









MACQUARIE
University

Part 1: Informatics is as much about computers as cardiology is about stethoscopes

Enrico Coiera



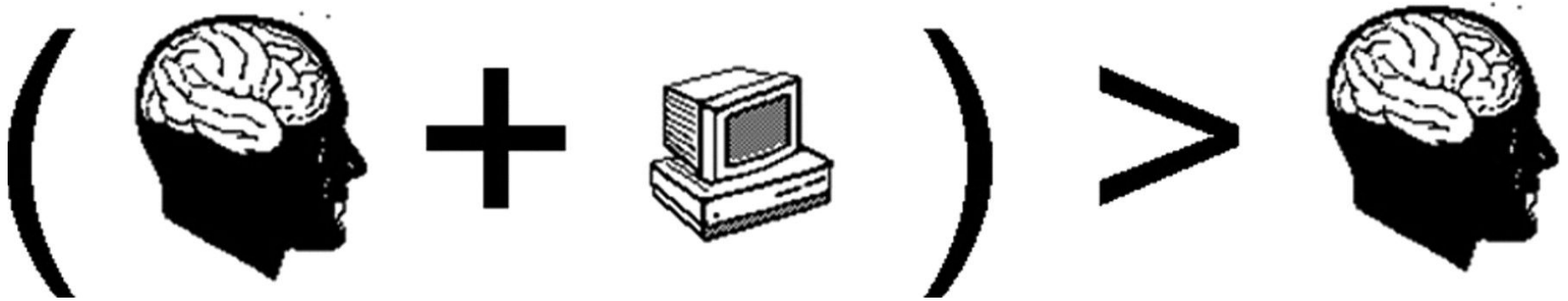
Medical informatics is as much about computers as cardiology is about stethoscopes.

studied the application of information technologies in medicine, the past decade has delivered one unassail-

Any attempt to use information technology will fail dramatically when the motivation is the application of technology for its own sake rather than the solution of clinical problems.¹⁻³

***BMJ* 1995;310:1381-7**

Friedman's Fundamental Theorem



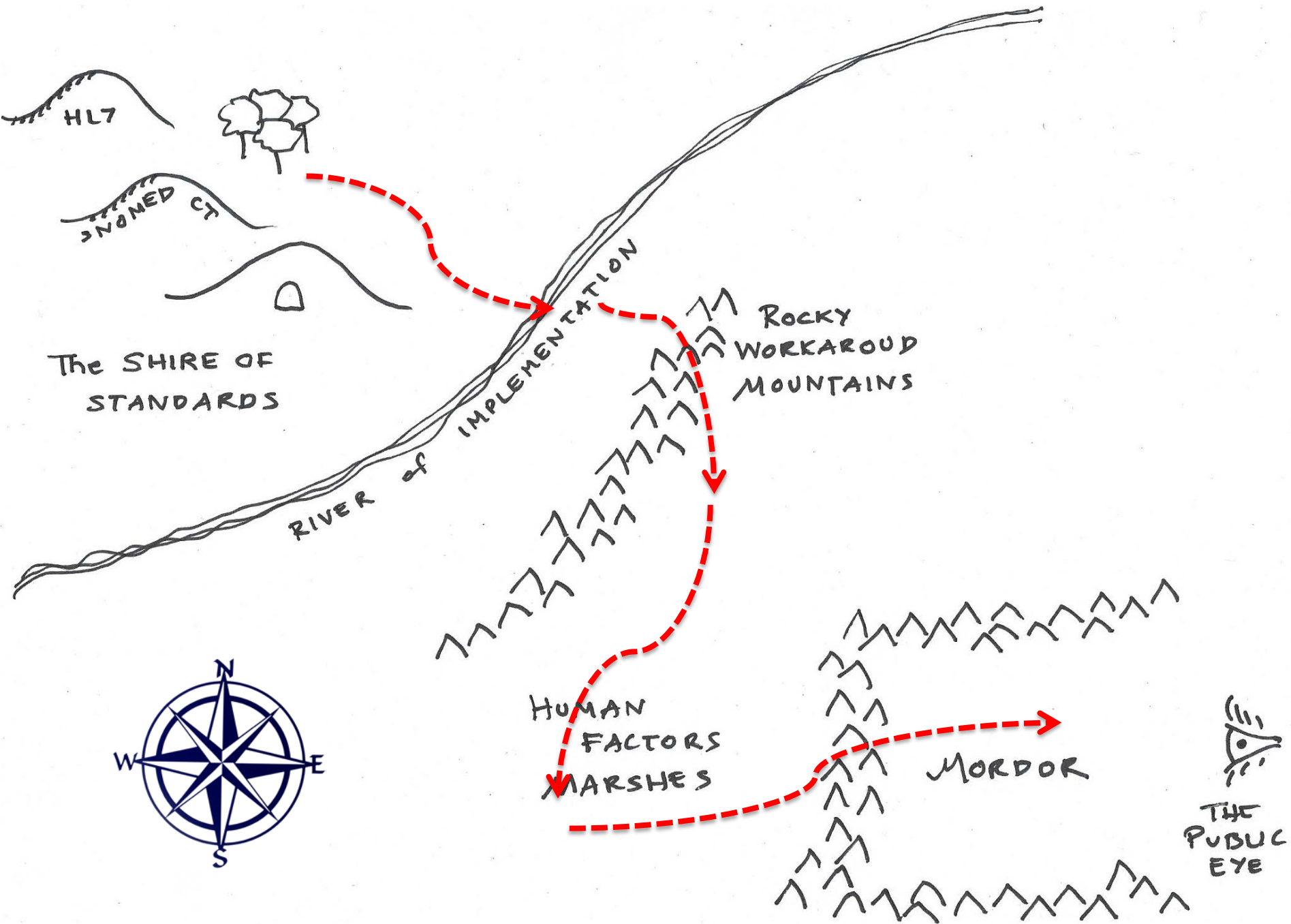
JAMIA 2009;16:169-170

In summary, the communication space is apparently the largest part of the health system's information space.

health system information “pathology” but is usually ignored in our informatics thinking. Yet it seems to be where most of the information in the clinical work-

The biggest information repository in health care lies in the people working in it, and the biggest information system is the web of conversations that link the actions of these individuals.

■ J Am Med Inform Assoc. 2000;7:277–286.



Information as universal panacea

:: **assumption:** Adding information will
(always) make everything work better





:: the value of e-health

Some broad generalizations from the recent literature:

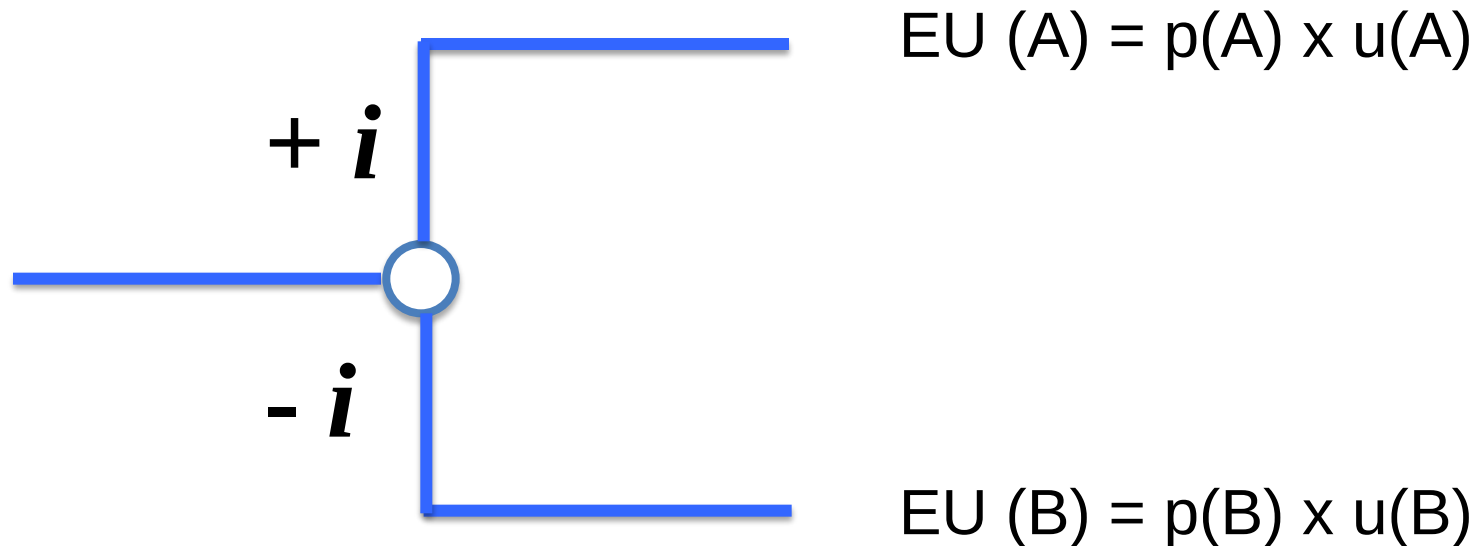
- **Electronic Health Records** decrease nurse but increase doctor data entry times, improve record completeness, but appear *not* associated with improvements in care quality.
- **Care pathways and plans** reduce practice variation by increasing compliance with standards of care, can improve process metrics (e.g. test ordering, drug order sets) but typically do *not* impact outcomes (e.g. LOS, death).
- **Telehealth** interventions can increase patient satisfaction, and patient outcomes in some but not all cases (e.g. chronic care). In many cases is surprisingly not cost-effective.
- **Decision support systems** typically improve the safety and efficiency of care and improve patient outcomes.

:: the value of information

Number needed to treat (NNT): How many patients must receive this treatment before one patient sees a benefit?

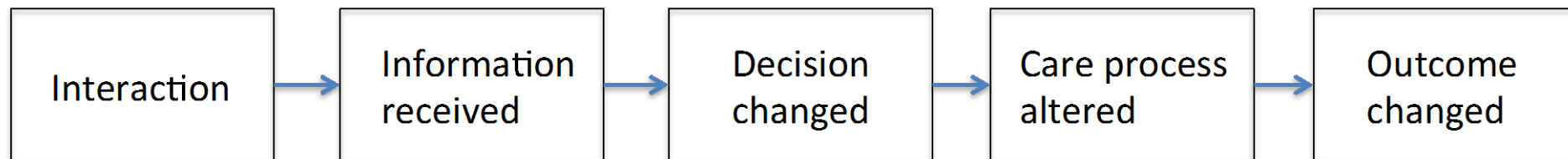
Number needed to read (NNR): How many times must this information be accessed before I see a change?

Expected Utility (EU) = $p(\text{event}) \times u(\text{event})$



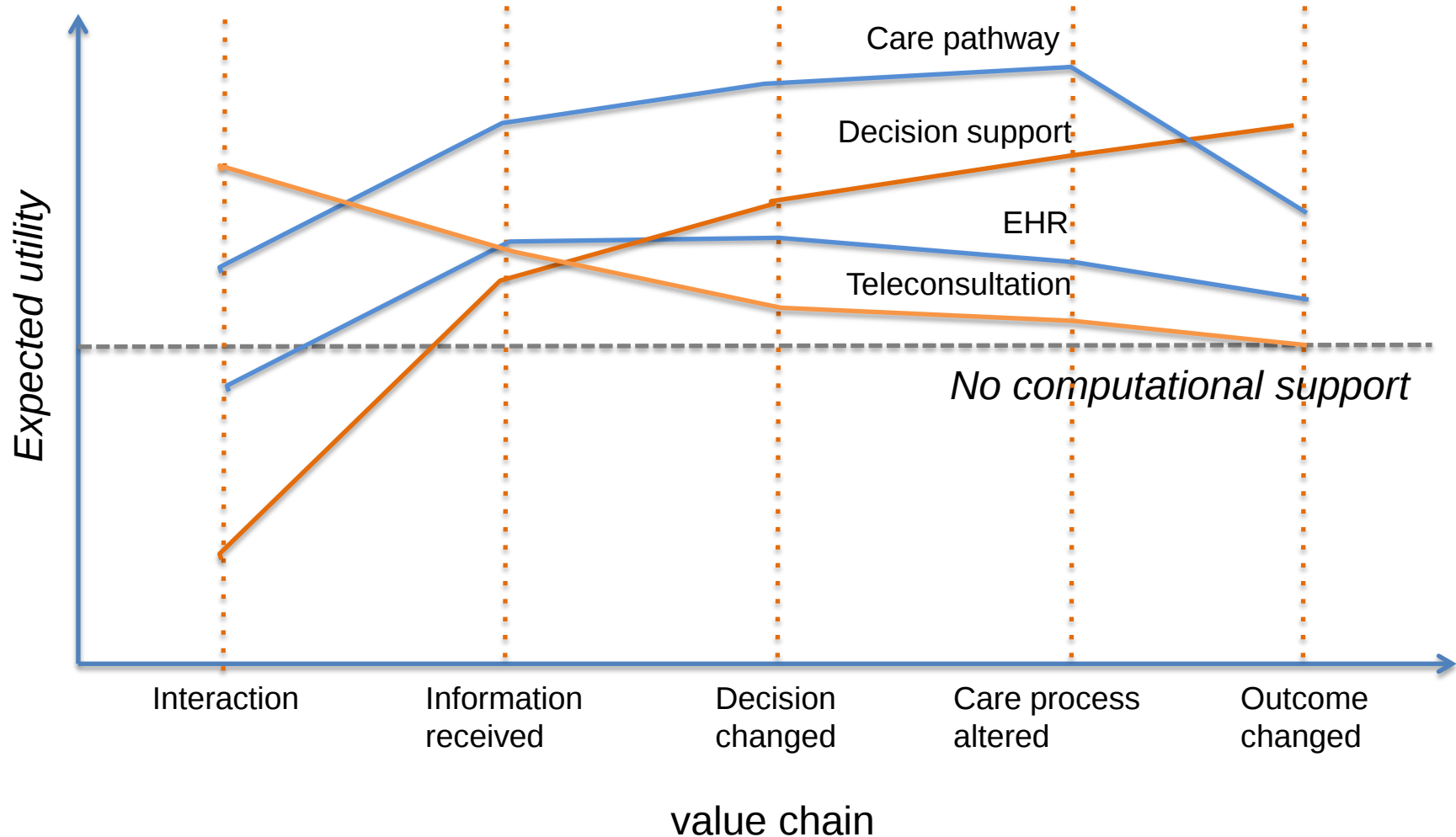
Value of Information (VOI) = $EU(A) - EU(B)$

