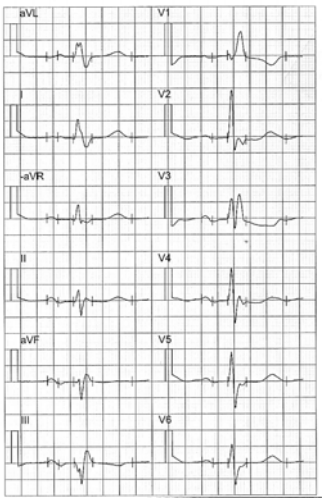


Blood Gas Values				
pH	7.39			
pCO_2	3.5	kPa	26	mm Hg
pO_2	7.3	kPa	55	mm Hg
Electrolyte Values				
Na^+	130	mmol/L		
K^+	3.4	mmol/L		
Creatinine	85	µmol/L	0.96	mg/dl
Ca^{2+}	1.15	mmol/L		
Cl^-	101	mmol/L		
Metabolite Values				
Glucose	24.8	mmol/L	446	mg/dl
Lactate	6.2	mmol/L	56	mg/dl
Oximetry Values				
Hb	132	g/L		
sO_2	87	%		
Other				
Base(Ecf)c	-8.6	mmol/L		
$HCO3^-$(P.st)c	18	mmol/L		

Zebra/Horse

- Uncommon condition
- Mistaken for common one
- Focus on false positive

Chameleon

- Common condition
- Uncommon presentation
- Focus on false negative

Stroke Mimics

- Migraine
- Seizure
- Infection
- Psychiatric

False Positive Stroke Dx

Stroke Chameleons

- Nausea/vomiting
- Fall
- Vertigo
- Movement disorder

False Negative Stroke Dx

STEMI

Stroke

Infection in the elderly

Improving Diagnosis in Health Care

Quality Chasm Series

Getting the right diagnosis is a key aspect of health care: It provides an explanation of a patient's health problem and informs subsequent health care decisions. For decades, diagnostic errors—inaccurate or delayed diagnoses—have represented a blind spot in the delivery of quality health care. Diagnostic errors persist throughout all settings of care and continue to harm an unacceptable number of patients.

Diagnostic Error: Definition

Failure to:

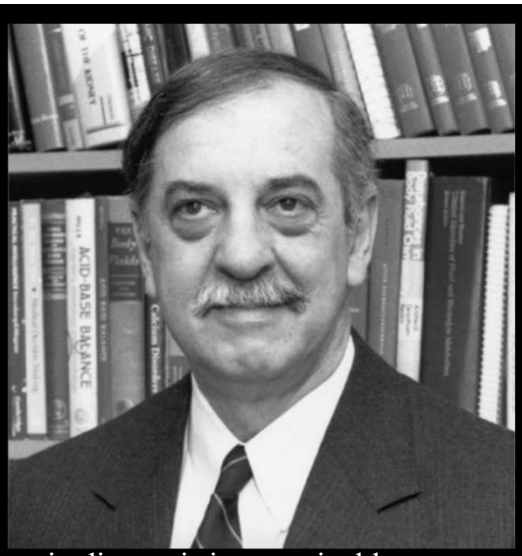
- establish accurate and timely explanation of the patient's health problem(s)

or

- communicate that explanation to the patient

ED Perspective

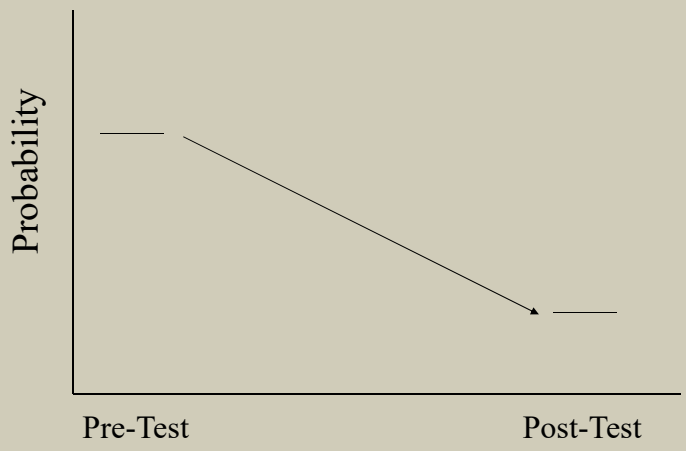
- Forefront of process
- Limited information
- Hindsight bias



