

Planning for the Next Generation of Electronic Health Records

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**Dental Public Health Colloquium
San Antonio, Texas
January 19, 2017**

Despite having undergone pretty much every sort of dental procedure, I claim no special knowledge of dental informatics in general or electronic dental record (EDR) systems in particular.

However, I believe EDRs and EHRs:

- Serve the same basic goals
- Suffer from the same basic shortcomings
- Are related to the care of the same species

Planning for the Next Generation of EHRs

- First, an inventory of what EHRs do right...
- ... and what do they do wrong
- How did we get in this mess?
- What else could/should EHRs be doing?
- The missing link
- Evolution

An Inventory of What EHRs Do Right

- Billing
- Legibility
- Availability
- Result reporting
- Order entry
- Alerts and reminders

An Inventory of What EHRs Do Wrong

- Alerts and reminders (alert fatigue)
- Data entry (tedious, redundant)
- Incompleteness
- Data overload (note bloat)
- Poor navigability

MEDICAL RECORDS THAT GUIDE AND TEACH—WEED

SPECIAL ARTICLE

MEDICAL RECORDS THAT GUIDE AND TEACH

LAWRENCE L. WEED, M.D.*

Weed LL. Medical records that guide and teach. *N Engl J Med*.
1968 278(11):593-600 and 278(12):652-657.

9/10

Pt. received 40 units of regular insulin yest. because of B & 4+ urine sugars. Got 2000 cc Amigen yest. & 500 cc D₅W. Was febrile all night up to 40 at 8 PM this gradually came down to 39. 8 PM yest. suctioned & coughed up c̄ return of 1/2 cup of thick white sputum — cultured also blood cultures. Was in must. tent c̄ mucomist overnight. At 4 PM yest had B-R base. Sputum smear unremarkable — WBC's but no bacteria.

9/10-12:30

10 o'clock urine 2-3+/0. Given 10 U. reg. ins. at 12:30 PM. Temp. down to 38? Suctioned N.T. c̄ little return. However during suctioning pt. vomited 100-150 cc green fluid. Proximal jejunostomy tube draining well now.

9/11-9 AM

Urine 3+ given 10 U reg. insulin. Pt. was hiccuping all night & this AM. Levine tube passed c̄ 900-1000 cc bileous fluid removed. Jejunostomy tubes have been draining minimally. Will have Levine tube down.

(THREE PAGES OF SIMILAR NOTES FOLLOW UNTIL 9/26/67)



- #1 *Rheumatoid Arthritis* — maintained on Aspirin gram 15 q.4.h. and Prednisone 5 milligrams twice a day.
- #2 *Anemia* — probably related to blood loss by G.I. tract but also rule out persistent folic acid deficiency and hypothyroidism. R/O myxedema & folic acid def. •
- #3 *Peripheral neuritis* — uncertain etiology
- #4 *Peripheral edema* — uncertain etiology — malnutrition
- #5 *Depression and memory impairment or slowing up of thought processes* — uncertain etiology — myxedema.

PLANS:

- #1 Continue same regime although would suggest elevating head of bed, addition of Belladonna and Maalox PC and HS.
- #2* Serum Iron, folic acid, total protein AG ratio. PBI.
- #3 Continue multiple vitamin possibly should add folic acid. Folic acid level to be checked.
- #4 Evaluate serum protein level as well as PBI.
- #5 Probably I am overly impressed by her skin texture suggesting myxedema and her voice changes which may be due to the Thorazine. If the PBI is normal, then perhaps a more vigorous or intensive trial on antidepressants, more rapidly acting such as Pertofrane or Aventyl should be given or possibly shock therapy employed.





What Else Could They Be Doing?

- Minimize annoyance
- Inform about the patient
- Educate the users
- Assist with patient care
- Support Research

“A general purpose [health] record system would serve to improve the quality, planning and administration of health services, to help in the evaluation of comparative therapies, and to forward research on epidemiology and human genetics, and problems of diagnosis and especially on the natural history of disease.”

“We recommend the establishment of a special standing committee...to guide the development of a general purpose health record system...”

*- President's Science Advisory Committee
Life Sciences Panel, 1963*

40+ years later...

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The Office of the National Coordinator for Health Information Technology
HEALTH IT PLAYBOOK

Introduction to the Health IT Playbook

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I'm seeking information:

