Planning for the Next Generation of Electronic Health Records

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Disclaimer

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.*

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 " return of ½ cup of thick white sputum – cultured also blood cultures. Was in must. tent " 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. 0 little return. However during suctioning pt. vomited 100-150 cc green fluid. Proximal jejunostomy tube drainage well now.

9/11-9 AM

Urine 3+ given 10 U reg. insulin. Pt. was hiccuping all night & this AM. Levine tube passed " 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)
**INFORMATICS INSTITUTE**

#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 Pertofran 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
Health IT Playbook Released

ONC released the Health IT Playbook to help providers get the most out of their health IT.

Learn More
The EHR as Shadow of Reality


Proposed situational awareness framework for the medical diagnostic process.

Major usability issue with military's EHR (Armed Forces Health Longitudinal Technology Application): difficulties in obtaining situational awareness of the patient. Wireless EHR for mass casualty situations, but an additional software system provided situational awareness for the incident commander. 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.
How Do We Capture Situational Awareness in the EHR?

**Phase 1:** Collect underpants

**Phase 2:** ?

**Phase 3:** 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”


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: 125Irr; 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: Alabamaian
Cook #3: Informatician
Case Study – Fourth Generation EHR

Patient
Gender: Female
Age: 40

Shortness of Breath
Duration: 2 weeks

Palpitations
Duration: 2 weeks

Admission Examination:
Pulse: Rate: 125
Rhythm: Irregular
Blood Pressure: 90/55
Heart Exam: Irregularly irregular
Lung Exam: Clear

Impression: Arrhythmia
Possible Diagnosis: Atrial Fibrillation

ECG
Case Study – Fourth Generation EHR

Patient
Gender: Female
Age: 40

Shortness of Breath
Duration: 2 weeks

Palpitations
Duration: 2 weeks

Admission Examination:
Pulse: Rate: 125
Rhythm: Irregular
Blood Pressure: 90/55
Heart Exam: Irregularly irregular
Lung Exam: Clear

Impression: Arrhythmia
Atrial Fibrillation

ECG

has_symptom
explains
make_diagnosis
confirms
differential_dx
Case Study – Fourth Generation EHR

Patient
Gender: Female
Age: 40

Shortness of Breath
Duration: 2 weeks

Palpitations
Duration: 2 weeks

Pulse: Rate: 125
Rhythm: Irregular

Blood Pressure: 90/55

Heart Exam: Irregularly irregular

ECG

Atrial Fibrillation

has_symptom

explains

confirms

treat

monitor

Digoxin

Digoxin Level

Vital Signs

explains

explains
Case Study – Fourth Generation EHR

Patient
Gender: Female
Age: 40

Shortness of Breath
Duration: 2 weeks

Palpitations
Duration: 2 weeks

Echocardiogram

Thyroid Function Tests

Pulse: Rate: 125
Rhythm: Irregular

Blood Pressure: 90/55

Heart Exam: Irregularly irregular

Atrial Fibrillation

Hyperthyroidism

Mitral Valve Disease

Pulmonary Embolism

differential_dx

discrimination

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has_symptom
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Patient
Gender: Female
Age: 40

Shortness of Breath
Duration: 2 weeks

Palpitations
Duration: 2 weeks

Pulse: Rate: 125
Rhythm: Irregular

Blood Pressure: 90/55

Heart Exam: Irregularly irregular

Alert: Recent TFTs!

Echocardiogram

Thyroid Function Tests

Atrial Fibrillation

Hyperthyroidism

Mitral Valve Disease

Pulmonary Embolism

Hyperthyroidism

Mitral Valve Disease

Pulmonary Embolism
Case Study – Fourth Generation EHR

Patient
Gender: Female
Age: 40

Shortness of Breath
Duration: 2 weeks

Palpitations
Duration: 2 weeks

Cardioversion

Thyroid Function Tests

Alert: Not recent onset A.Fib!

Pulse: Rate: 125
Rhythm: Irregular

Blood Pressure: 90/55

Heart Exam: Irregularly irregular

Hyperthyroidism

Atrial Fibrillation

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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
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
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
Recap

- 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