The value of information is different for each stage



There are fewer events as we move down the chain but each event becomes increasingly more useful

:: information value signatures



:: some implications

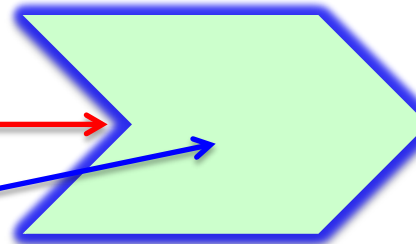
- Information only has value when it changes what we do for the better (data on its own does nothing)
- Information value signatures show where to expect / measure benefit (Ch. 11, 3rd Ed. Guide to HI)
- The EHR alone is too upstream from decisions to easily see significant outcome changes
- Better to see e-health solutions as a bundle of components
- To improve outcomes, bundle the EHR with downstream tools like CDSS



The substitutability of human work with computer work

:: assumption: human tasks can be *directly* replaced by automation

$$\left(\text{brain icon} + \text{computer icon} \right) > \text{brain icon}$$

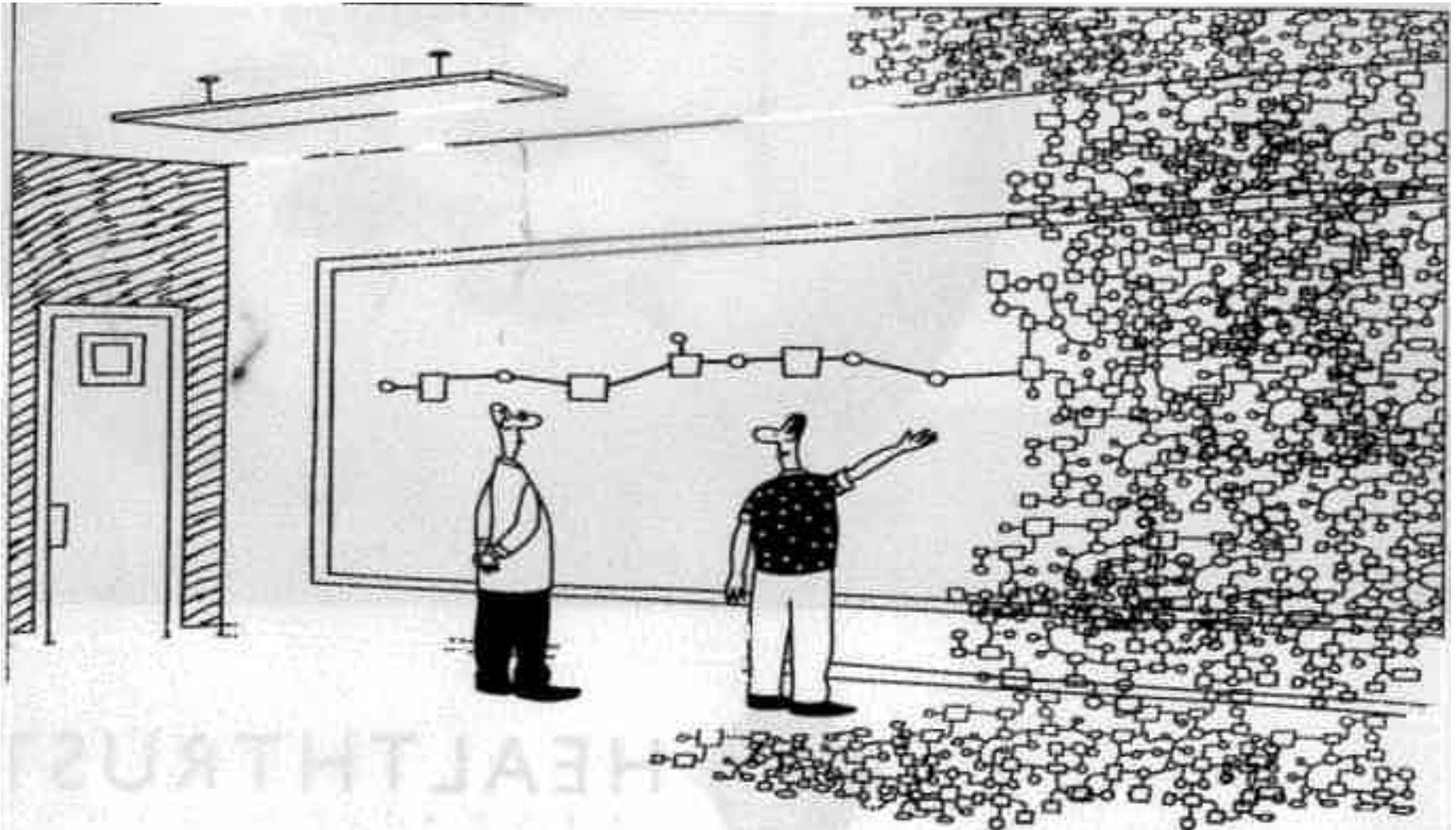


Communication space
tools e.g. paper, talk

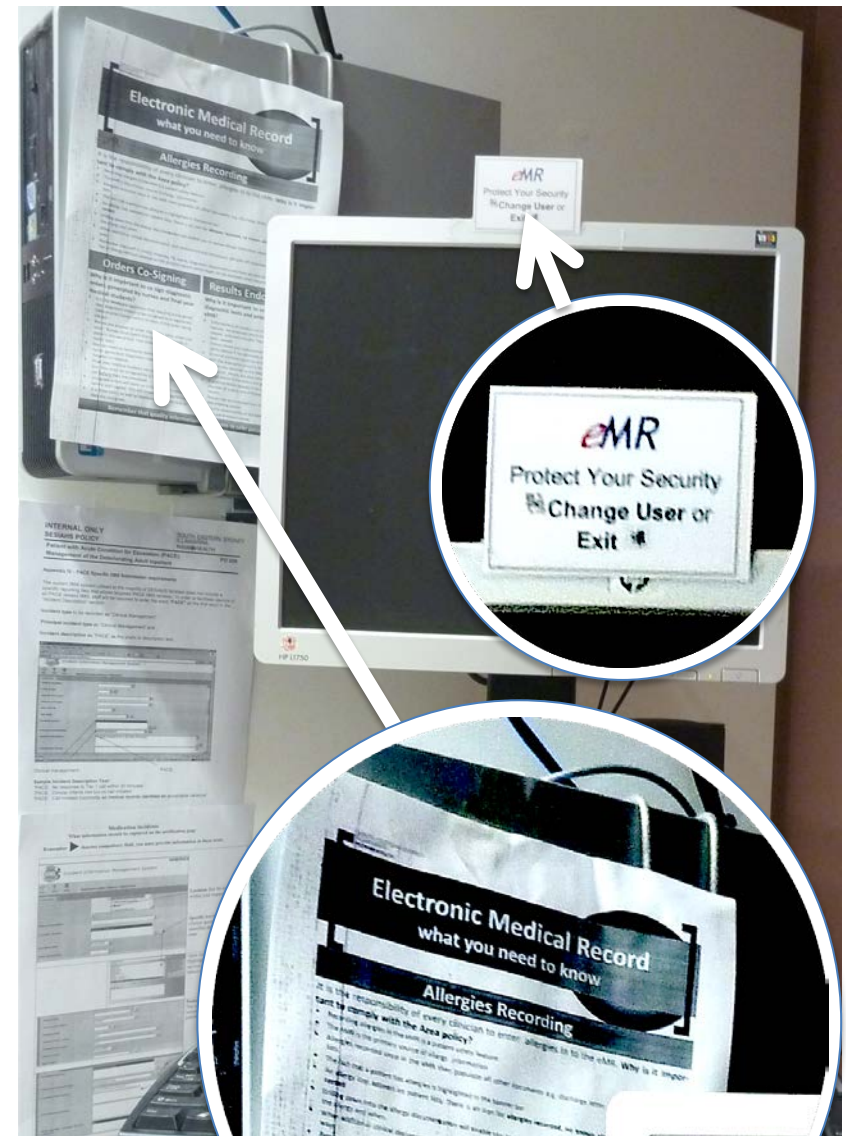
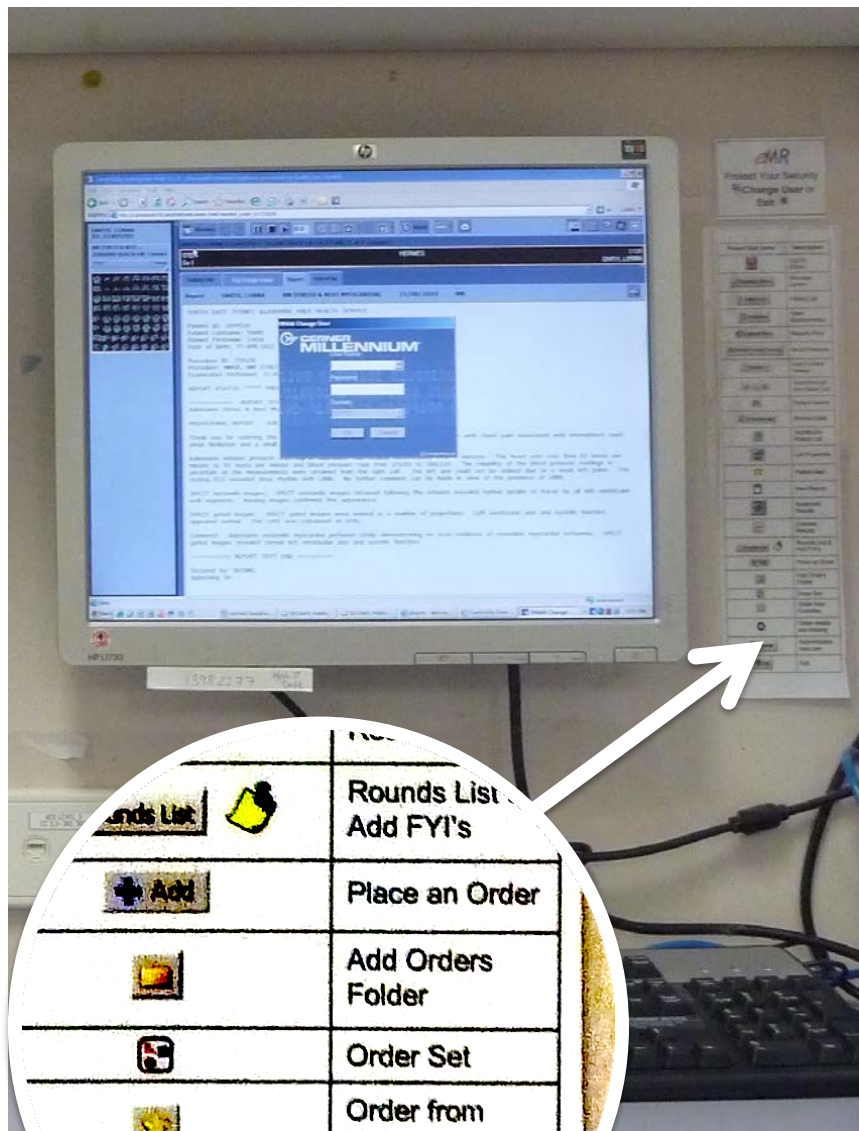
Workarounds

work as imagined

work as done



"This is where the idea for the new EHR starts getting a little complicated"



:: why workarounds happen

- Designers confuse ‘work as imagined’ with ‘work as done’:
 - Streamlined processes ignore necessary variation and local context
 - Designs may ignore cognitive realities (cognitive load, interruptions, multitasking ...)
- In reality work is often non linear:
 - Pathways and dependencies between tasks may be invisible until the context changes.
 - Work is adaptive to changing needs over time and tools are thus modified or re-purposed.
 - In complex settings computerised processes can be brittle to change.