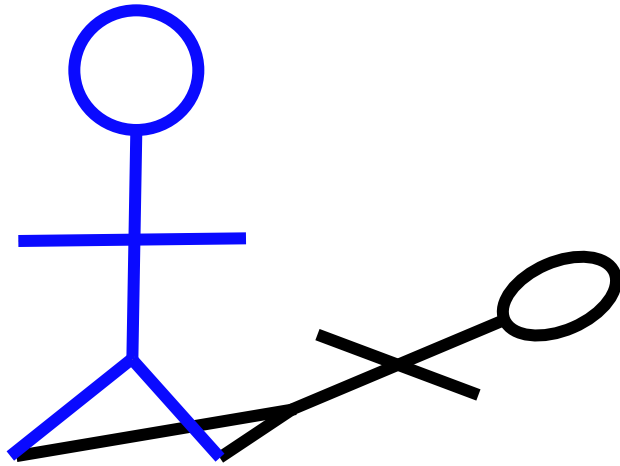
For Providers & Professionals >

For Patients & Families >

For Policy Researchers & Implementers >

Federal Advisory Committees (FACAS) >

The EHR as Shadow of Reality



Situational Awareness



Situational Awareness

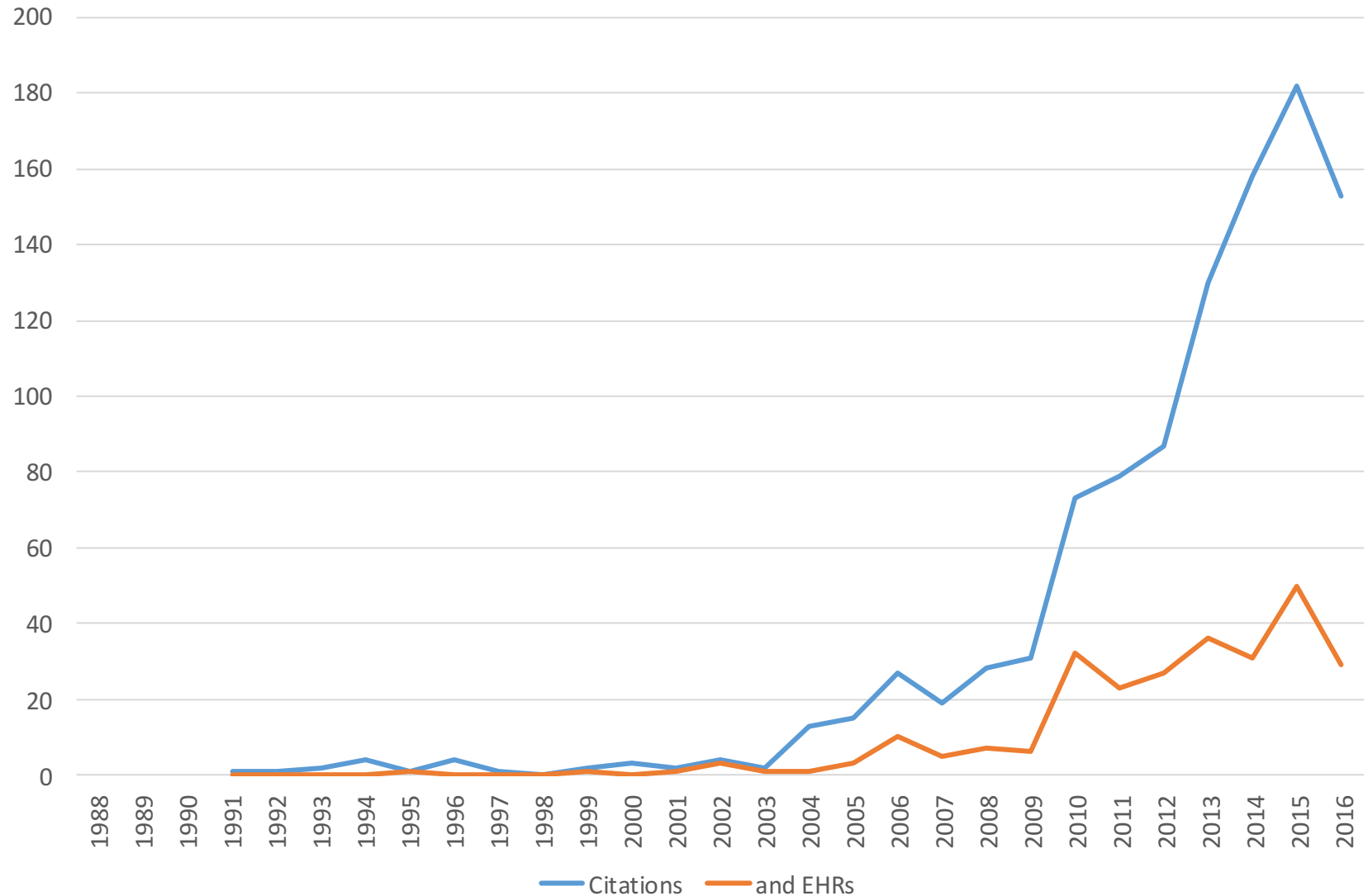
Singh H, Petersen LA, Thomas EJ. Understanding diagnostic errors in medicine: a lesson from aviation. *Qual Saf Health Care*. 2006;15(3):159–64.

Staggers N, Jerrold J. Proposed situational awareness framework for the medical diagnostic process. *Mil Med*. 2010 Jul;175(7):518-24.

Lenert LA. Major usability issue with military's EHR (Armed Forces Health Logistical Technology Application). *J Am Med Assoc*. 2010;303(12):1211-1212.

Lenert LA. Potential lessons for how doctors should write notes to improve the clarity of their thinking and to make their reasoning more transparent so that the writer and subsequent readers of notes can learn from care. *2016 AMIA Fall Symposium*. 2016:763-771.

Situational Awareness in the Medical Literature



How Do We Capture Situational Awareness in the EHR?



PHASE 1

PHASE 2

PHASE 3

Collect
underpants



Profit



Missing: Formal Representation of the Situation

- Formal representation of symptoms, exam findings, interpretations, differential diagnoses, and ...?
- Formal representation of interrelationships
- Preferences and priorities (clinician and patient)
 - ♦ What can we not afford to miss?
 - ♦ What is ok to ignore?
- Strategy, not just tactics

Tactics versus Strategy

Tactics - an action or method that is planned and used to achieve a particular immediate goal



Strategy - a careful plan for achieving a goal usually over a long period of time

Case Study – First/Second Generation EHR

Note: “History: 40 year old female, 2 weeks shortness of breath & palpitations.

