

Health Informatics and HCI

Jim Warren

Professor of Health Informatics

Learning Objectives

- To gain awareness of IT applications in health
- To be able to identify a few common HCI problems for health IT systems
- To be aware of some leading-edge health IT applications with HCI aspects and associated possibilities for research topics

Outline

- What is Health Informatics?
- Some HCI-focused projects I've done
- Some core HCI lessons in health
- Some more AI-oriented health informatics with HCI aspects
- Some neat stuff in the wider world

'Health Informatics' defined

- One of the journals in the field is called *Methods of Information in Medicine*
- Anything about how to process and distribute information to support health and healthcare
 - Clinical decision support systems (CDSS)
 - Electronic medical records
 - Consumer Health Informatics (e.g. use of Internet)
 - Medical imaging (CT, MRI, etc.)
 - Also, standards, and strategy and policy...

An HCI study I did: PREDICT usability

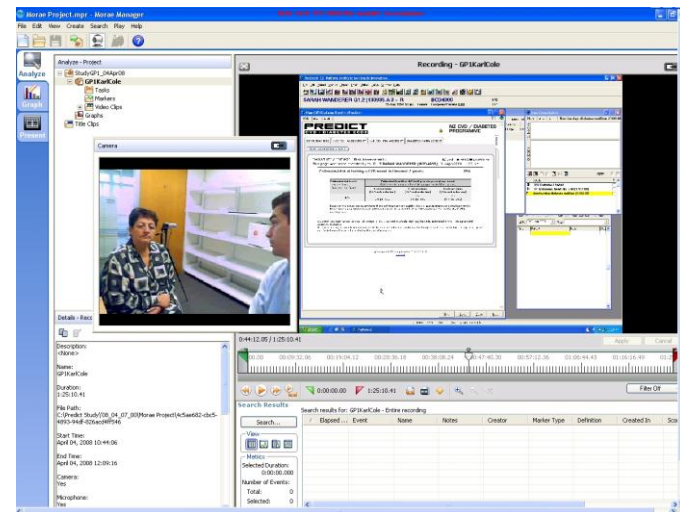
- PREDICT is a CDSS that computes probability of a patient having a cardiovascular event (e.g. heart attack, stroke) in the next 5 years (CVR₅)
 - Can play ‘what if’ should patient change risk factors (lower blood pressure, quit smoking)
 - Has about 1000 rules to compute recommended actions to manage down CVR
- Has been used in about 250,000 consults, mostly in general practice

Usability (and safety)

- Some say PREDICT usability could be better; what kind of problems might be present?
 - Data entry burden is high
 - Data validation is awkward
 - Uptake of data from the Practice Management System (PMS) database is incomplete
 - Recommendations are too numerous
- Well, so let’s study PREDICT in use and see

Challenge: Consent, Recruitment and the Problem with Video

- Video recording and General Practice can be a little difficult to mix
- Most decision support tools are only used on a proportion of patients
 - i.e., only want to recruit and to invoke equipment sporadically



Challenge: Realistic Test Cases and Software Environment

- Sounds easy enough to put a 'realistic' patient into a PMS
- But when does their record begin?
 - Our scenario began with a sick certificate for flu the previous week (now GP wanted to assess CVD risk)
 - But we need to set up complete history, including that visit a week ago
- Time moves on!
 - 'A week ago' keeps moving
 - Actually very hard to synthesize patients
 - Physicians very sensitive to infeasible clinical data!
 - Ethics issues in re-using past real case data
 - And to keep them current
 - PMS designed to enter data as you go – not to fake a past!

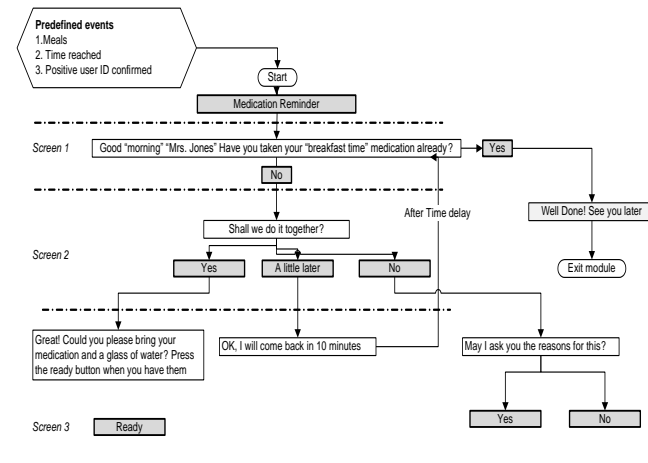
Another study: Robotic elder care



- 'Cafero' waiter robot with clinical monitoring tools on the tray
- Linux based navigation system on bottom
- Windows touchscreen and voice interface up top