"Absolute certainty in diagnosis is unattainable, no matter how much information we gather . . . . Our task is . . . to reduce the level of diagnostic uncertainty enough to make optimal therapeutic decisions."
Jerome Kassirer

"Medicine is a science of uncertainty and an art of probability."
William Osler

Bayes' theorem



Time-Sensitive Diagnoses

- Pulmonary embolism
- Stroke
- Sepsis

- Lung cancer
- Multiple sclerosis
- Rheumatoid arthritis

Over-Investigation

Medical Care Overuse Causes Waste, Harm in Healthcare

June 8, 2015 • Bryn N

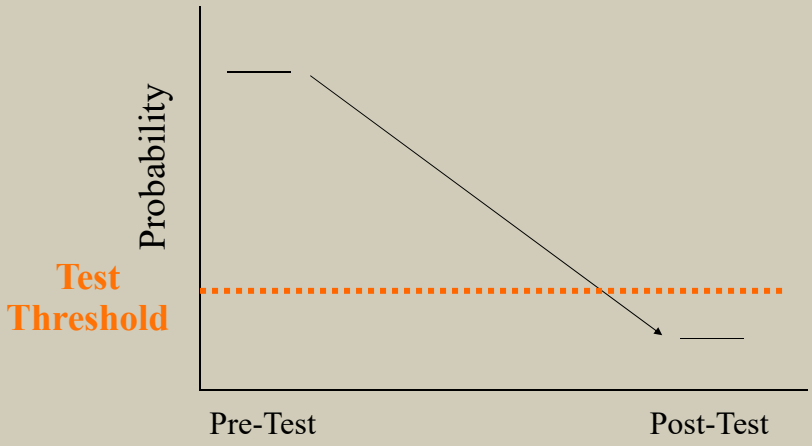
A trickle of anecdotes

There's one about th
still had a troponin b
that three tests in a 1
attack.

BCE 72 Overinvestigation in Emergency Medicine

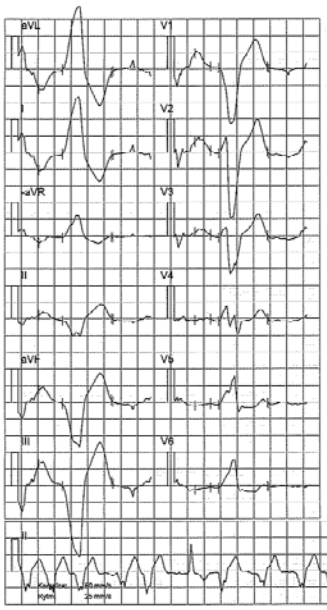
With increased access to timely advanced diagnostic testing in EDs rational resource utilization is becoming ever more important. In his Best Case Ever **Dr. Shahbaz Syed** argues that a patient at Janus General who presented to the ED with chest pain, died as a result of overinvestigation, and explains how understanding the factors that contribute to overinvestigation, Baysian theory, diagnostic decision analysis, radiation risk, and teaching "dogma" may help prevent overinvestigation in Emergency Medicine...

Test Threshold



Diagnostic Error in EM

- Failure to accurately evaluate the likelihood of time-sensitive conditions based on available information



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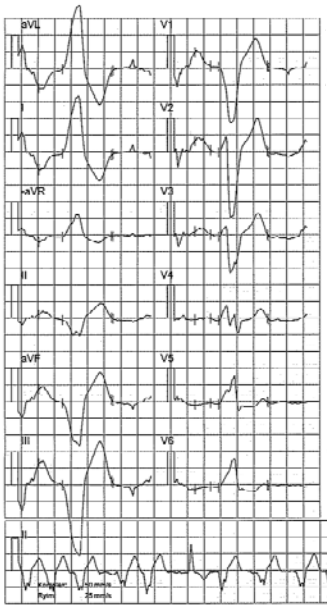
Ventricular tachycardia?

Atrial fibrillation
+
left bundle branch block?