Vital signs: HR: 125Irr; BP: 90/55; RR 20

Physical exam: heart rate irregularly irregular, lungs clear

Impression/Plan: “Arrhythmia, possible atrial fibrillation; order ECG”

Orders: “ECG” → Report: “Atrial fibrillation”

Note: “Problem list: Atrial Fibrillation

Impression/Plan: Differential diagnosis: mitral valve disease, pulmonary embolism, hyperthyroidism; order echo, ABG, TFTs”

Orders: “Digoxin, Echo, Arterial Blood Gases, Thyroid Function Tests “

Note: “Problem List: Hyperthyroidism

Impression/Plan: Cardioversion; hyperthyroidism workup (go examine neck)”

Orders: “Cardioversion, TSH level, Thyroid scan”

Note: “Impression/Plan: Pulmonary embolism due to cardioversion...”

Case Study – Third Generation EHR

History: “40 year old female, 2 weeks shortness of breath and palpitations.”

Vital signs: HR: 125lrr; BP: 90/55; RR 20

Physical exam: “heart rate irregularly irregular, lungs clear”

Impression/Plan: “Arrhythmia, possible atrial fibrillation; order ECG”

Orders: ECG → “Atrial fibrillation”

Problem list: Atrial Fibrillation

Impression/Plan: “Differential diagnosis: mitral valve disease, pulmonary embolism, hyperthyroidism; order echo, ABG, TFTs”

Orders: Digoxin, Echocardiogram, Arterial Blood Gases, T3/T4

Alert: “Patient had recent thyroid function tests”

Problem List: Hyperthyroidism

Impression/Plan: “Cardioversion; hyperthyroidism workup (go examine neck)”

Orders: Cardioversion, TSH Level, Thyroid Scan

Impression/Plan: “Pulmonary embolism due to cardioversion...”