:: workarounds are gifts

- Workarounds are signals that there is a mismatch between work as imagined and work as done.
- We can think of *workarounds as repairs*, providing *missing information, new pathways or tools* to improve a system's fitness for purpose, fixing inadequacy in design, or meeting emergent or unanticipated needs. (JAMIA, 2014:21;414-22)
- Communication tools are often the bridge between work as imagined for an IT and work as done



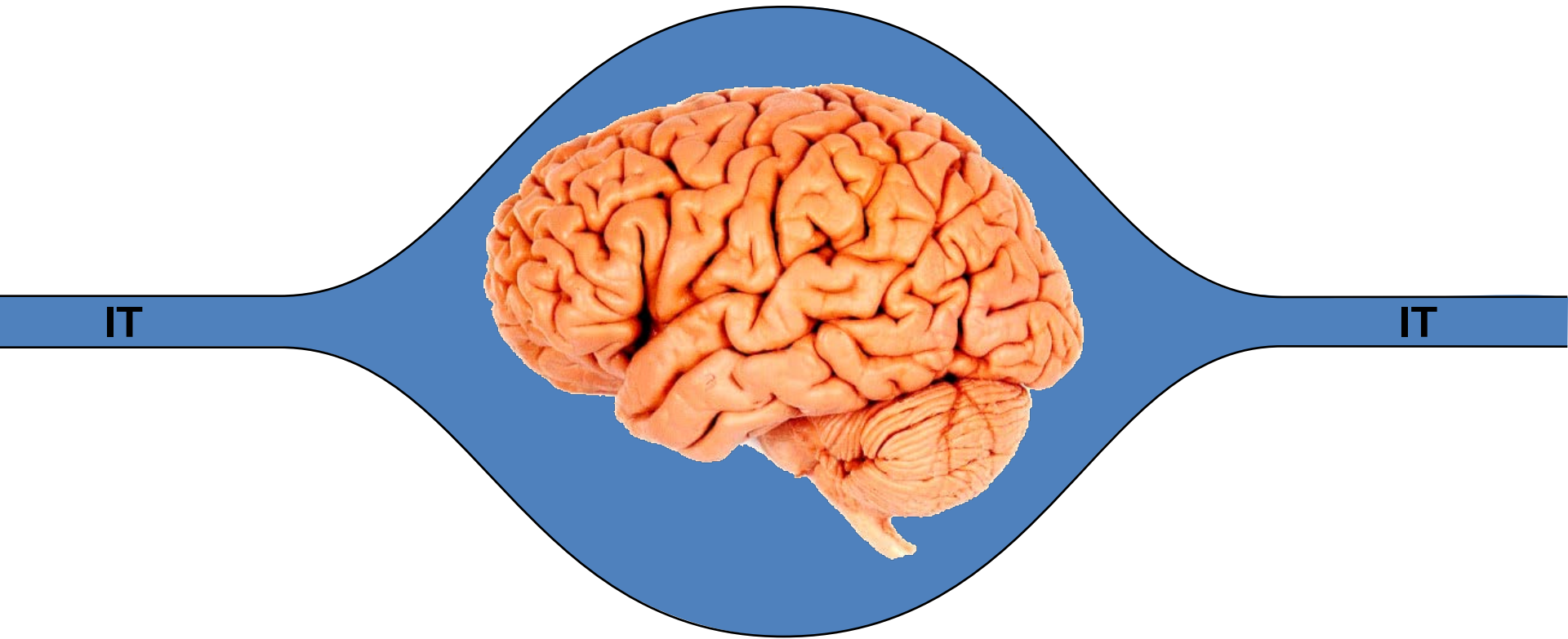
**Which tasks should
we computerise?**

IT

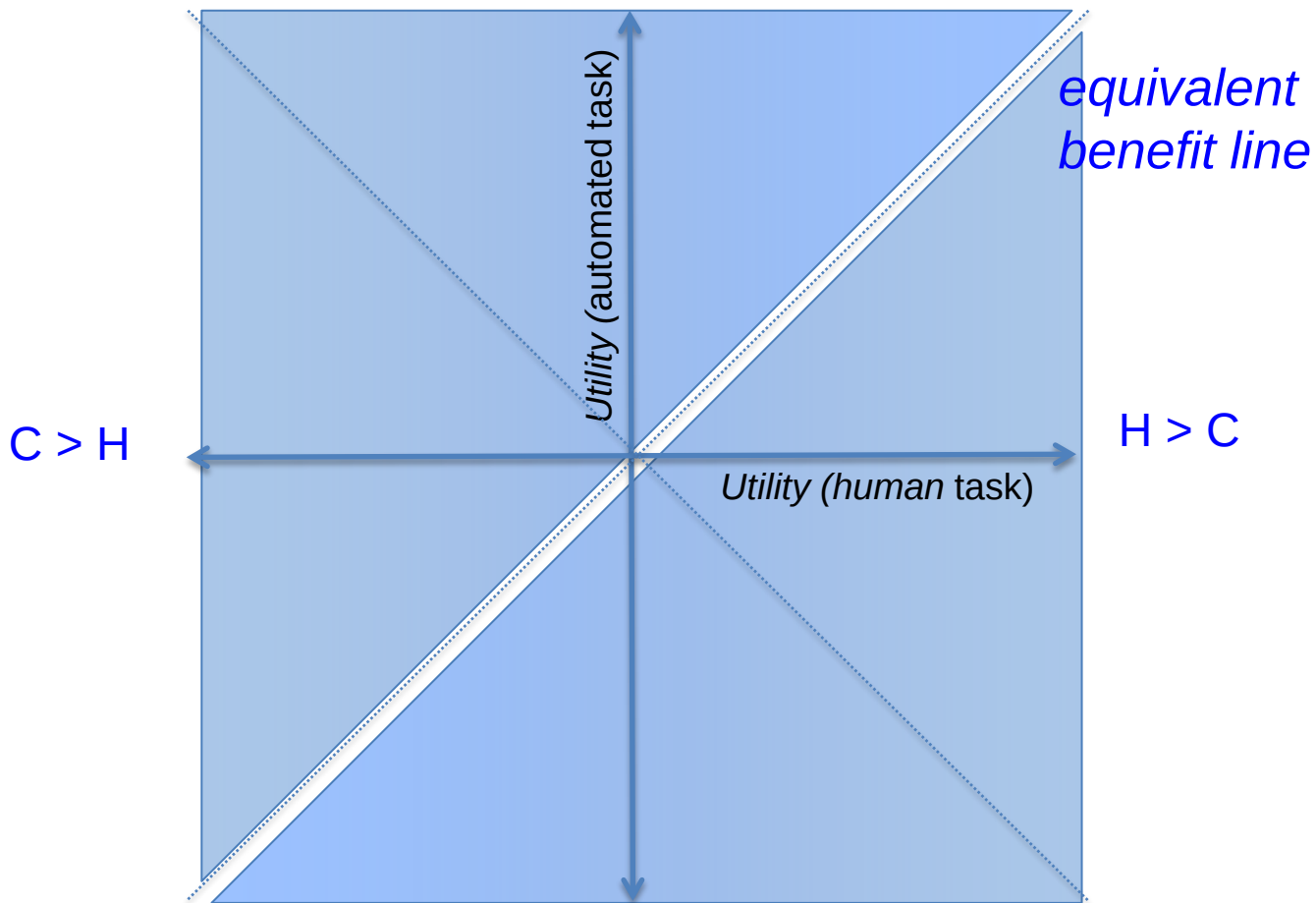


IT

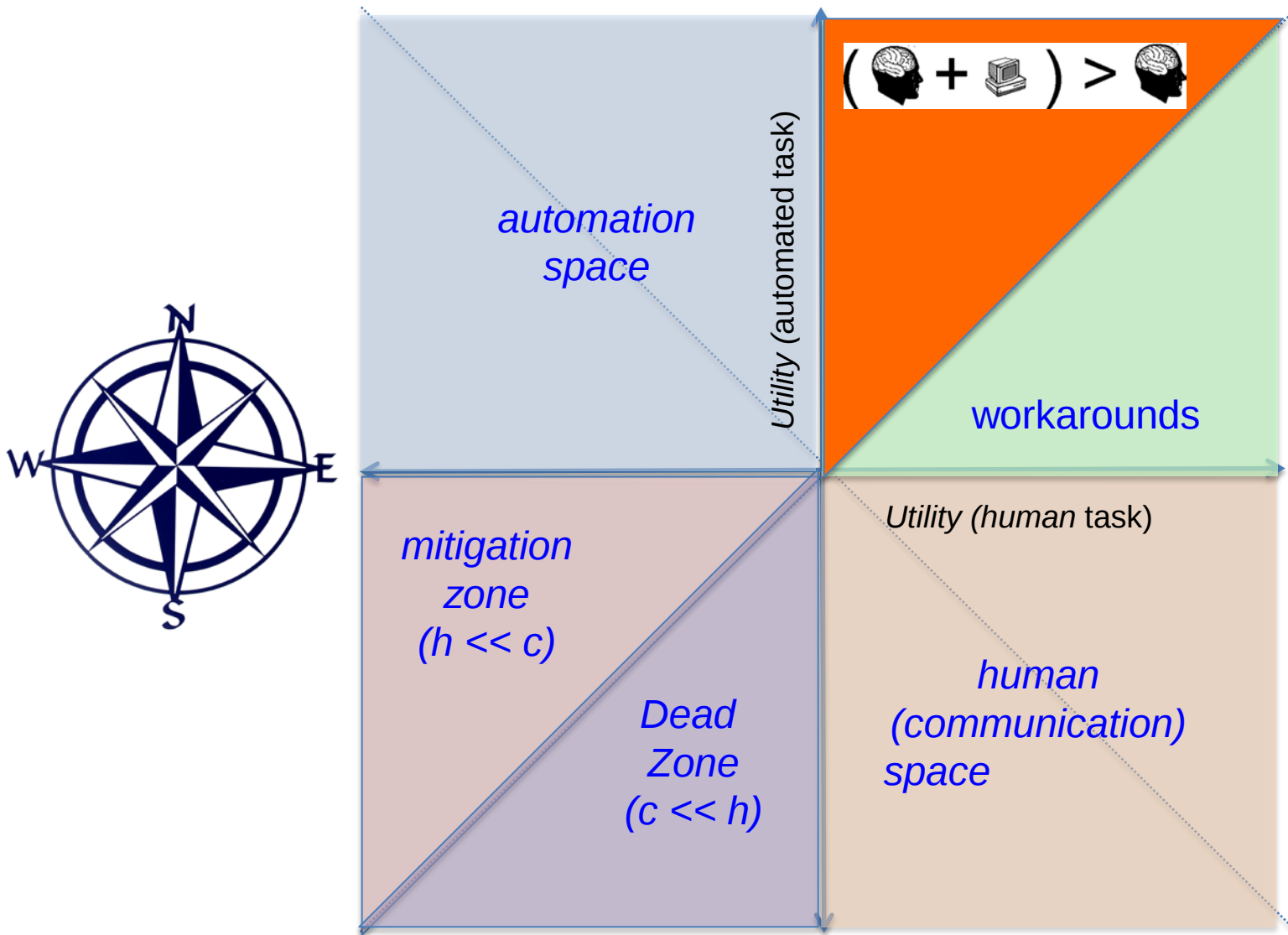




Compare the outcome of executing a task by humans vs. by automation



:: a new geography



If you know where you are, then
you have a better of chance of
getting to where you want to go.