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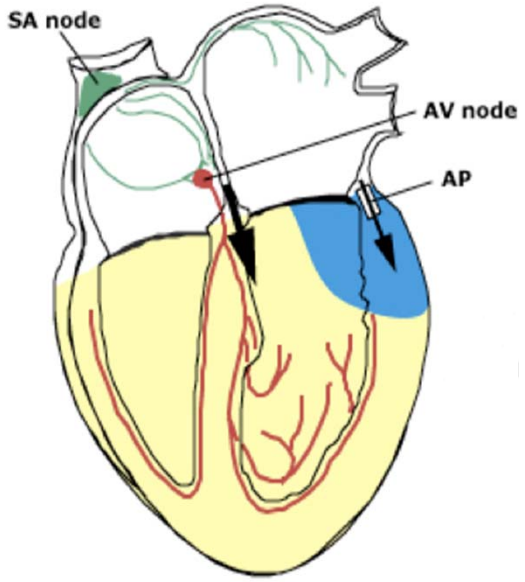
	Regular	Irregular
Narrow QRS		
Wide QRS		Polymorphic VT Atrial fibrillation + • bundle branch block • Na-channel blockade • hyperkalemia • bypass track



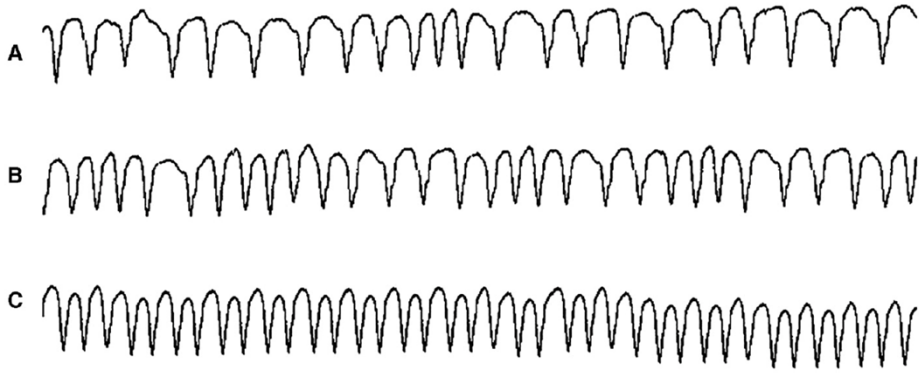
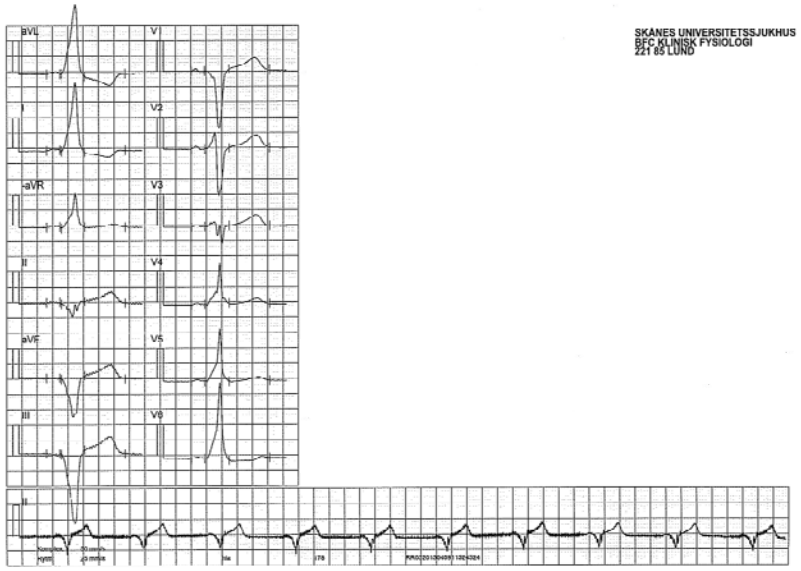


Fig. 9 Therapeutic misadventure in a patient with WPW AF. A, Rapid, wide, irregular QRS complex tachycardia. The physician did not consider the possibility of WPW and used diltiazem. B, After administration of diltiazem, an AV nodal blocking agent, the mean ventricular rate has increased. C, Markedly increased rate approaching 300 beats/min.