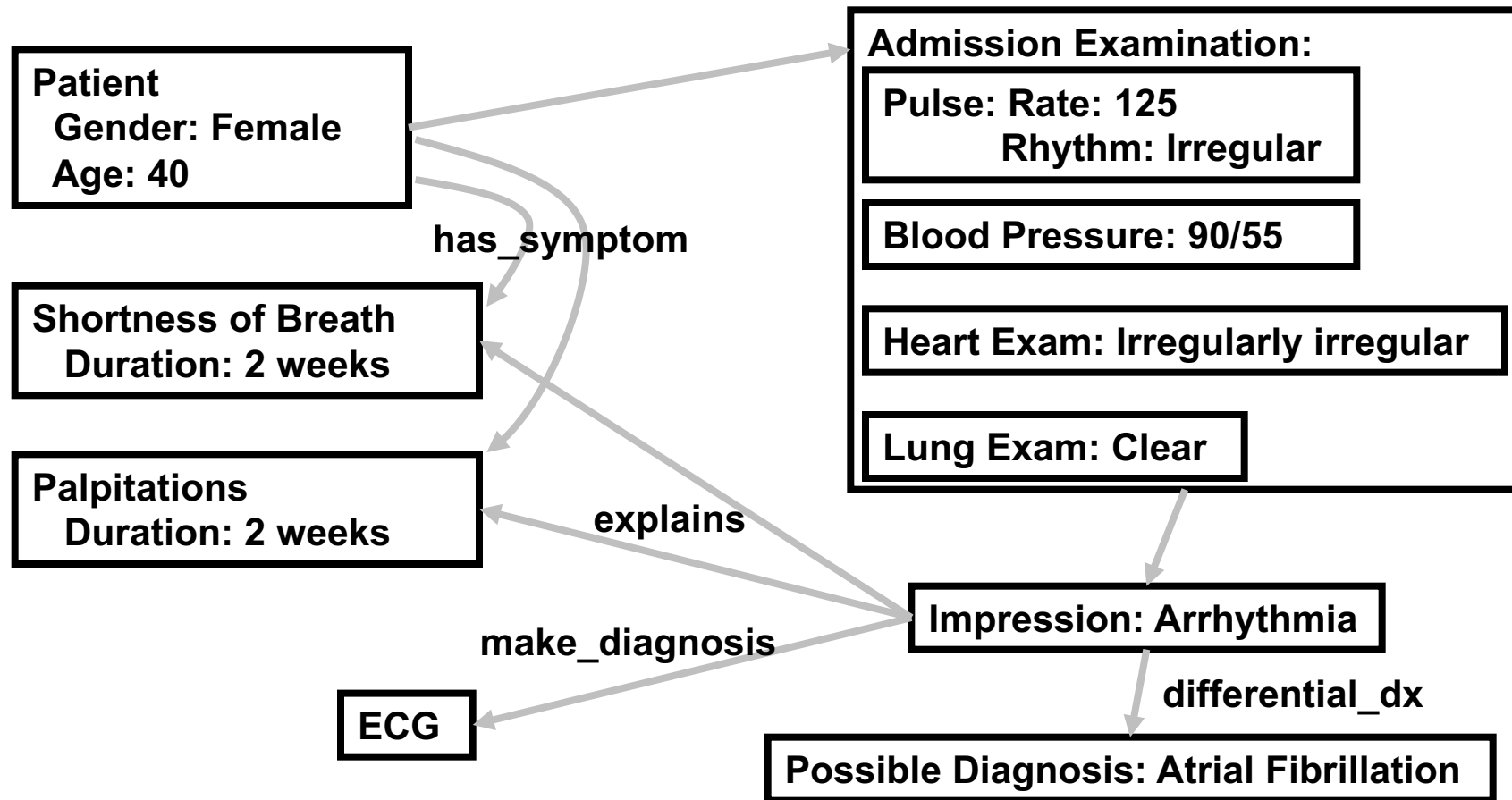
Cook #1: Vegan

Cook #2: Alabamian

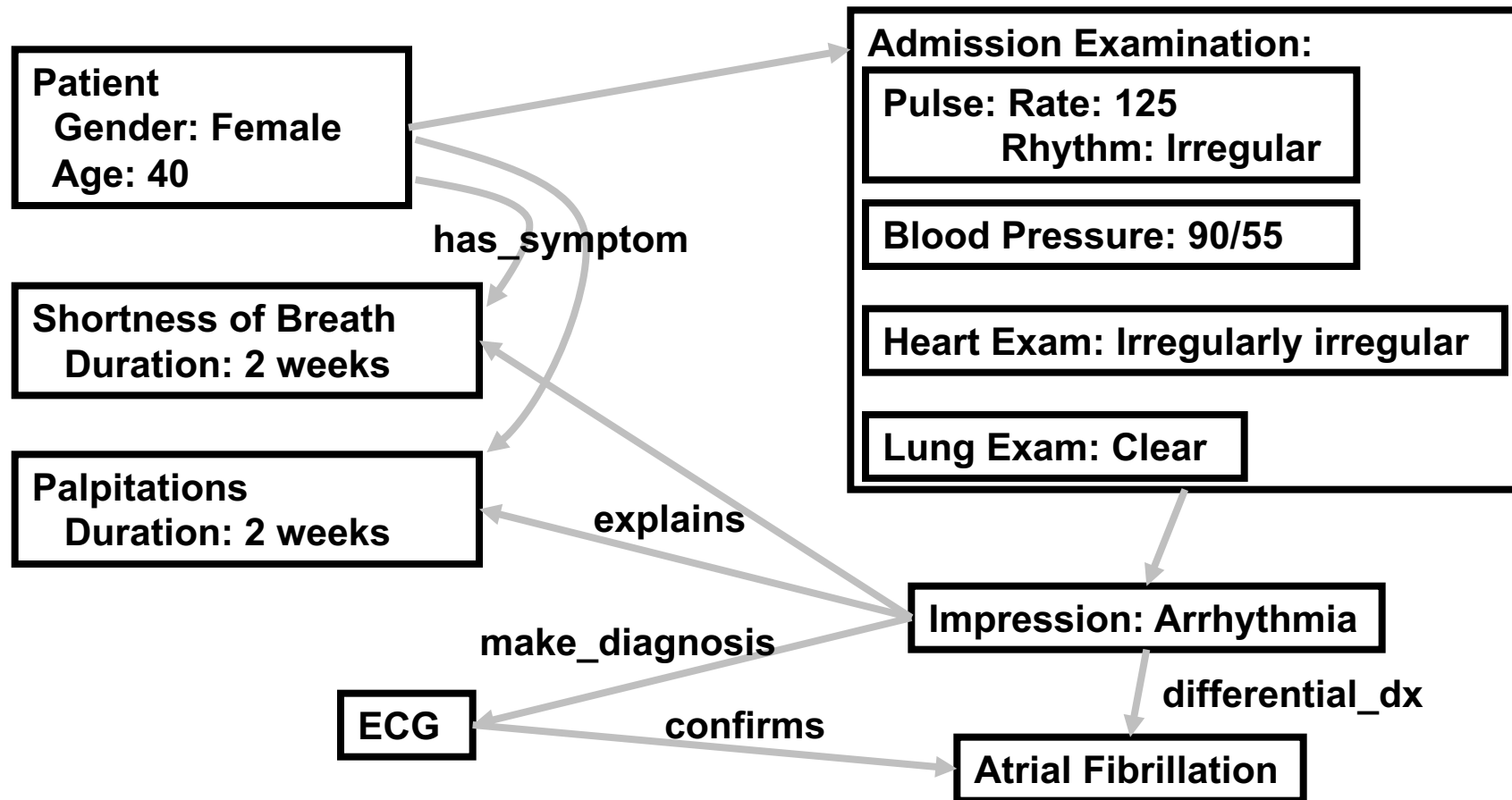
Cook #3: Informatician



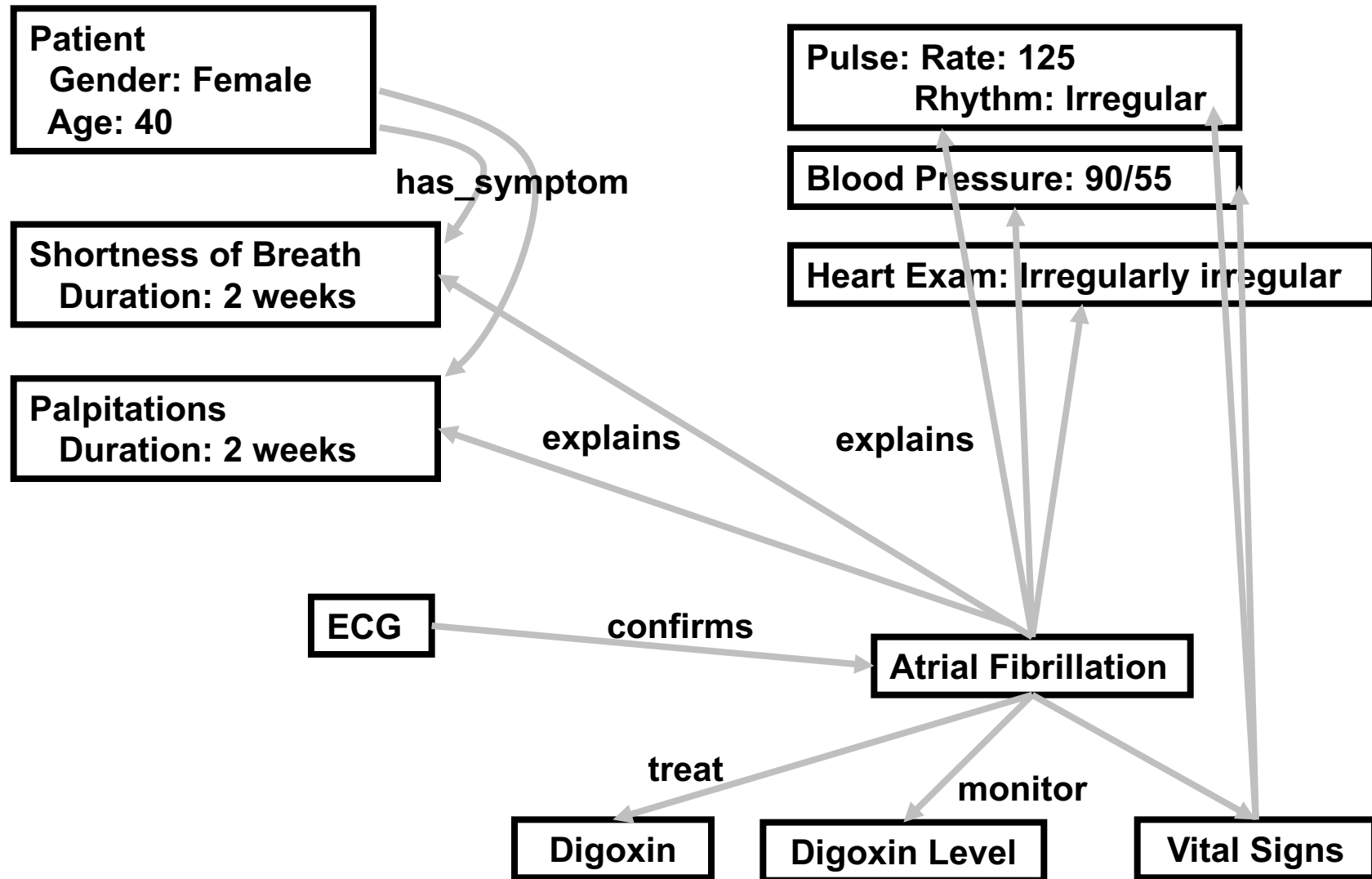
Case Study – Fourth Generation EHR



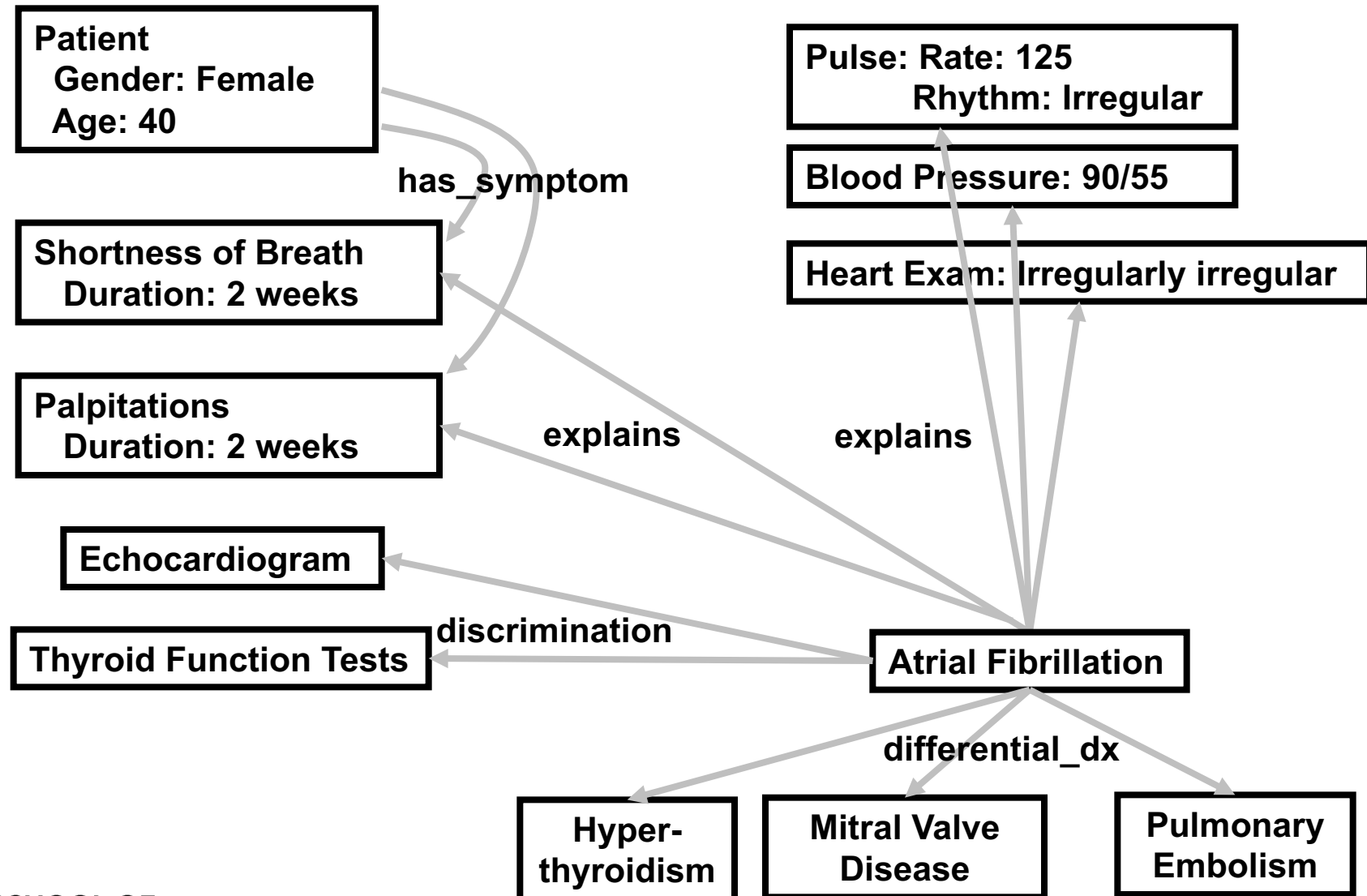
Case Study – Fourth Generation EHR



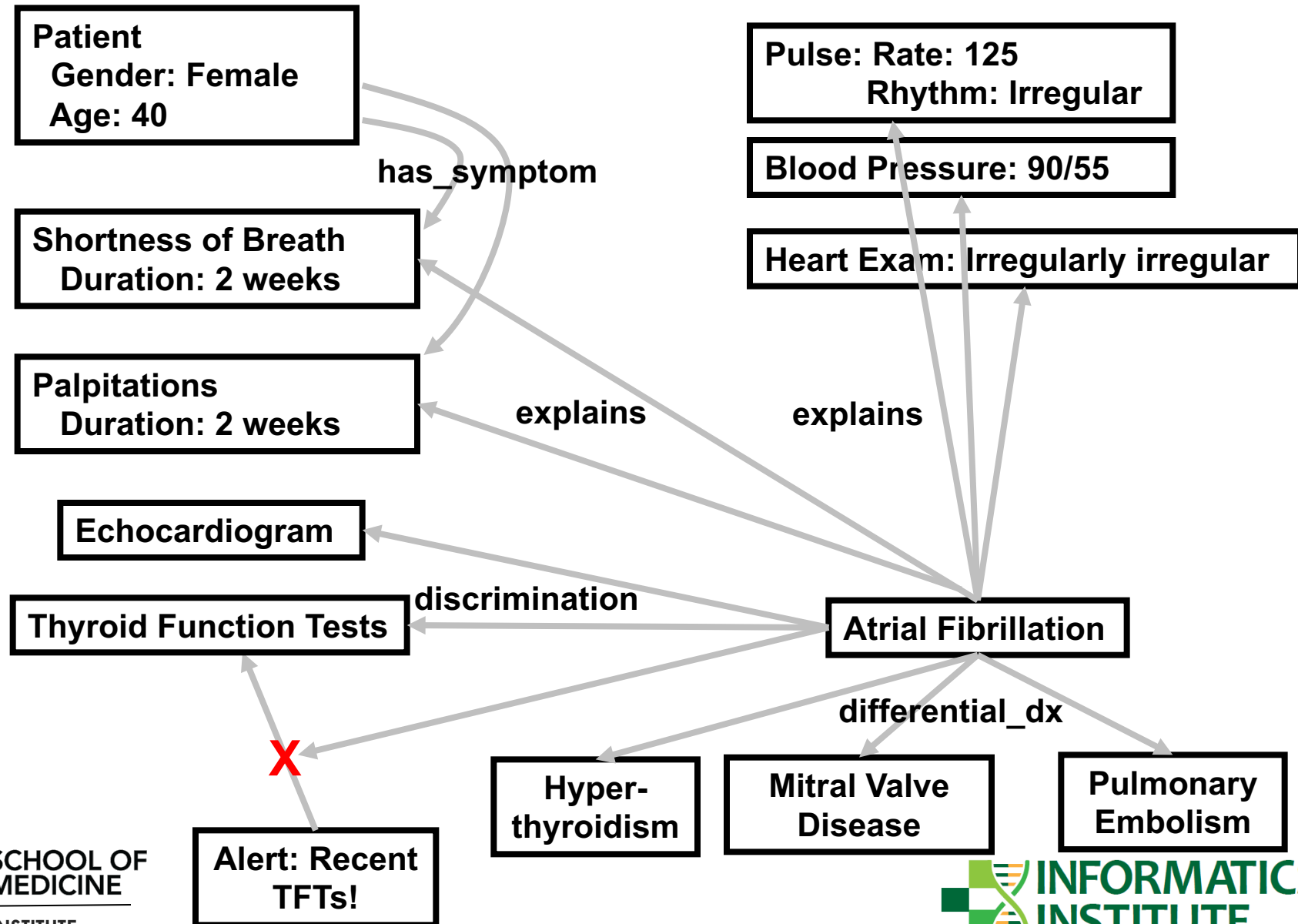
Case Study – Fourth Generation EHR