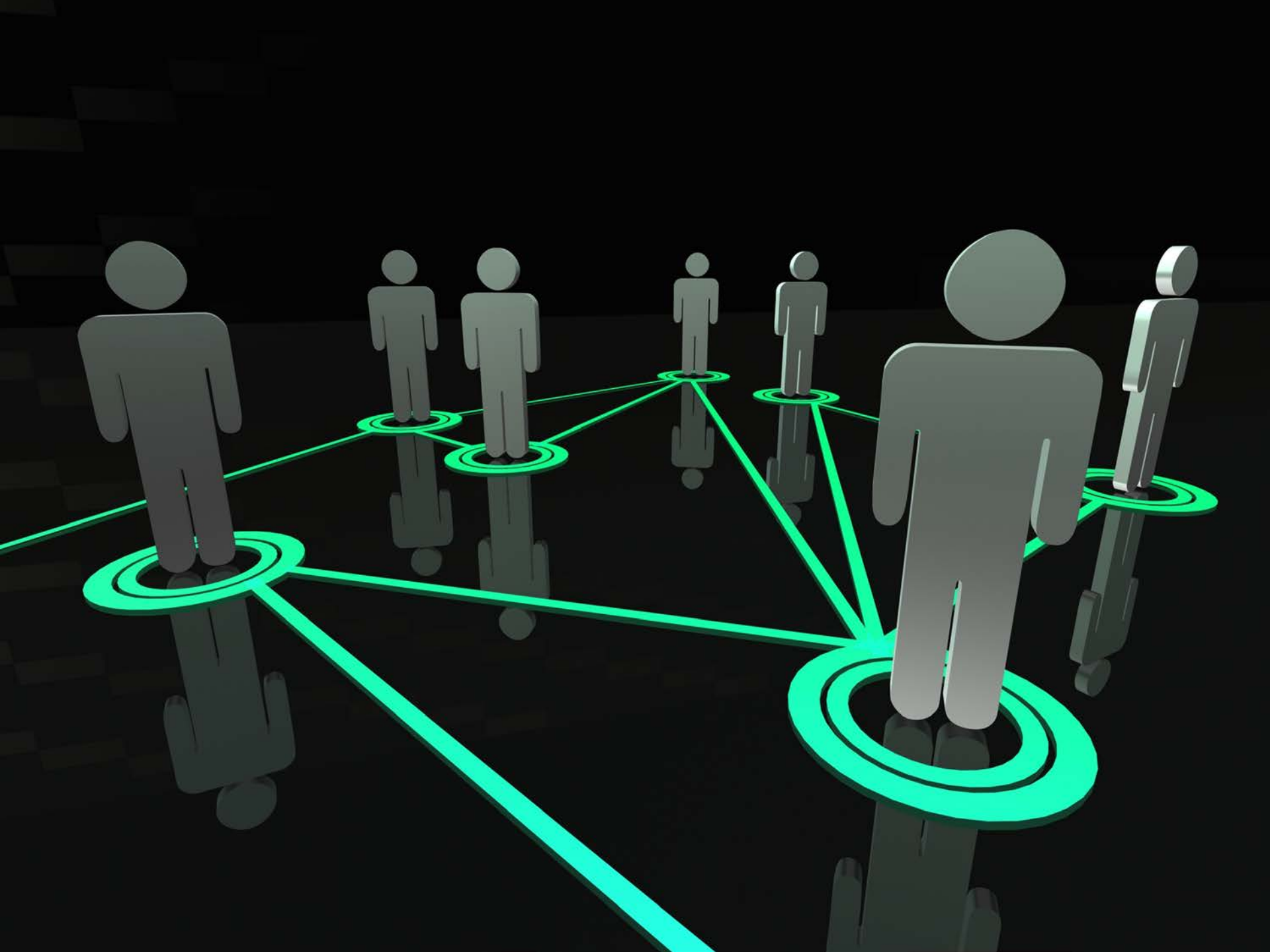


Part 2: Building e-health services that exploit social networks

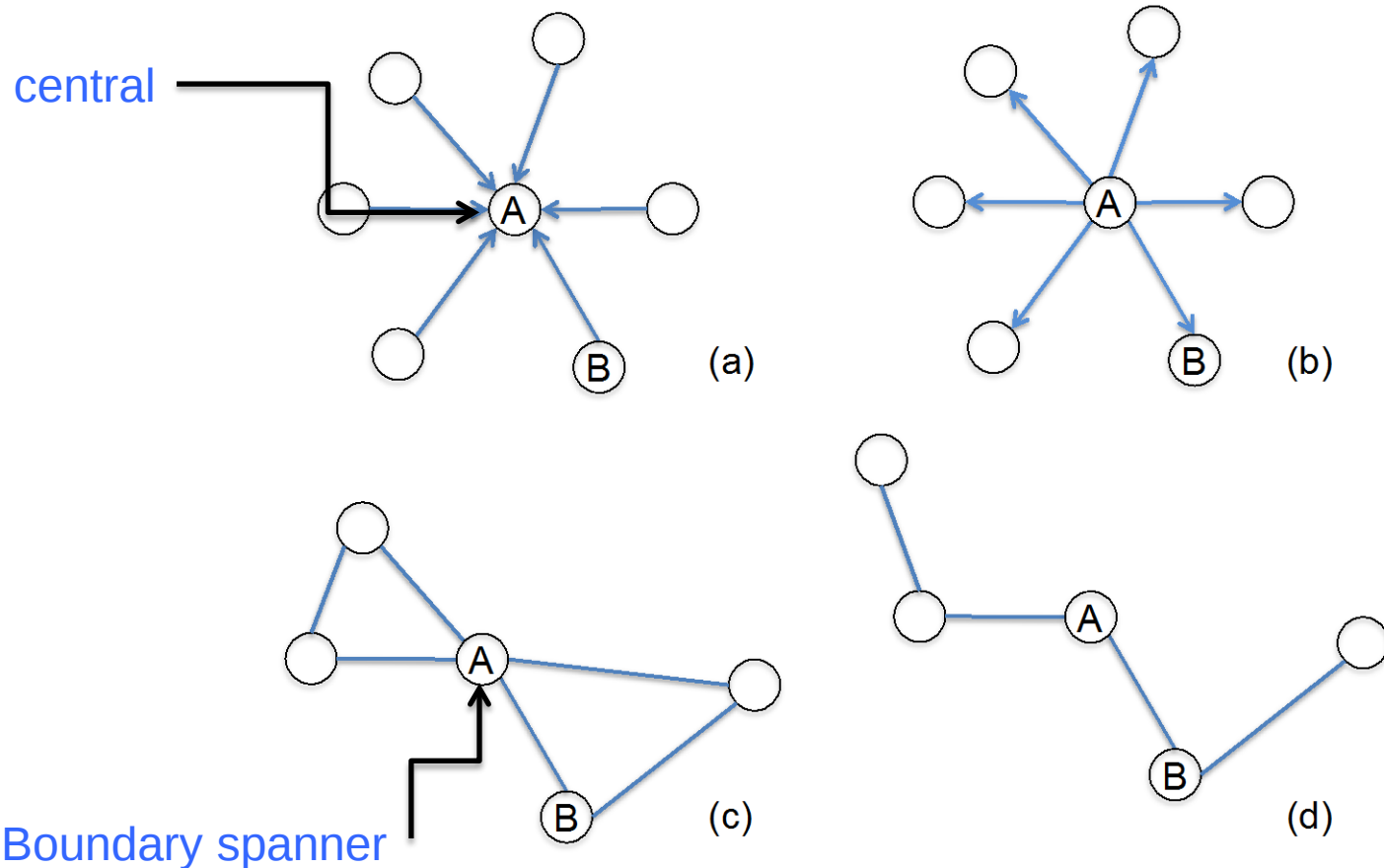
Enrico Coiera



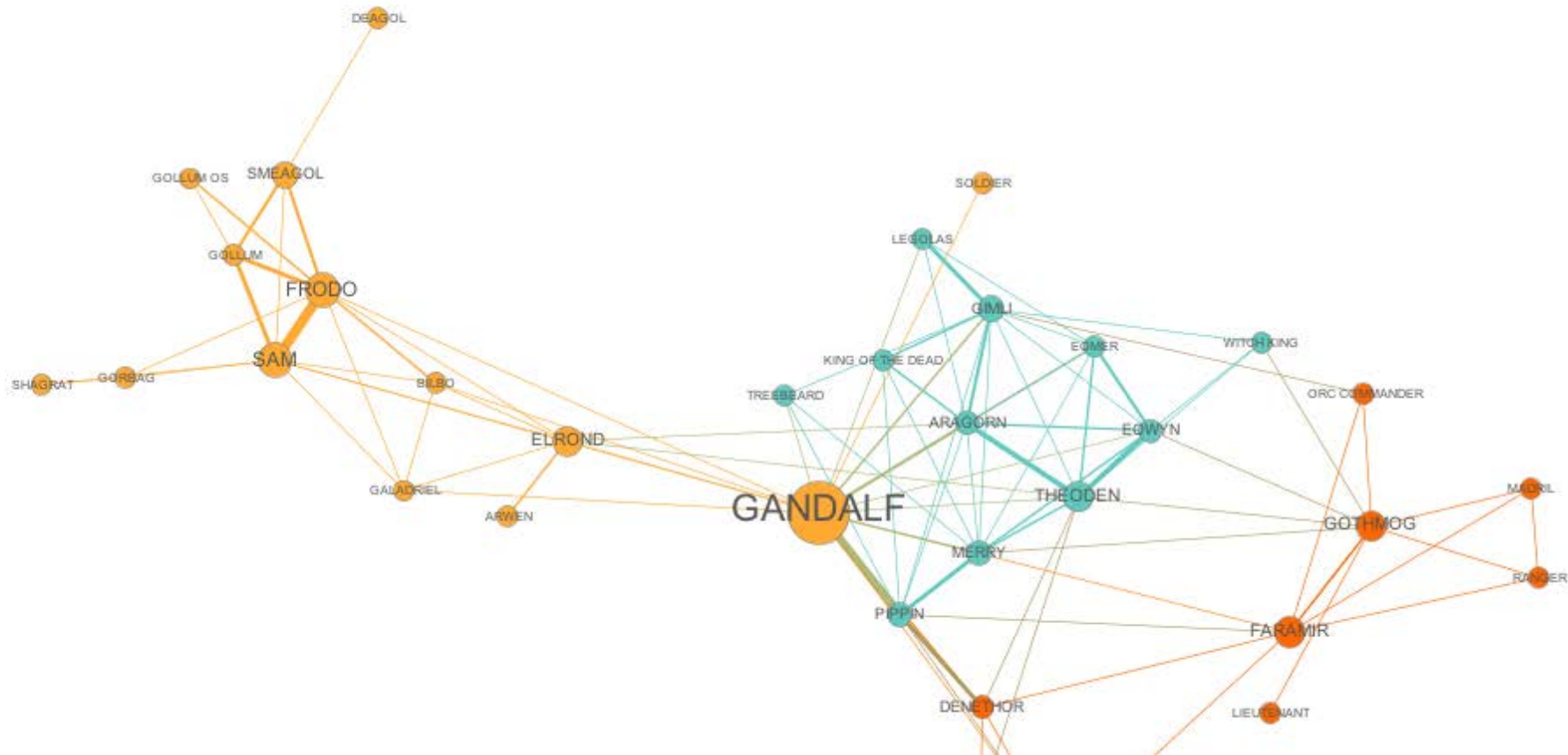
one:: Social networks



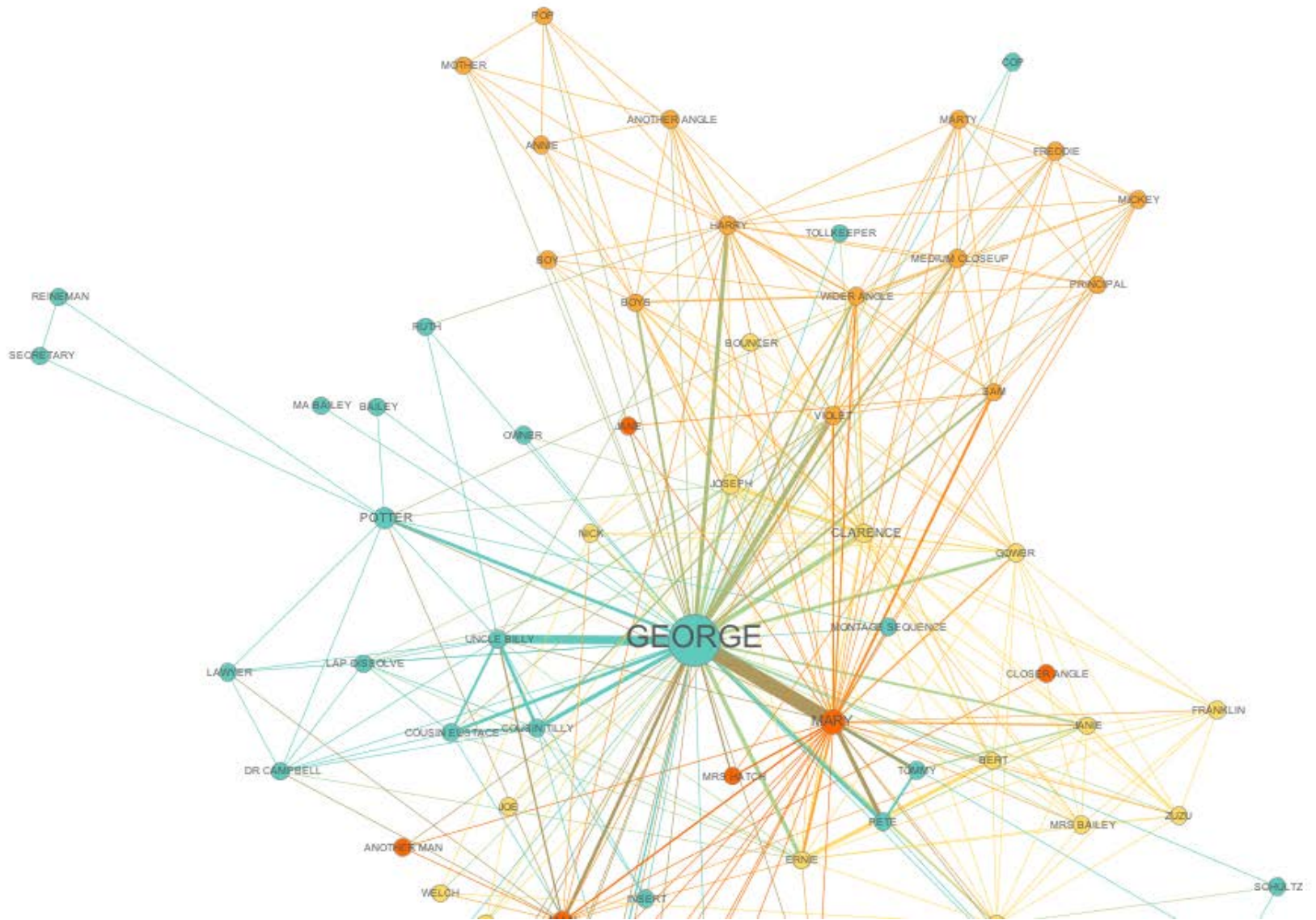
Centrality measures influence in a network



The Lord of the Rings: The Return of the King (2003)

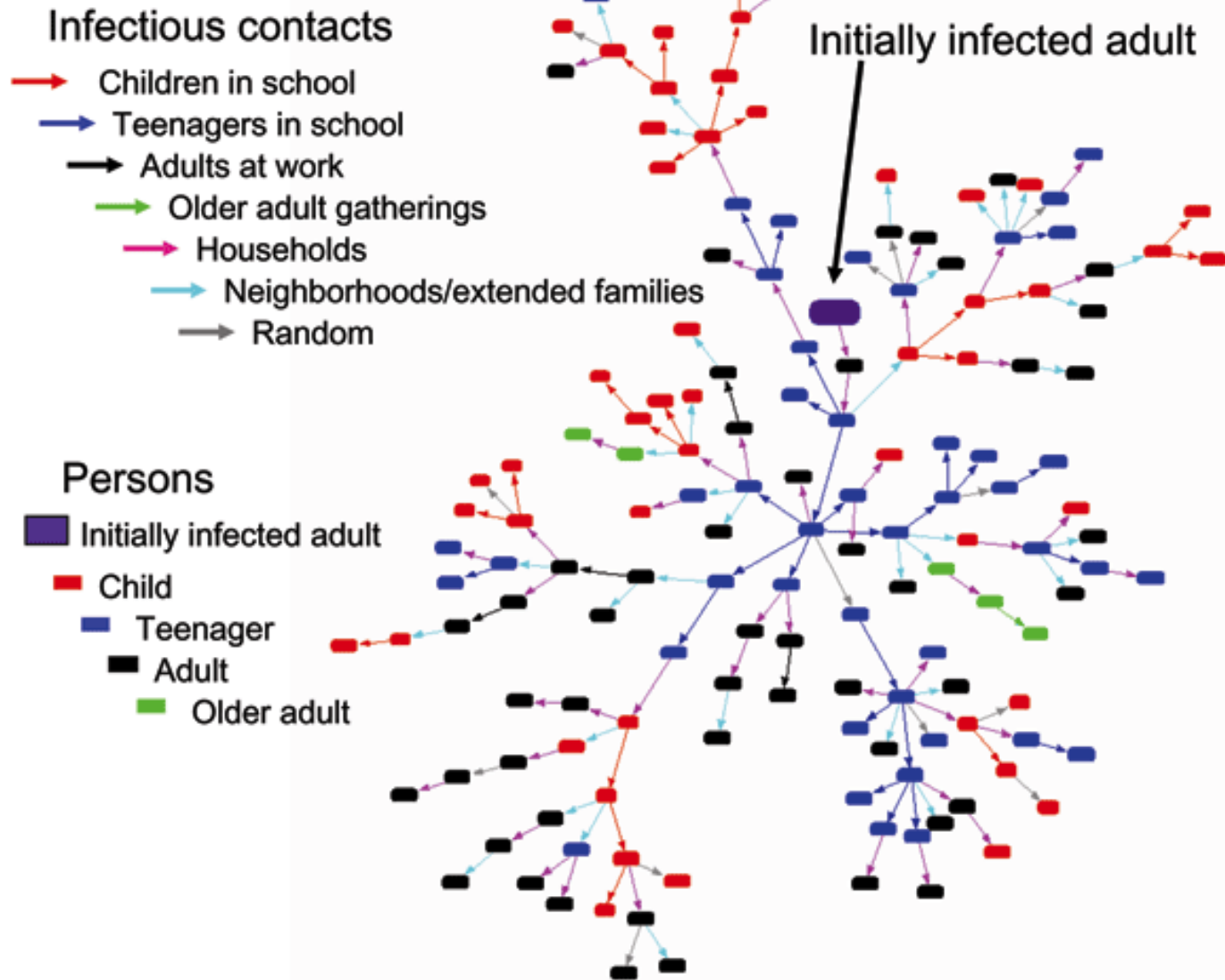


It's a Wonderful Life (1946)

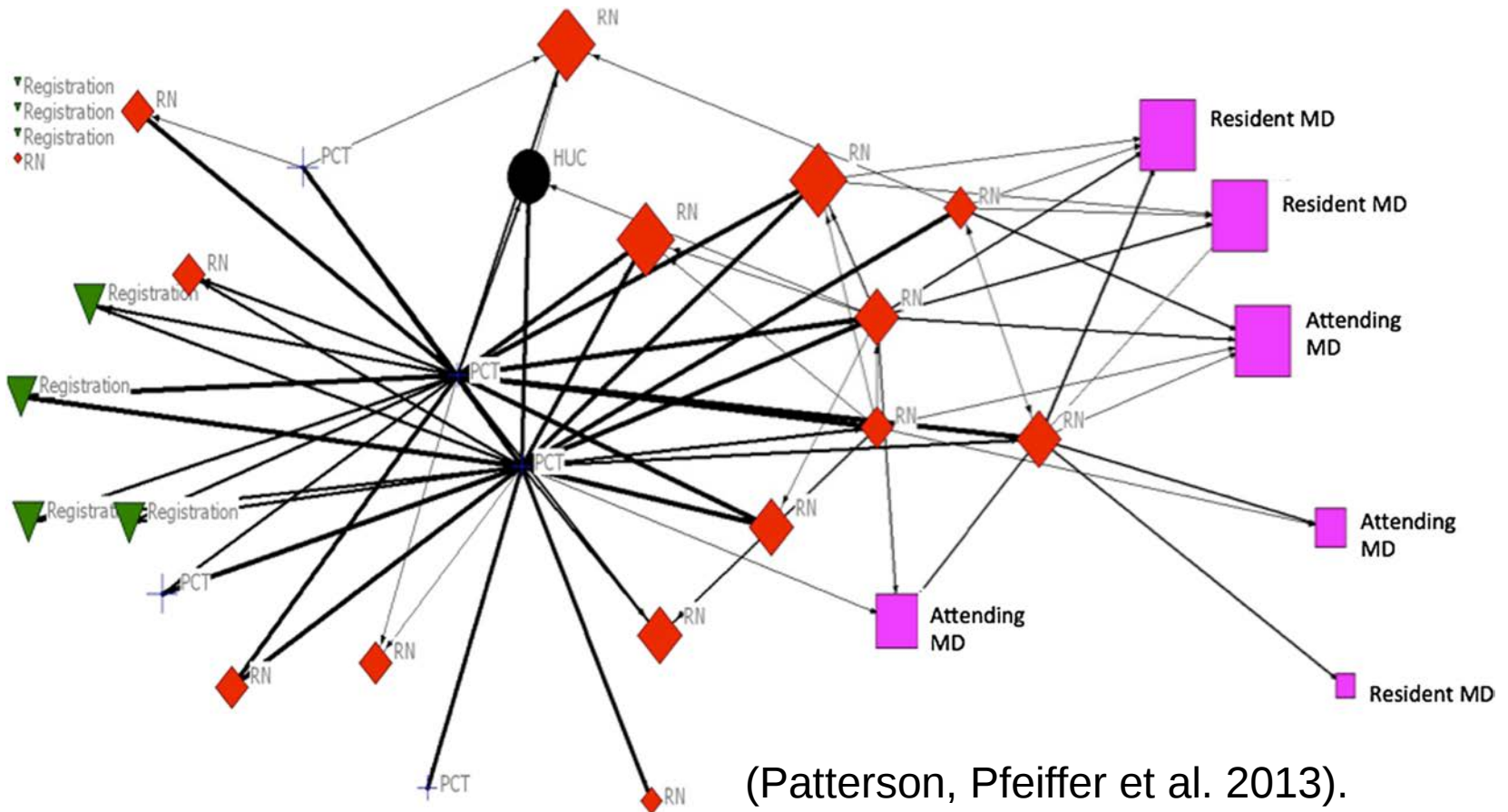


Homophily