Application / Study

- Elder care
 - Testing in a residential care facility (supported living: periodic caregiver visits, nurse on call)
 - Promoting quality use of medicine
 - Adherence to taking it (or knowing why not)
 - Physiological monitoring of effectiveness (and for safety)
 - Asking about side-effects
 - Providing education (and entertainment)
- Tested with morning medications of 12 residents



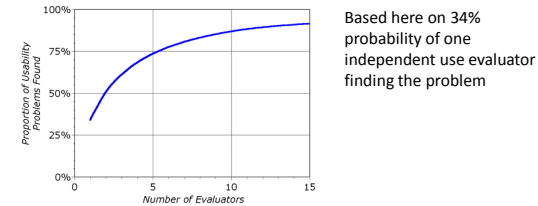
Measures / findings

- Video recorded
- Interviewed
 - Structured, open-ended
- Needed to tilt head lower!
- Patients like it and can use it well enough unless having significant dementia or macular degeneration
- Want features to video call and alert family



Lesson 1: Remember Nielsen

- A common problem will appear after a few sessions



- For systems in production use, you can just ask a couple real users and they'll tell you about all the worst problems ("saturation")

Lesson 2: Show name, the right name (aka, don't kill the patient: type 1)

Patient full name, age/dob, and gender

Ideally, patient photo

Navigation controls

Sub-window (often in HTML) with clinical details

Don't let the subwindow navigate to a different patient without refreshing the main window

Don't let the main window navigate to a different patient without refreshing the subwindow

Lesson 3: Show all the data

(aka, don't kill the patient: type 2)

- Must always avoid truncating a field

Amoxicillin should be given under no circumstances due to severe allergic reaction
- Must do best to make navigation easy and presence of more data apparent
- Most medical data is indefinite upper bound repeating groups (e.g., problems, medications)
 - No obvious answer; tabs are used a lot
 - Allow comments fields on every visual 'chunk' of patient data (hmm... if only you knew how the data might get transmitted and reformatted!)

Lesson 4: Microsoft CUI

- API and style guide based on extensive study of common clinical HCI problems

Usage Examples			
temazepam – tablet – DOSE 20 mg – oral – at night	Started	26-May-2010	
oxygen 60% – inhalation gas – RATE 15 L per minute – continuous – with non re-breather bag	Started	25-May-2010	✓
co-amilofruse – 5 mg and 40 mg in 5 mL – solution – DOSE 5 mL – oral – once a day	Started	24-May-2010	
salbutamol – 100 micrograms per dose – metered dose inhaler – DOSE 2 puffs – inhaled – four times a day as required	Started	24-May-2010	

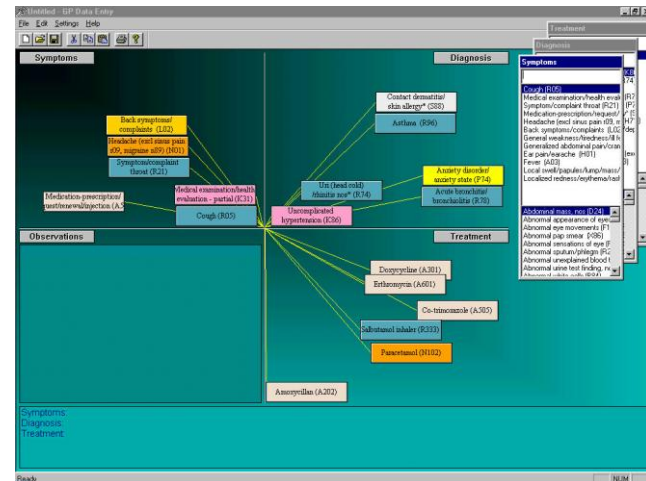
In this correct example, there is a space at the end of the list with a height equivalent to one line of text.

More AI-ish: anticipative interfaces

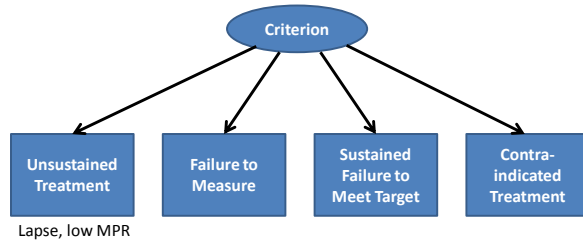
- Can learn from existing general practice records
 - Frequencies of symptoms, diagnoses/problems, and treatments (particularly drug prescriptions)
 - Can learn associations of these items: conditional probability
 - $P(Dx|Sy) = P(Sy \wedge Dx) / P(Sy)$, can be quite different than the *a priori* $P(Dx)$
- Leverage this to speed data entry – offer most probable items for easy selection
 - E.g. as 'intelligent' split menu

Lesson 5: research ethics

- There's not much you'll do research-wise in this area without needing research ethics approval (called IRB – institutional review board – in the US)
 - Takes time; doesn't always go smoothly
 - Acknowledge risks (confidentiality, safety): they're always there
 - Indicate benefits and safeguards
- Need clinical collaborators