Fengler et al. Am J Emerg Med 2007;25:576-583



Diagnostic Errors: Etiology

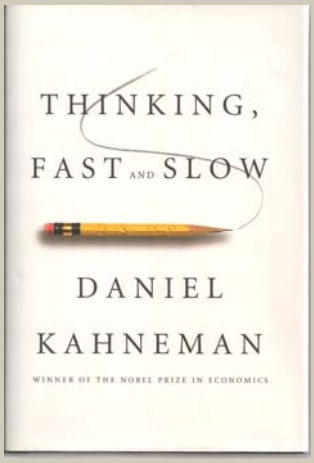
System-Related Errors

- Limited time/data
- Multitasking
- Interruptions
- Equipment failure

No-Fault Errors

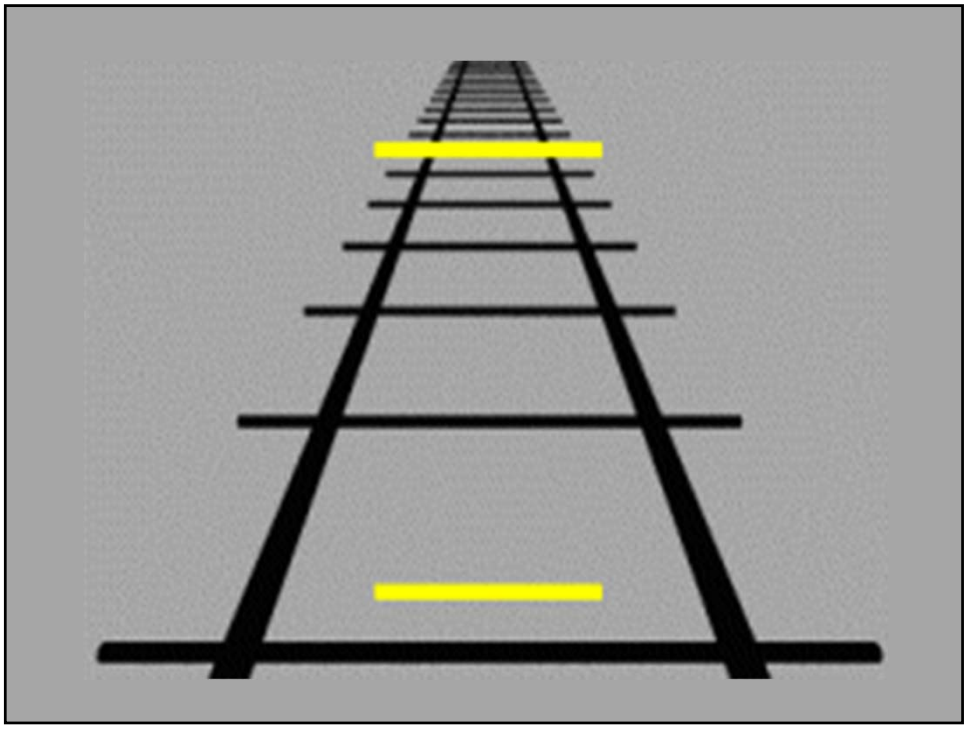
- Uncooperative patient

Cognitive Errors



System 1

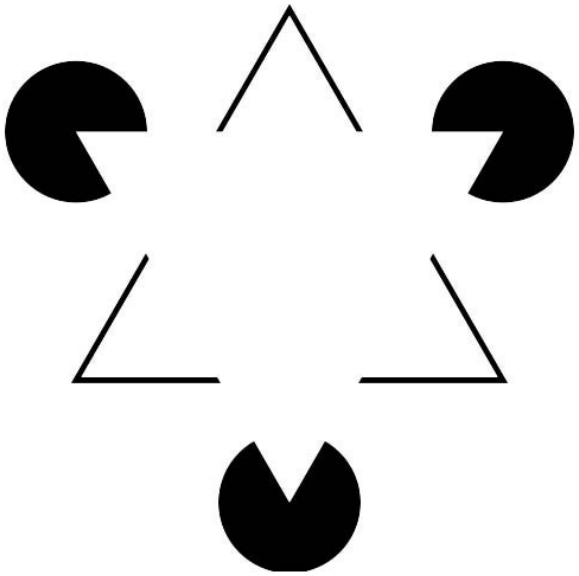
- Unconscious
- Pattern recognition, coherence
- Jumps to conclusions
- Effortless/Emotional



