Health Informatics and HCI

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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

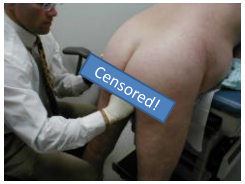
- PREDICT is a CDSS that computes probability of a patient having a cardiovascular event (e.g. heart attack, stroke) in the next 5 years (CVR_5)
  - Can play 'what if' should patient change risk factors (lower blood pressure, quit smoking)
  - Has about 1000 rules to compute recommended actions to manage down CVR
- Has been used in about 250,000 consults, mostly in general practice

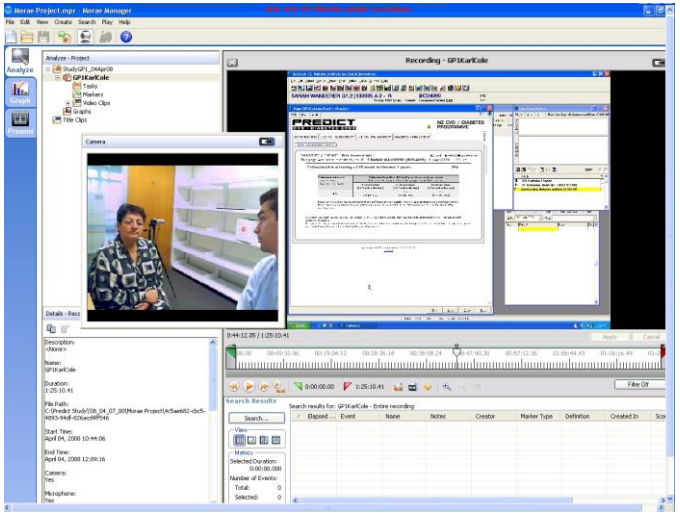
Usability (and safety)

- 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

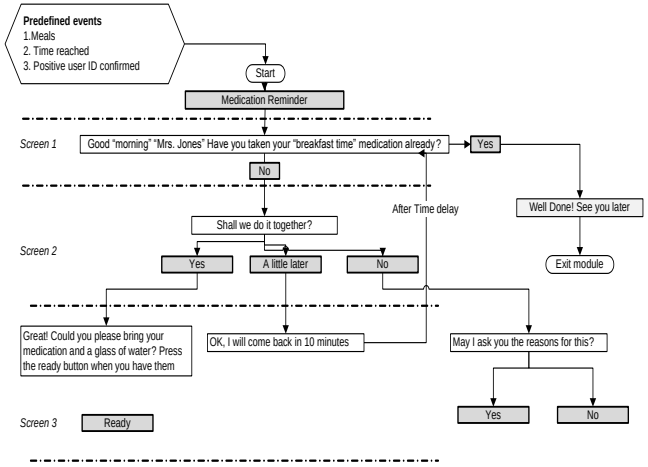
- Sounds easy enough to put a 'realistic' patient into a PMS
- But when does their record begin?
  - Our scenario began with a sick certificate for flu the previous week (now GP wanted to assess CVD risk)
  - But we need to set up complete history, including that visit a week ago
- Time moves on!
  - '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



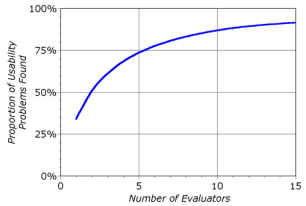
Measures / findings

- 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

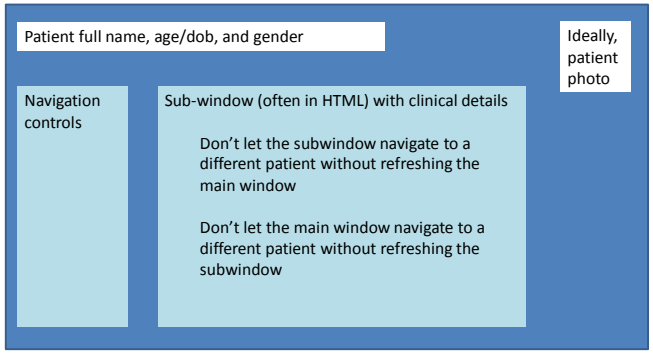
- A common problem will appear after a few sessions