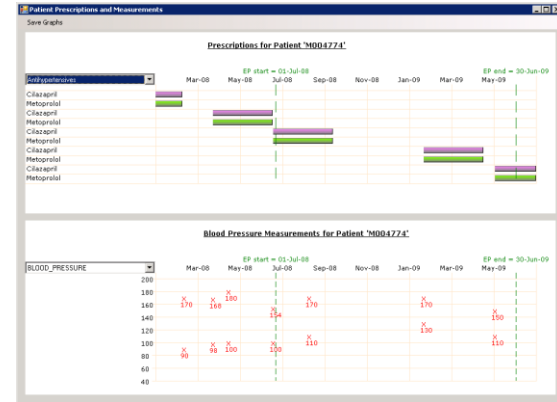


Even less HCI-ish: quality audit

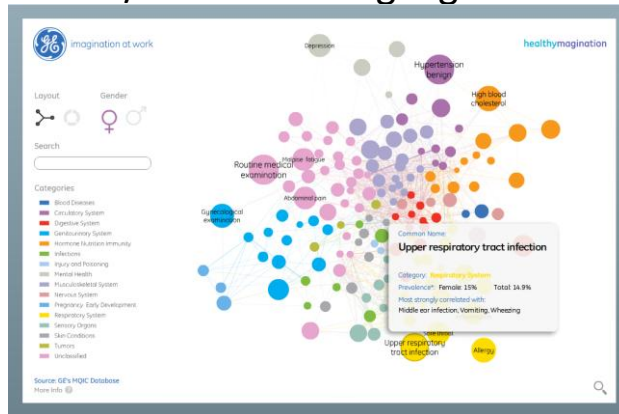


- Model of criteria for long-term treatment
 - Use an ontology (in Protégé/OWL) to hold parameters of treatments, problems and measurements

Example visual presentation of a case with low Medication Possession Ratio (MPR)



GE / MIT unlocking big data



- <http://www.gereports.com/the-magic-of-big-data-ge-mit-unveil-new-way-of-visualizing-disease/>

Power of animating data: GapMinder



- <http://www.gapminder.org/> http://www.ted.com/talks/hans_rosling_at_state.html

Next for Watson: Health!

IBM WATSON

The Science Behind an Answer

Watson performs so fast that it can rival the greatest human contestants in understanding a Jeopardy! clue and arriving at a single, precise answer. The significance of this accomplishment can be difficult to comprehend.

Watch the video to see how the computing system designed to play Jeopardy! works.

The first person mentioned by name in "The Man in the Iron Mask" is this hero of a previous book by the same author.

Possible Answers

- bathe
- batle
- be
- beam
- bear
- beat
- become
- beg
- balance
- ban
- bang
- base

A video series about the IBM DeepQA project >

Prediction over time with option for 'what if'

Your HEART FORECAST

Heart Foundation | THE UNIVERSITY OF AUCKLAND | ENIGMA+

Introduction Step 1
Your Risk Factors Step 2
Your Heart Forecast Step 3

Risk of a heart attack or stroke within the next 5 years

LEVEL OF RISK

40% HIGH
20% MEDIUM
10% LOW

30 40 50 60 70 80 90

Age

● Your current risk right now
— Point where heart pills are recommended (15% risk)
— Your projected risk if no changes are made
— Your ideal risk zone (Based on Non-Smoker, TCHDL ratio:4, BP: 120/80)

You can reduce your risk of a heart attack or stroke by:

- not smoking
- eating a healthy heart diet
- exercising by being active for at least 30 minutes on most days of the week

This will help you to feel good and lower your blood pressure and cholesterol.

You can adjust these factors on the next page to see what they can do for your risk of a heart attack or stroke.

Back Next

patientslikeme

wandering33 shared an InstantMe score

141,638 patients
1000+ conditions

Who's like you?

Share your experience. The more you share, the easier it will be to find patients like you. Start by adding a condition, symptom or treatment.

I have
I take
I am Male Female
My Age

Join Now! (it's free)

You have questions about your disease — but you also have answers for others. Change your life while helping others change theirs.

By learning from other patients like you... and seeing the community experience... YOU can take control of your disease.

- In Forum Discussions
- Through Private Messages
- From Profile Comments
- Browse Symptom Reports
- Explore Treatment Reports
- Check out Treatment Evaluations
- Profile Charts let you see how your treatments affect your health over time
- Doctor Visit Sheets help you improve your discussion with your doctors

Conclusion

- Health IT presents exciting HCI challenges
 - Both practical and for research
 - Please let me know (jim@cs.auckland.ac.nz) if you might be interested in a Health Informatics research topic for honours

- Social networking for health information and support
 - What are other people with my condition doing / taking? And how are they making out?
 - The wisdom of a good-sized group of patients is surprisingly good