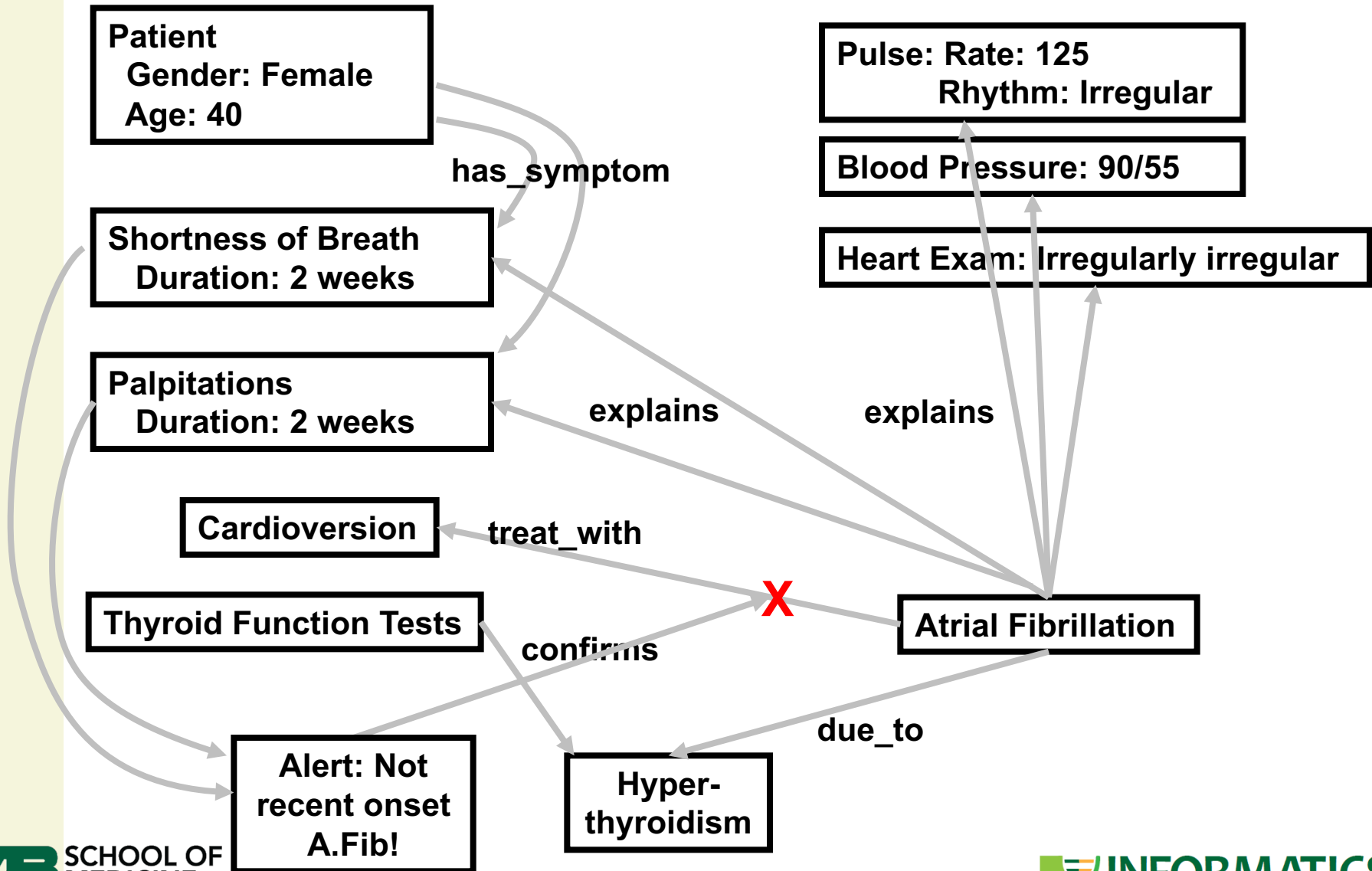
Case Study – Fourth Generation EHR



Case Study – Fourth Generation EHR



Case Study – Fourth Generation EHR



Now the System Can:

- Start work-up for hyperthyroidism
- Empower infobuttons to provide just-in-time knowledge
- Help identify the goal (e.g., degree of anticoagulation)
- Suggest tests (e.g., pregnancy test)
- Explain role of genetics (e.g., Cytochrome P450 variant)
- Personalize goal-based drug selection and dosing
- Plan for cardioversion
- Write the note

Writing the Note

History: 40 year old female, 2 weeks shortness of breath & palpitations.

Vital signs: HR: 125lrr; BP: 90/55; RR 20

Physical exam: heart rate irregularly irregular, lungs clear

ECG: Atrial Fibrillation

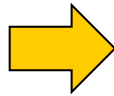
Labs: Elevated Thyroxine level

Impression: Dr. Cimino attributes the patient's shortness of breath and palpitations to underlying atrial fibrillation. Differential diagnosis included mitral valve disease, pulmonary embolism, and hyperthyroidism. Laboratory tests confirm hyperthyroidism.