Based here on 34% probability of one independent use evaluator finding the problem

- 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)



Lesson 3: Show all the data (aka, don't kill the patient: type 2)

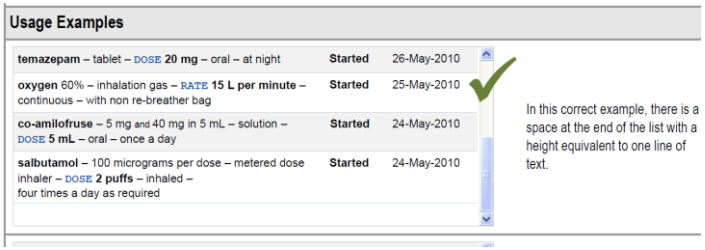
- Must always avoid truncating a field

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 reformated!)

Lesson 4: Microsoft CUI

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

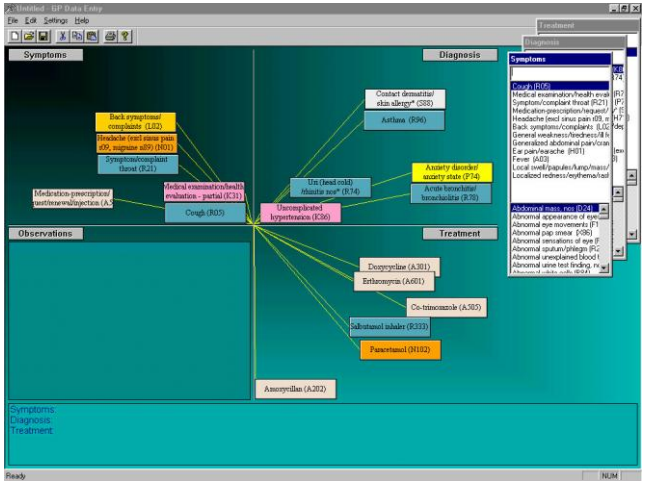


Lesson 5: research ethics

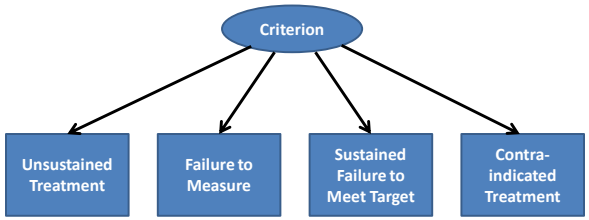
- There's not much you'll do research-wise in this area without needing research ethics approval (called IRB – institutional review board – in the US)
  - Takes time; doesn't always go smoothly
  - Acknowledge risks (confidentiality, safety): they're always there
  - Indicate benefits and safeguards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

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^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