- "love of the same"
- Social networks see aggregation by individuals with similar attributes.
- Even weak social ties see this aggregation
- Two causal processes:
 - “Birds of a feather” – social ties more likely to form between similar individuals
 - Social contagion – individuals alter behaviors to fit into social structures and become more similar with time; behaviors propagate across networks



A medication advice-seeking network



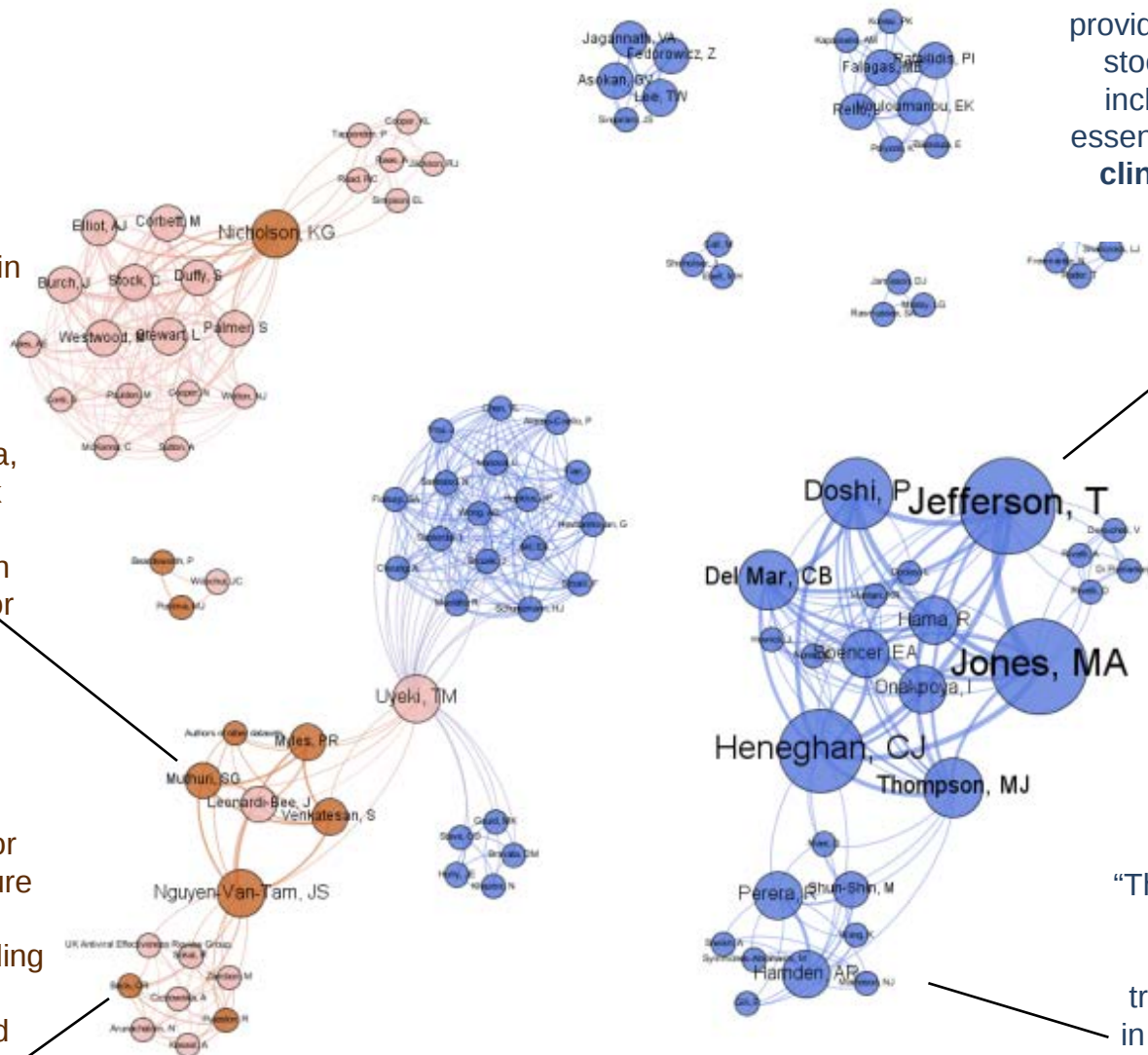
(Patterson, Pfeiffer et al. 2013).