System 2

- Conscious
- Analytical
- Rule-based
- Tedious

Diagnostic Errors: Cognitive Sources



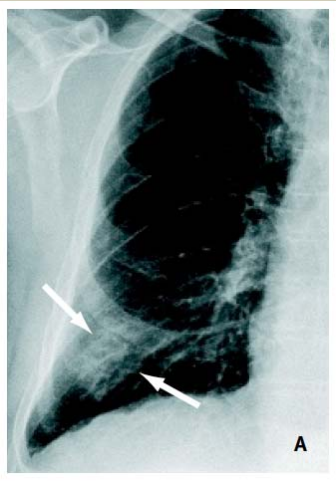
Diagnostic Errors: Cognitive Sources

”We only see what we know.”

Johann Wolfgang von Goethe

Diagnostic Errors: Cognitive Sources

Premature Closure



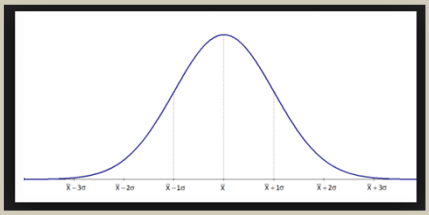
- Fever
- Dyspnea
- Pleuritic chest pain
- ↑ WBC, ↑ CRP

Faulty Data/Knowledge/Interpretation?

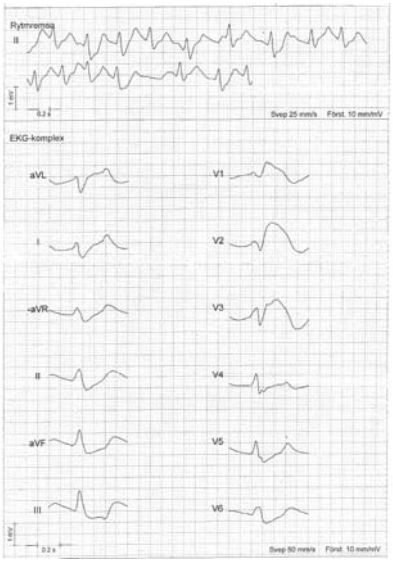
Neuro Exam*	Stroke Suspected	Stroke Missed
Good	333	62
Poor	29	41

* includes NIHSS elements

Arch et al. Stroke 2016;47:668-73

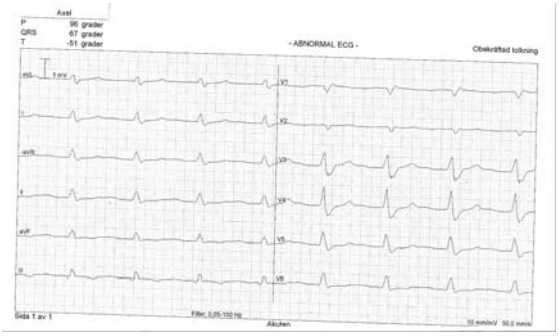


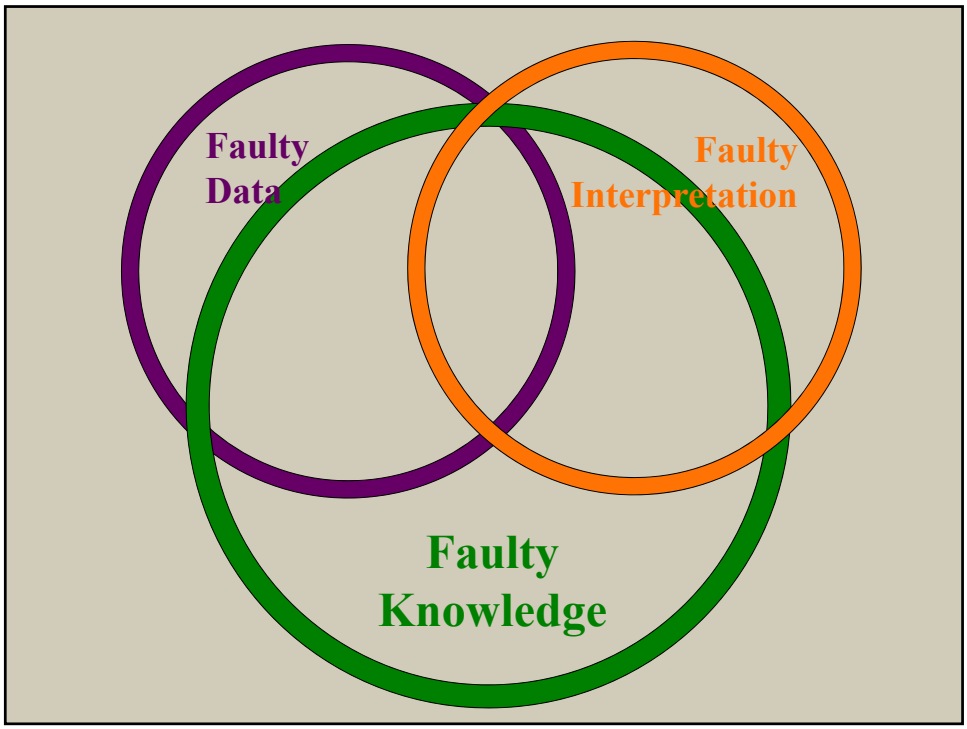
"The root cause of diagnostic error is difficult to study as errors tend to be defined only in hindsight and the 'microscope' that can enable detection of mental processes in live time has yet to be invented."
Geoffrey Norman