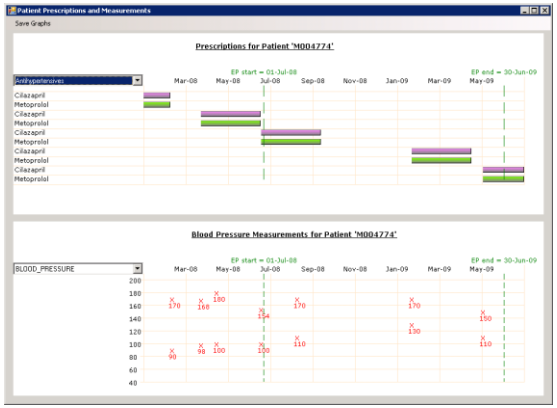
Even less HCI-ish: quality audit



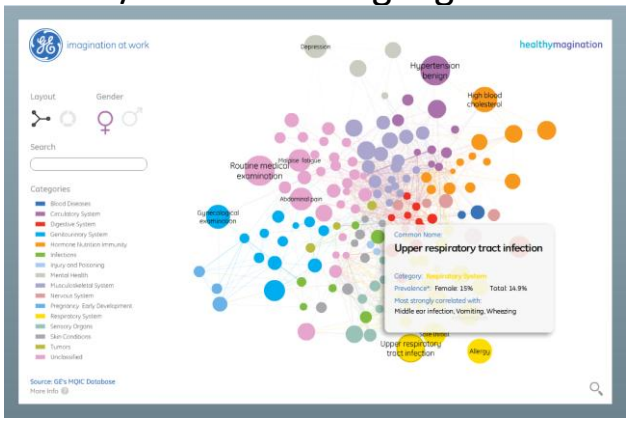
Lapse, low MPR

- 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)

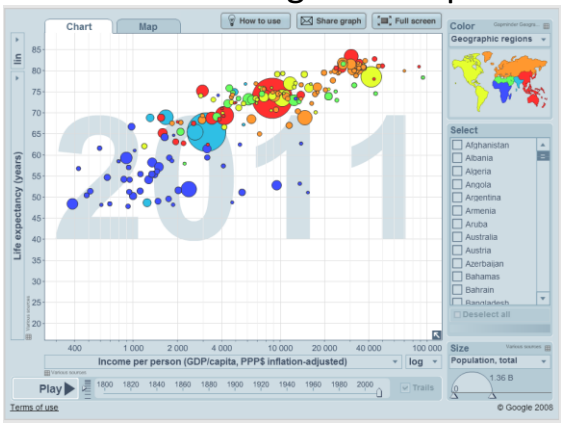


GE / MIT unlocking big data



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

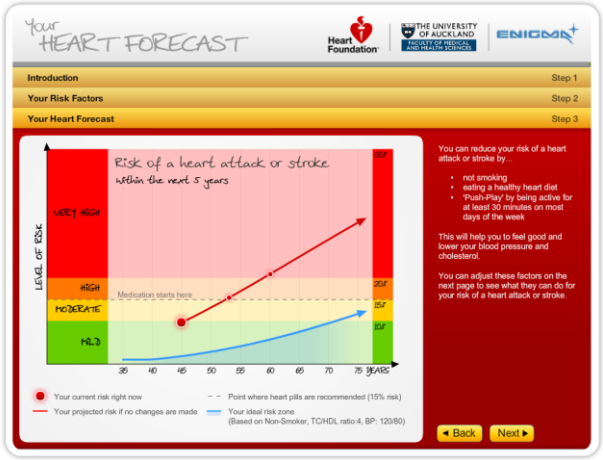
Power of animating data: GapMinder

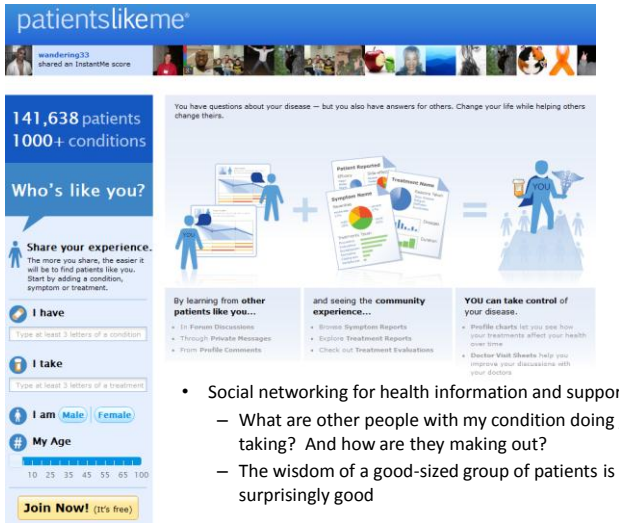


http://www.gapminder.org/ http://www.ted.com/talks/hans_rosling_at_state.html

Next for Watson: Health!

Prediction over time with option for 'what if'





- 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

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