Social networks in healthcare

- Social networks underpin:
 - the diffusion of safety and quality practices
(*BMJ Qual Saf* 2012;21(3):239-49)
 - the way clinicians seek advice from each other
(*IJMI* 2010;79(6):e116-e25)
 - How physicians adopt new drugs
(*Soc Sci Med* (1967) 1975;9(4–5):233-36)
 - how evidence propagates
(*Soc Sci Med* 2011;72(5):798-805)

“encourage early initiation of neuraminidase inhibitor treatment in **outpatients** who are appreciably unwell with suspected or confirmed influenza, or at increased risk of complications, including those with influenza A H3N2 or influenza B.”

“NAIs should be deployed during a future pandemic for either post-exposure **prophylaxis** or **treatment** depending on national policy considerations and logistics.”



“...We believe these findings provide reason to question the stockpiling of oseltamivir, its inclusion on the WHO list of essential drugs, and its **use in clinical practice** as an anti-influenza drug.”

“The benefit of oseltamivir and zanamivir in preventing the transmission of influenza in **households** is modest and based on weak evidence.”

Financial Conflicts of Interest and Conclusions About Neuraminidase Inhibitors for Influenza

- 26 systematic reviews between Jan '05 – May '14
- n = 37 assessments about use of these drugs (e.g. prophylaxis, treatment).
- Among assessments associated **with a financial conflict** of interest, 7 of 8 (88%) were favorable.
- Of those assessments **without a financial conflict of interest**, only 5 of 29 (17%) were favorable.
- Those without a financial conflict more likely to have statements about quality of primary studies e.g. safety (79% v 14%).

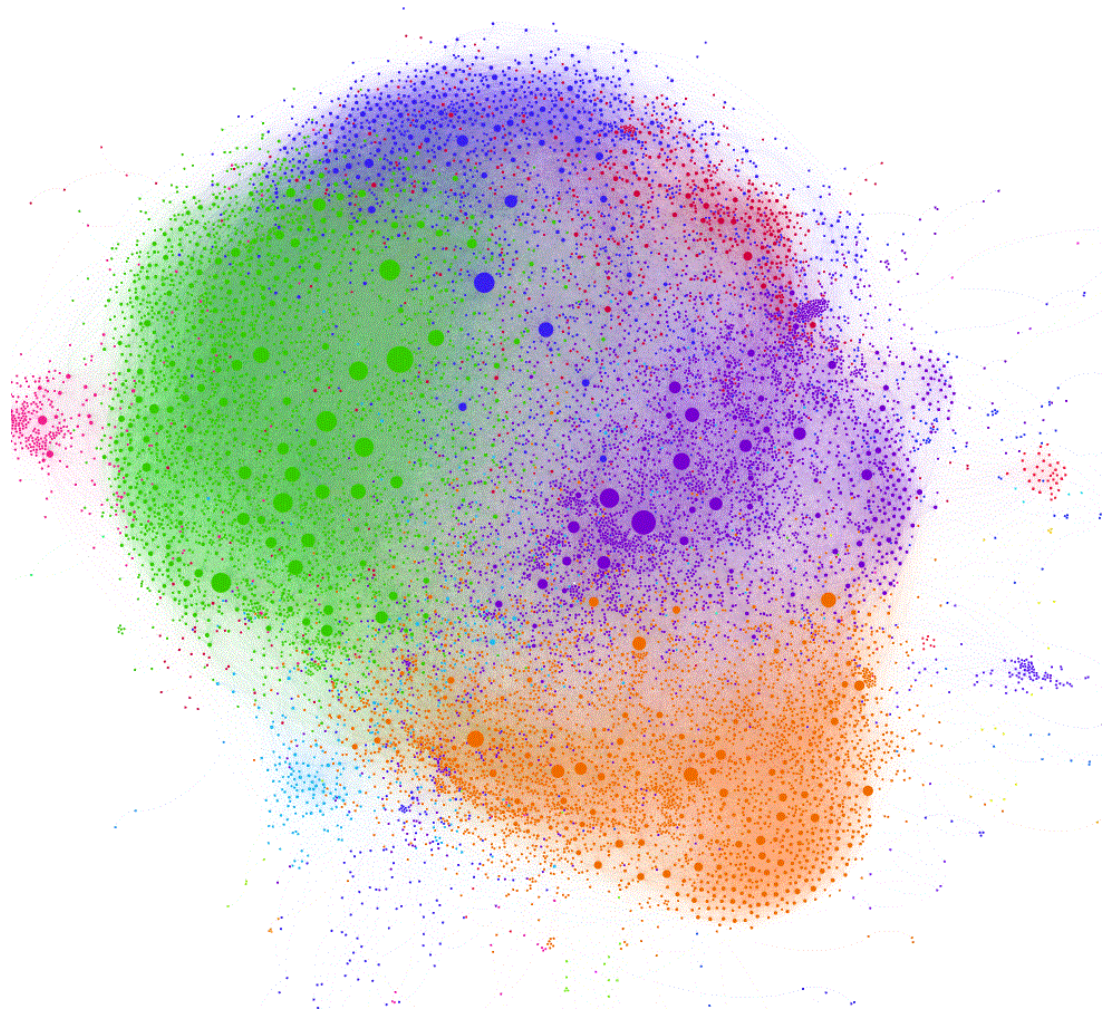
Ann Intern Med. 2014;161:513-518

Twitter networks discussing human papillomavirus vaccines

30,621 users, 83,551
tweets over 6 months

Distinct communities with
little interaction between
them can be identified
including:

- Media outlets (purple)
- Pro-vaccine posters (green)
- Anti-vaccine posters (orange)

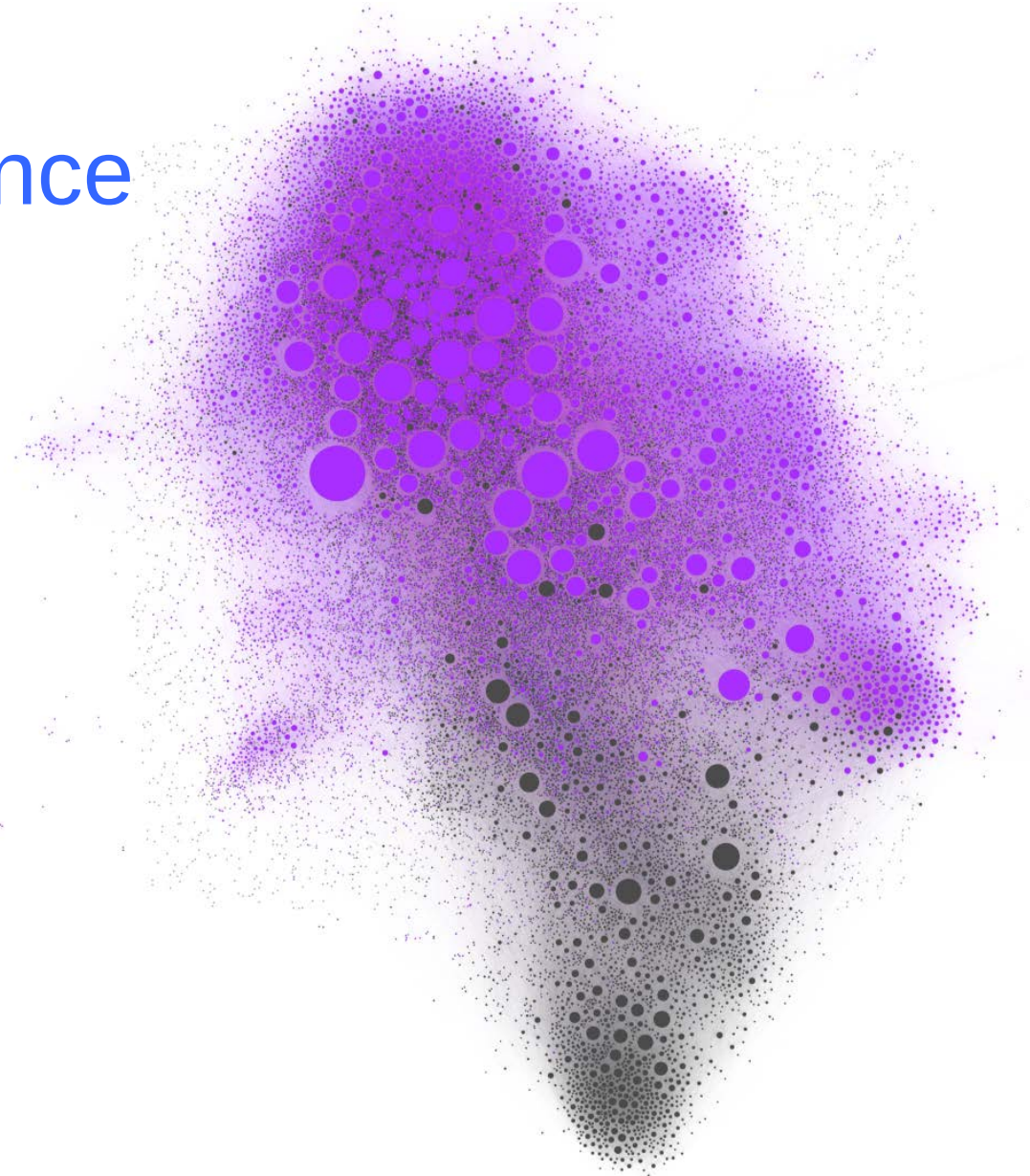


Opinion surveillance

Grey : those exposed to a majority of negative opinions; Purple: those exposed to mostly neutral/positive tweets.

9046 (29.54%) exposed to majority of negative tweets. Their likelihood posting a negative tweet was 37.78% compared to 10.92% (1234/11,296) for users were exposed to majority positive/neutral tweets.

Relative risk of 3.46 (95% CI 3.25-3.67, $P < .001$).



J Med Internet Res 2015;17(6):e144

Identifying those at risk of negative views

- Content based models degrade in predictive power over time, because what people write can change rapidly (new words, phrases, links).
- *Social connection models* are most stable over time and can identify if you have anti-vaccine opinions with accuracy of 88.6%.
- *Who you connect with* appears to tell us more than *what you say* online.

(Medinfo 2016; Zhou, Coiera et al.)

Friends and natural selection ...

- Friend genotypes at the single nucleotide polymorphism level tend to be positively correlated (homophilic).
- Other genotypes are negatively correlated in friends (heterophilic).
- Some of the correlation can be explained by specific systems:
 - an olfactory gene set is homophilic;
 - and an immune system gene set is heterophilic.
- Homophilic genotypes exhibit significantly higher measures of positive selection suggesting a synergistic fitness advantage (Christakis, Fowler, PNAS, 2014)

two:: social media



Facebook

- > 1 billion users
- 1.24 % of the people on earth
- 80% are non US web users
- 50% log in every day, and 48% of 18-34 yr olds check it when they wake up
- 18-24 yr old demographic grew 74% in one year.
- 750 million photos uploaded on 2011 new year's day weekend.