STEMI?

Blodgasvärden		
↓ pH	6,777	
↑ pCO_2	7,39	kPa
↓ pO_2	2,18	kPa
Elektrolytvärden		
↓ cNa^+	114	mmol/L
↑ cK^+	7,1	mmol/L
cCrea	385	µmol/l
cCa^{2+}	1,00	mmol/L
↓ cCl^-	79	mmol/L
Metabolitvärden		
↓ cGlu	66	mmol/L
↑ cLac	15	mmol/L
Oximetervärden		
ctHb	114	g/L
FCOHb	0,3	%
FMetHb	0,6	%
sO_2	9,4	%
Beräknade Värden		
$cBase(Ecf)_c$	-23,9	mmol/L
$cHCO_3^-(P.st)_c$	5,3	mmol/L





Reducing Diagnostic Error Risk

Cognitive Debiasing

- Be aware of your biases
- Apply counter-strategy

Theoretical Concerns

- Which of the 38+ biases?
- Risk of over-investigation

Lack of Evidence

- Sherbino et al. Teach Learn Med 2011;23:78-84
- Shimizu et al. Med Teach 2013;35:e1218-29
- Sherbino et al. CJEM 2014;16:34-40
- Norman et al. Acad Med 2014;89:277-84
- Smith et al. Diagnosis 2015;2:117-121

0 - 1 - 2

Chest/Thoracic Pain

Pain or discomfort localized to or under the chest wall (including the back)
If pain localized to the midline of the back: use instead Back Pain

BACKGROUND

M	☐ Current medications? ☐ Birth control pill, other hormonal treatments?
A	☐ Allergies?
P	☐ Past medical history? ☐ Prior heart or thromboembolic disease?
L	☐ Life circumstances?
E	☐ Alcohol: how often? How much?
S	☐ Smoking: amount? Prior smoking?

HISTORY

O	☐ When did the pain start? What were you doing? ☐ Time till max intensity: sec? min? hr?
P	☐ Pain location? Size of the painful area? ☐ Radiation?
Q	☐ Cramping, aching, sharp, ripping, burning?
R	☐ Worse with deep inspiration? ☐ Worse with movement?
S	☐ VAS (1-10)?
T	☐ Constant or intermittent? Increasing? ☐ Prior similar painful episodes?
+	☐ Wind: shortness of breath? ☐ Walk: leg pain/swelling? ☐ Warm: fever/chills?

PHYSICAL

Vitals	☐ RR, SpO2%, HR, BP, Temp?
Heart	☐ S3/S4, murmurs? ☐ Elevated JVP?
Lungs	☐ Rales? ☐ Decreased breath sounds?
Chest	☐ Redness? Rash? ☐ Tenderness on palpation?
Abdo	☐ Upper abdominal tenderness?
Legs	☐ Swelling? Edema?