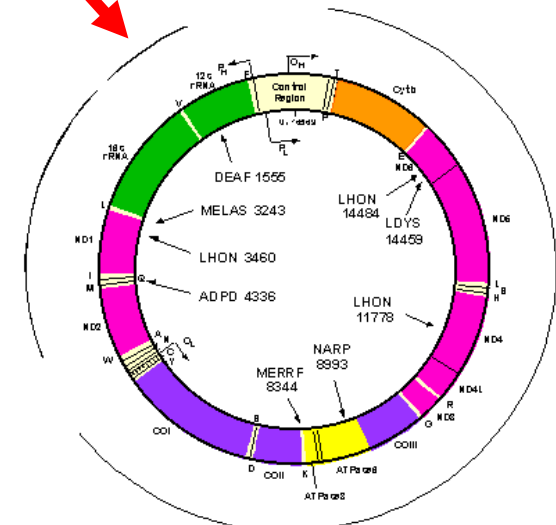
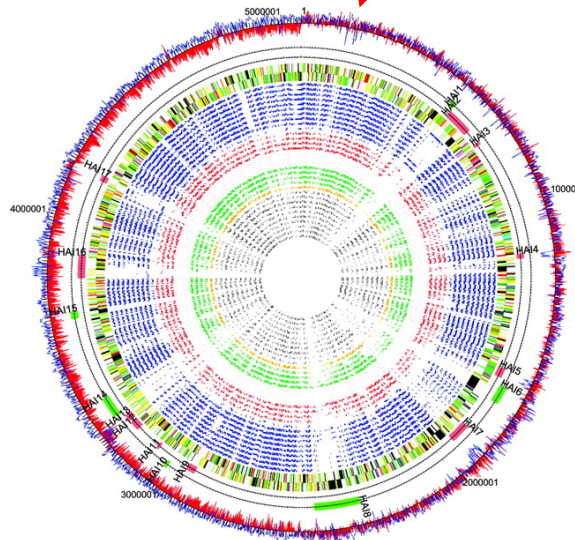
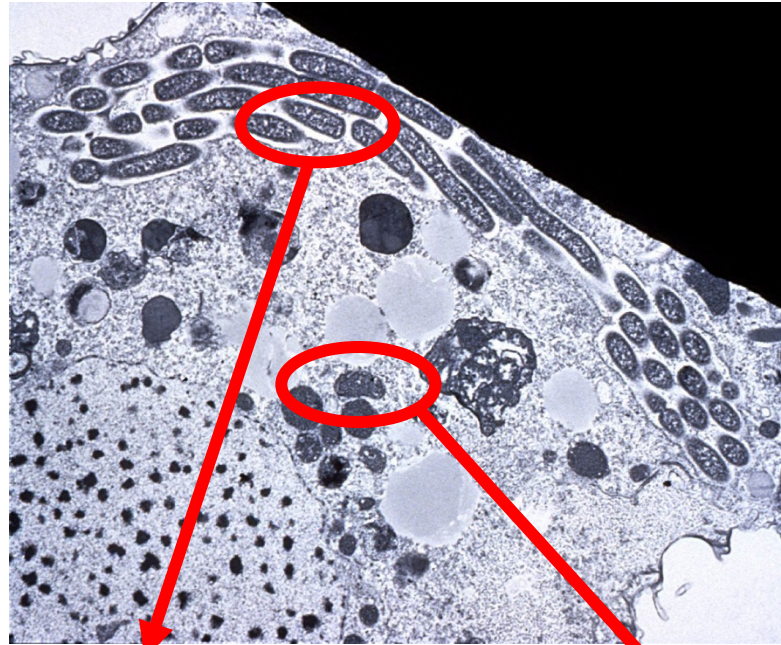
Plan:

- 1) Treatment of the atrial fibrillation is expected to improve the patient's symptoms.
- 2) Treatment plan includes evaluation and treatment of the cause of the hyperthyroidism and electrical cardioversion.
- 3) Evaluation of her hyperthyroidism includes physical examination of the patient's neck, TSH level, and Thyroid scan. Follow-up of these results is scheduled for one week from now to plan appropriate treatment.
- 4) Patient will be treated in the interim with propranolol to control of her ventricular response rate.
- 5) Because her symptoms have been present for two weeks, atrial fibrillation is assumed to be subacute, requiring anticoagulation for one month. Based on her age and gender, a pregnancy test should be performed. Based on her genetics...

Evolution: The Parasitism Metaphor



Evolution: The Mutualism Metaphor



Evolutionary Steps

- Identify situational concepts and relationships
- Construct user interface for capturing situation
- Change medical, nursing and patient education
- Improve the benefit/effort ratio

Planning for Next Generation Electronic Health Records

- Better data entry
- Better user interface (searching, navigation)
- Reducing redundant data entry
- Integrated health information exchange
- Smarter alerts and reminders
- Just-in-time education for decision support
- Learning health system

- What we have today..... a billing diary
- What we need..... formal situation representation
- The challenges..... informatics, design, education
- The way forward..... incremental, integrated,
“critical mass” additions
- The next generation EHR...an Intelligent assistant

An Opportunity in for Dental Health Records



An Opportunity in for Dental Health Records