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 Click on member photos for more details



Our Current Communities

Neurological Conditions

[MS \(Multiple Sclerosis\)](#)

[Parkinson's Disease](#)

Mood Conditions

[Depression](#)

[Anxiety](#)

Highlights



Lithium & ALS Study

See how ALS patients taking lithium are doing in real-time. [Learn more...](#)

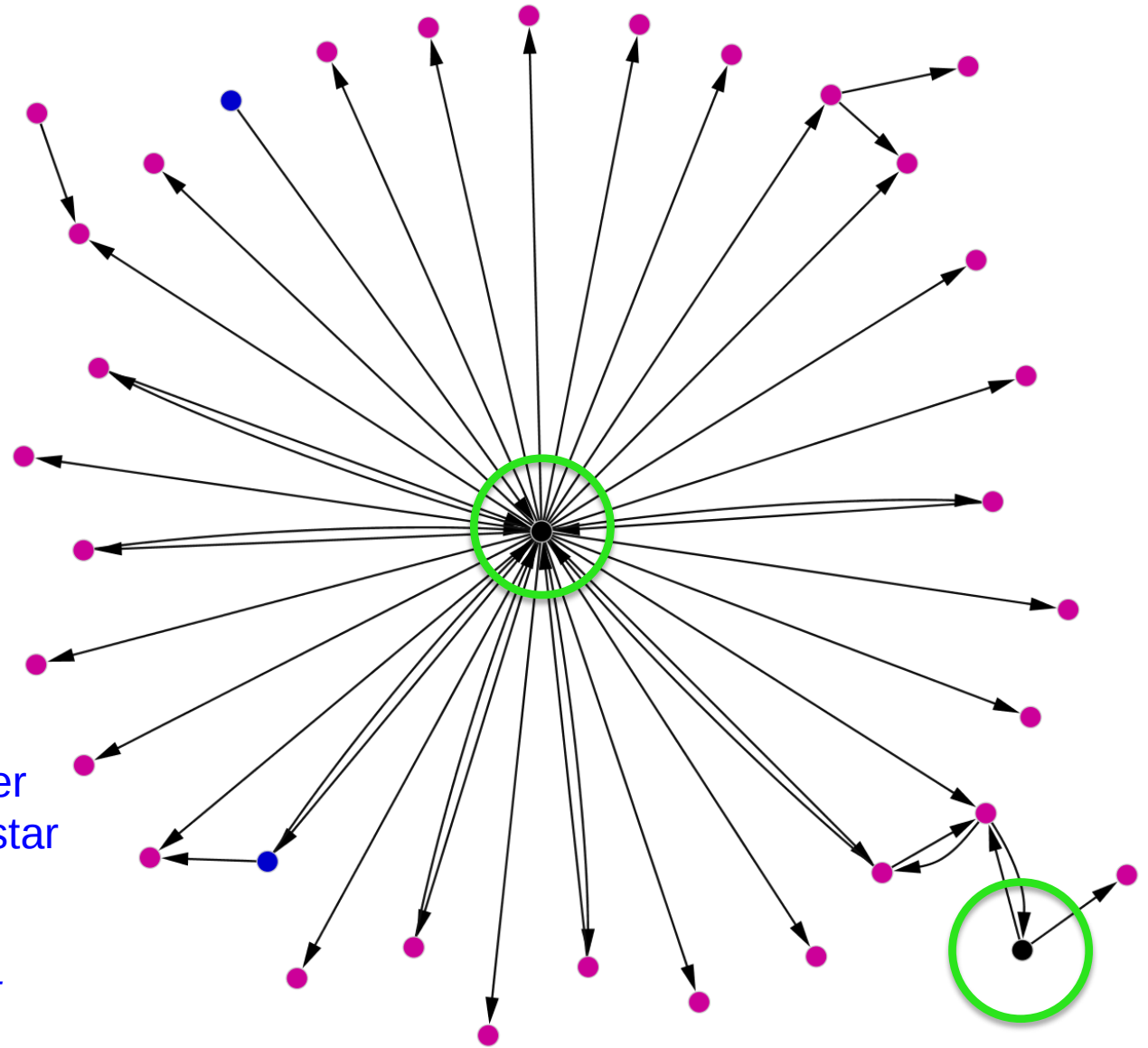
Social media in the service of care delivery

- **Emergency services:** SoMe used for broadcast, emergency communication cascades and buddy networks, to track first hand accounts (video, audio and GPS), team co-ordination.
- **Measuring quality and safety of clinical services:** Crowdsourced ratings correlate with traditional quality measures, hospital mortality and infection rates.
- **Public health and health promotion:** One way broadcasting of public messages; online communities help behavior change is important e.g. smoking cessation. Contact tracing e.g. Ebola in Nigeria
- **Disease management:** online spaces where patients can interact with clinicians, and each other e.g. online engagement correlate with lower levels of self-reported stress and depression in cancer patients.

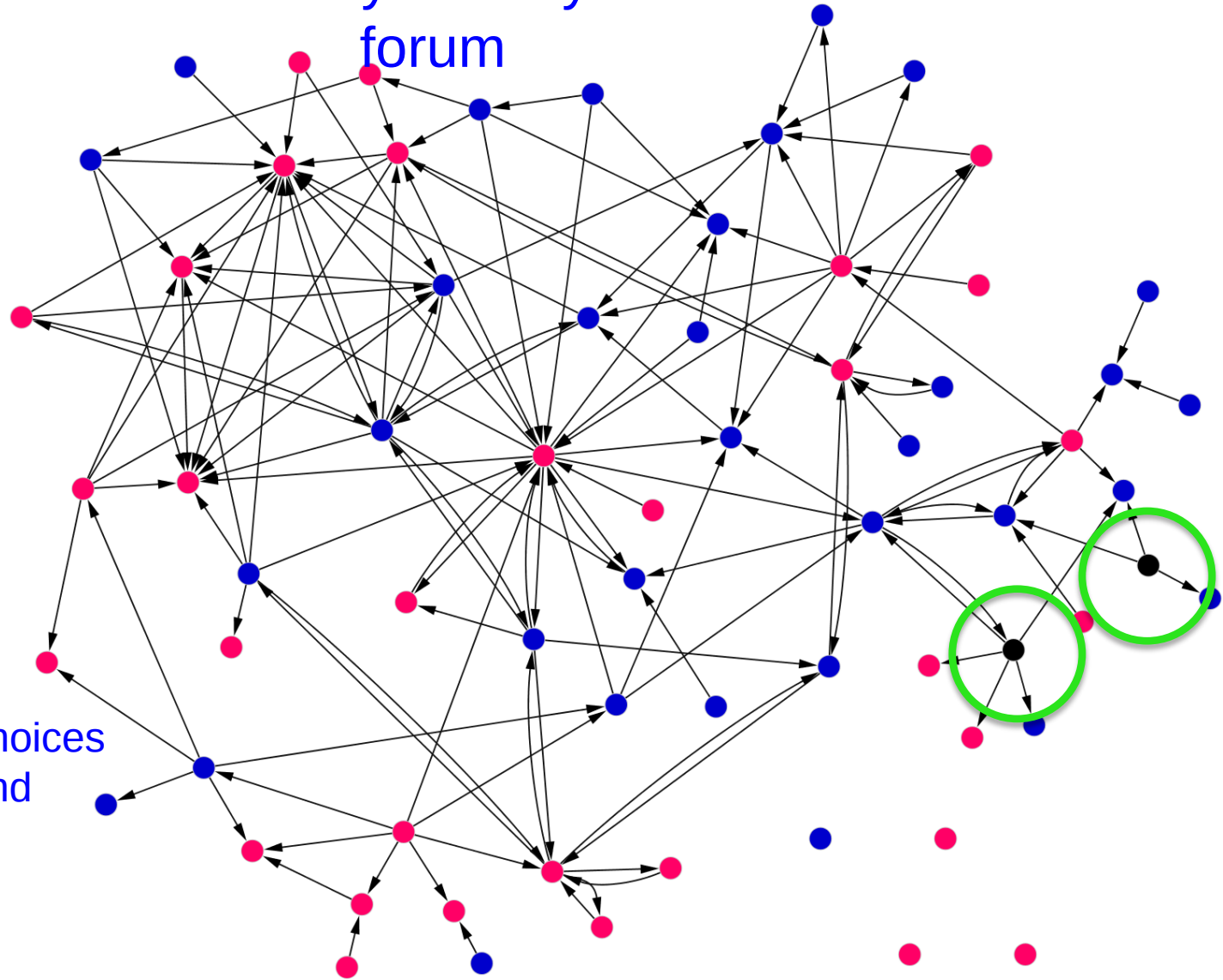
(Coiera, BMJ, 2013)



GP dominates at center of a question-answer star network that is not actively social e.g. *"I have condition x, what are my options?"*



Stay healthy forum



An active social
network where choices
are discussed, and
clinicians are not
central

Healthy.me trials

- **Preventative Care Setting:**

Influenza vaccination: RCT, 742 young adult participants (Lau et al., JAMIA, 2012):

- >100% increase in influenza vaccination (4.9% -> 11.6%)
- 64% increase in GP visits (17.9% -> 29.5%)

STI screening: RCT, 369 participants (7.6->15.3%)(Mortimer et al, JAMIA, 2015).

Asthma action plans: RCT, 330 adults, no impact (JMIR submitted)

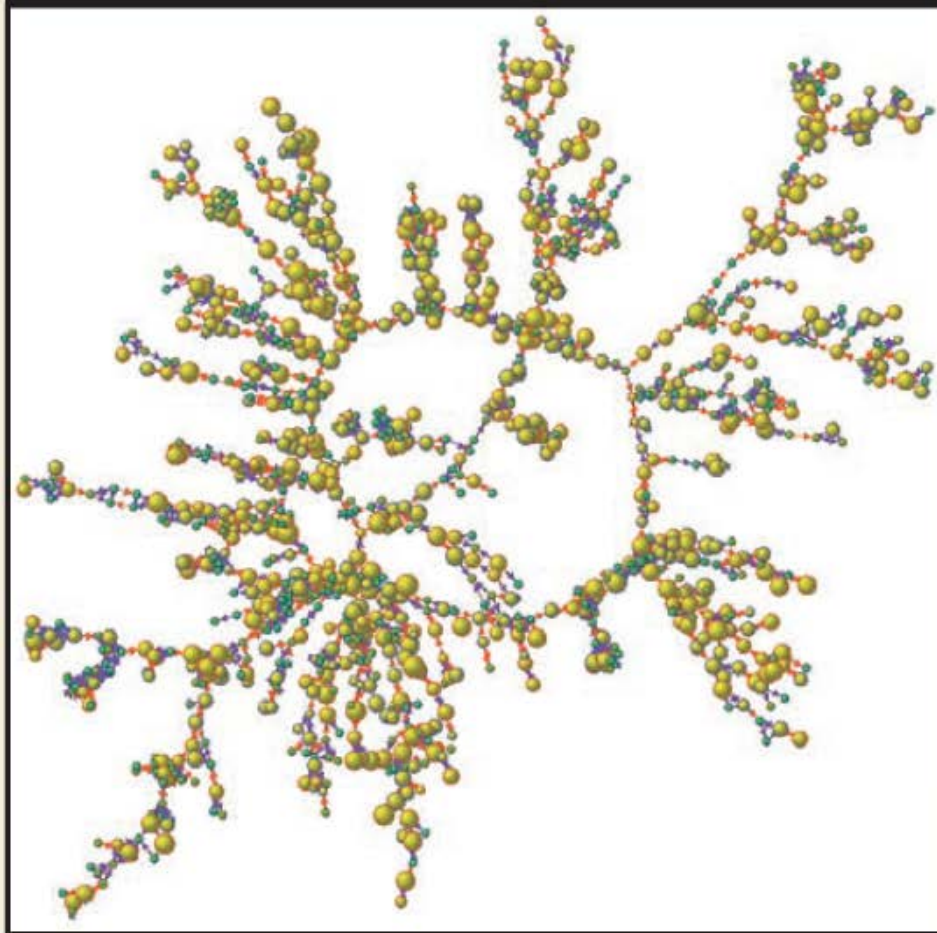
- **Mental Health Setting:** Before-after cohort study, 709 young adult participants:

- mental health help-seeking rate ~32% to 54%, higher than 25% community average

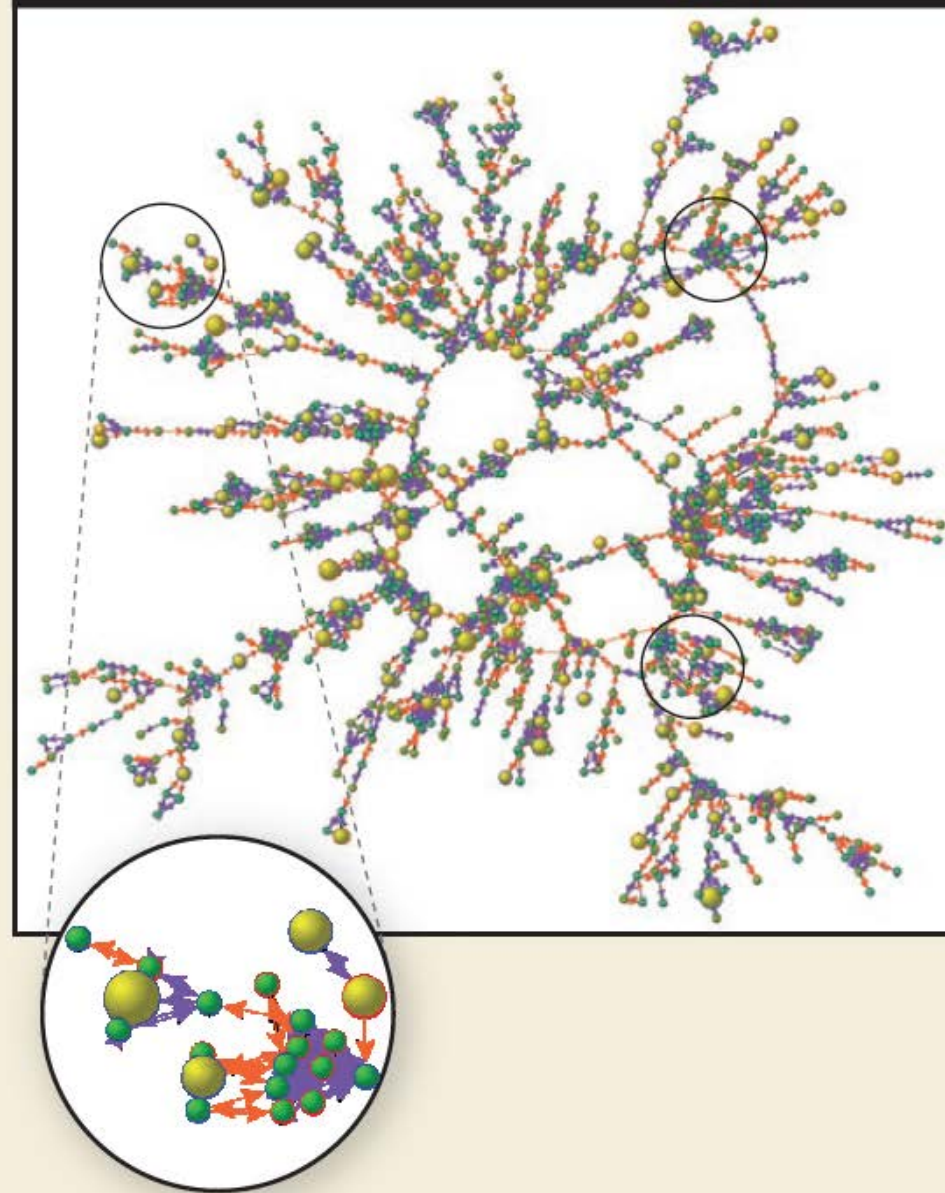
three:: Social diseases

Many major diseases seem to
be a social network

1971

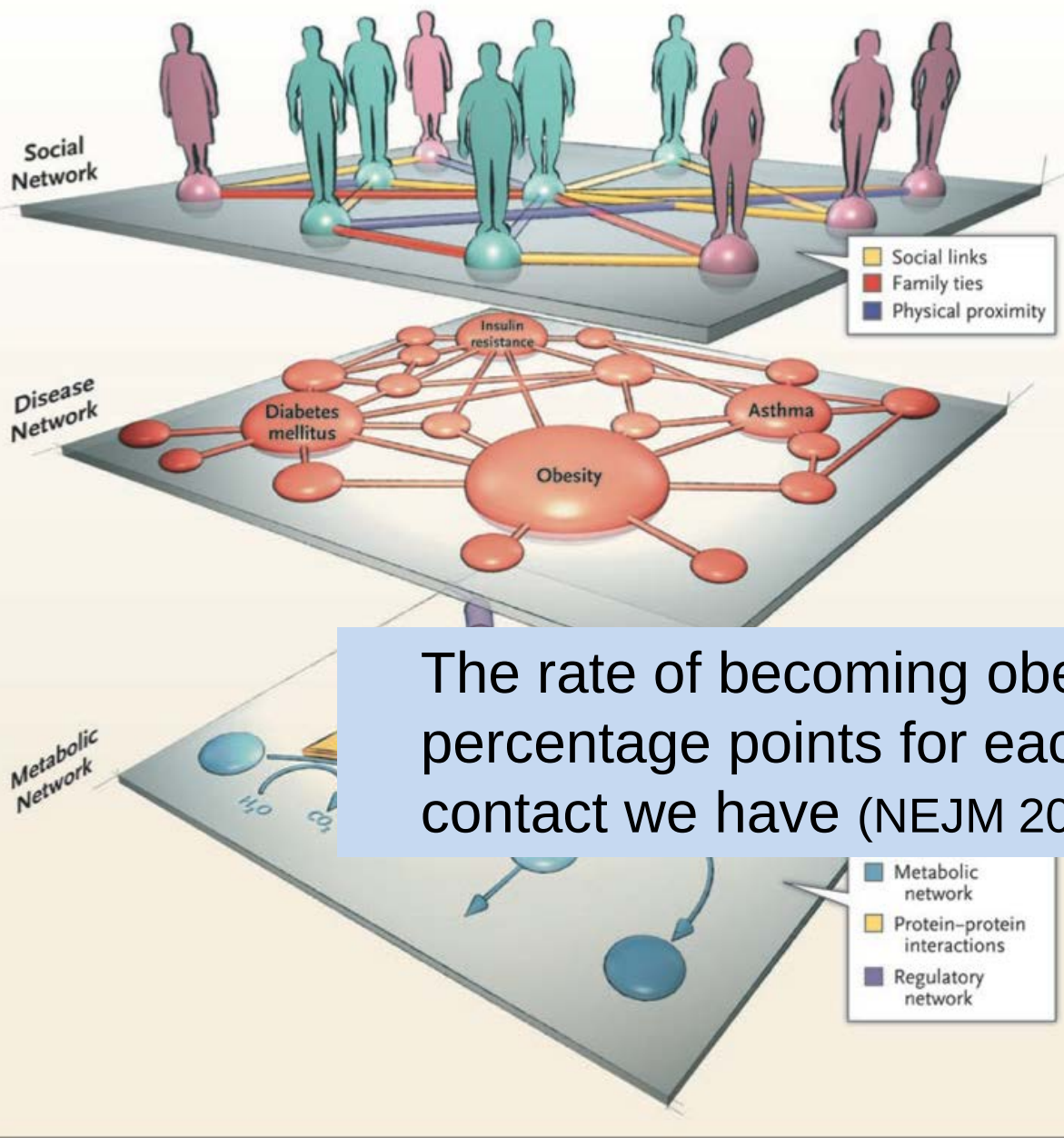


2000



Smoking is a social network

Christakis and Fowler, NEJM 2008; 358:2249-225



Obesity has strong social network effects

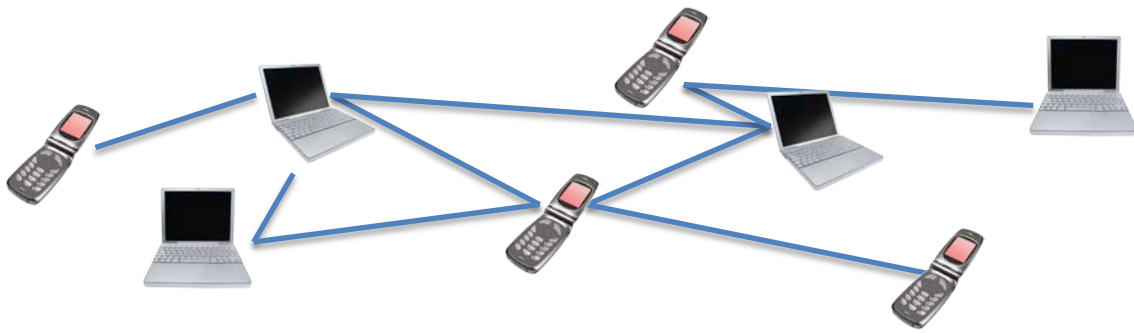
The rate of becoming obese increases by 0.5 percentage points for each obese social contact we have (NEJM 2007;**357**(4):370-79

Barabási A, NEJM 2007; 357:404-407

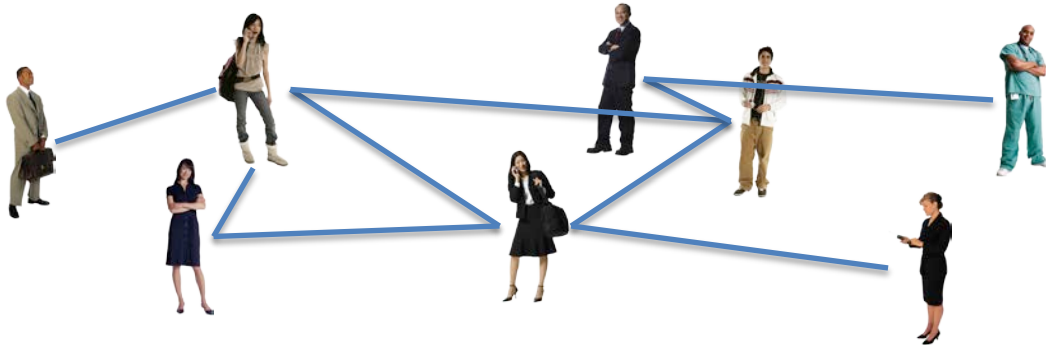
Social networks and disease

Many of the diseases we worry about at a population level have strong social network effects underlying them e.g.

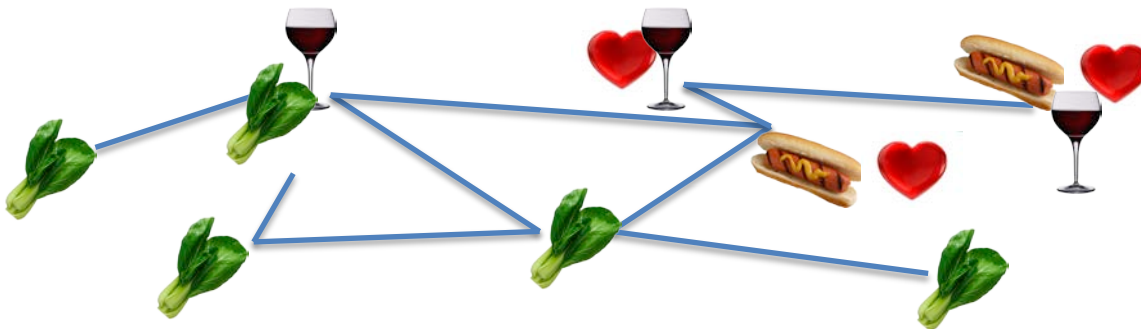
- Infectious disease spread
- Mental health – depression
- Heart disease, obesity
- Alcohol, drugs and smoking



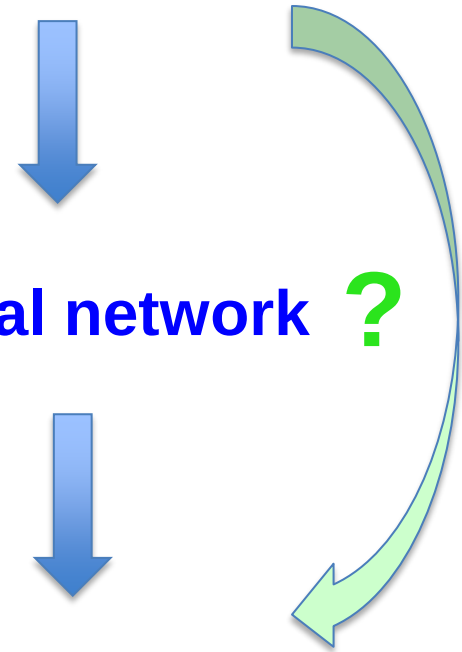
Social media



Social network ?



Social disease



Network interventions

- **Individuals**: target influential central individuals
- **Groups**: reset group norms
- **Network induction**: spread messages across a network e.g. snowballing, viral memes
- **Network alteration**: add or remove individual's or change connections

(Valente, Science, 2012)

Can social media treat social disease?

- **Weak Hypothesis** - social media have a role in transforming health care services by creating new modes of interaction
- **Strong Hypothesis** - where a disease is socially mediated, then social media are a channel for its cure
- Will **network therapy** be major transformational tool in the way we manage the seemingly intransigent challenges of conditions such obesity, depression, diabetes, and heart disease?

(Coiera, BMJ, 2013)

Thank you

@enricocoiera

enrico.coiera@mq.edu.au