TESTS

- ☐ WBC & CRP
- ☐ Troponin if > 40 years
- ☐ EKG

CONSIDER

1. Acute coronary syndrome
2. Pulmonary embolism
3. Aortic dissection

0 - 1 - 2

Time-Sensitive

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A320
AIRBUS

JAMA Internal Medicine | Original Investigation

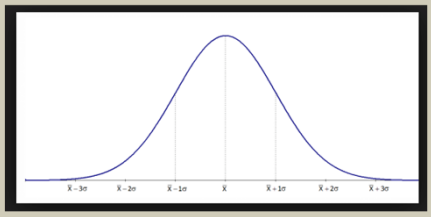
Effect of Systematic Physician Cross-checking on Reducing Adverse Events in the Emergency Department
The CHARMED Cluster Randomized Trial

Yonathan Freund, MD, PhD; Hélène Goulet, MD, MPH; Judith Leblanc, MsC; Jérôme Bokobza, MD; Patrick Ray, MD, PhD; Maxime Maignan, MD, PhD; Sabine Guinemer, MD; Jennifer Truchot, MD; Anne-Laure Féral-Pierssens, MD; Youri Yordanov, MD; Anne-Laure Philippon, MD; Edwin Rouff, MD; Ben Bloom, MD; Marine Cachanado, MsC; Alexandra Rousseau, PhD; Tabassome Simon, MD, PhD; Bruno Riou, MD, PhD

Freund Y et al. JAMA Internal Medicine 2018;178:812-9

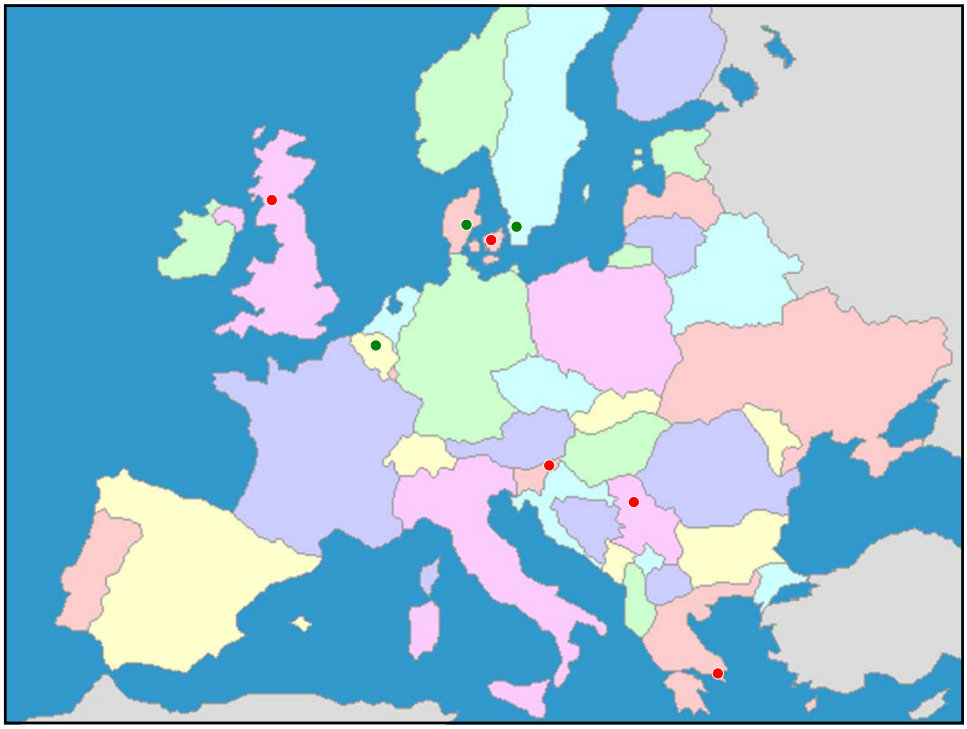
Cross-Checking	Adverse Event	
Yes	54/840	6.4%
No	90/840	10.7%
RRR (p = 0.01)	40%	

Scenario-Based Classroom Training



Emergency Medicine Core Competences

- Take EMCC
- Teach EMCC
- Direct EMCC locally
- Run local scenarios



Take-Home

Anonymous Internal Medicine Dogma: "When you hear hoofbeats, think horses, not zebras"
Kline's Dogma Collar: "If you don't know what a zebra looks like, good luck putting a saddle on that 'horse' "

Kline GA. CMAJ 2004;171:1491-2

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