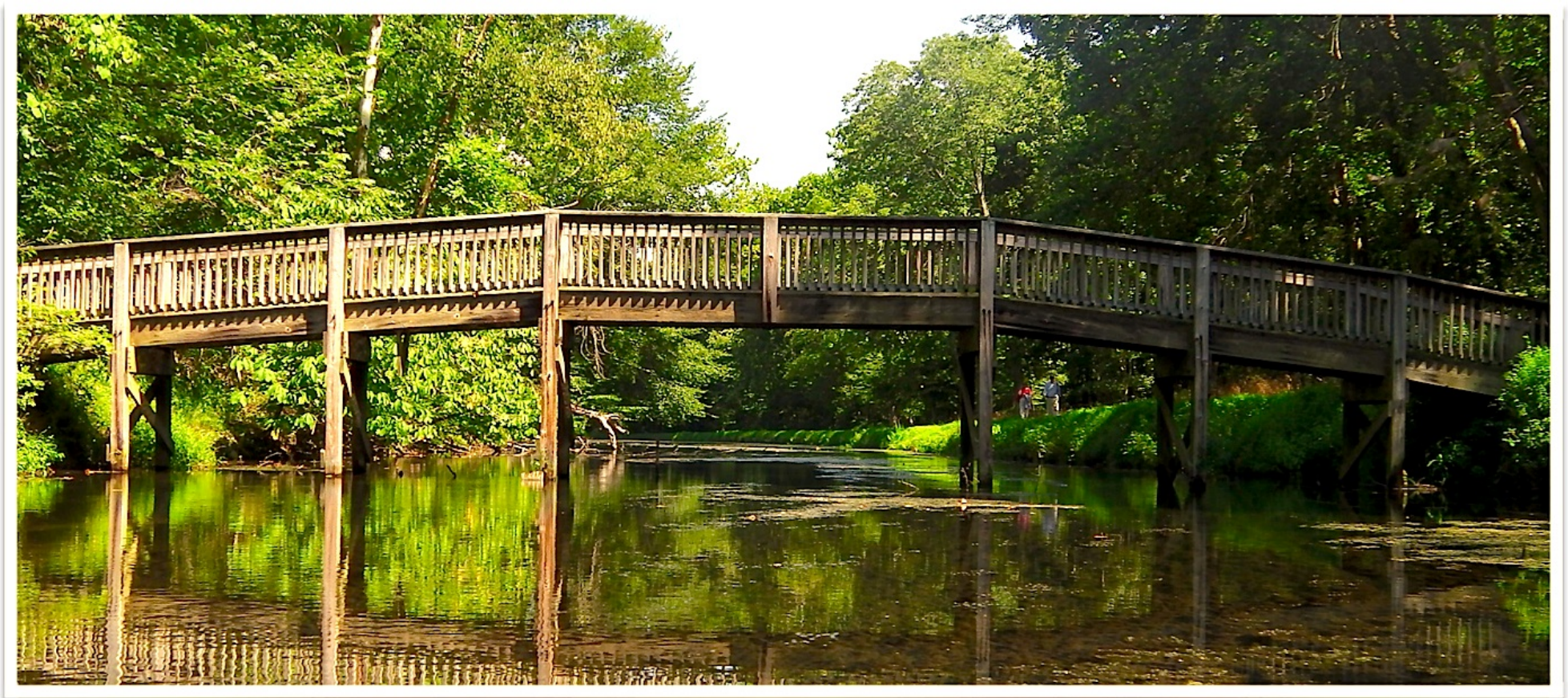


Morphine, Magic and RUM

Keys to improving healthcare data use to achieve the triple aim

Joe Bormel, MD, MPH

Former ONC Director of Health Outcomes

and EHR vendor VP/CMO

June, 2014

Stress-Free Productivity

Take home messages:

Usability is important

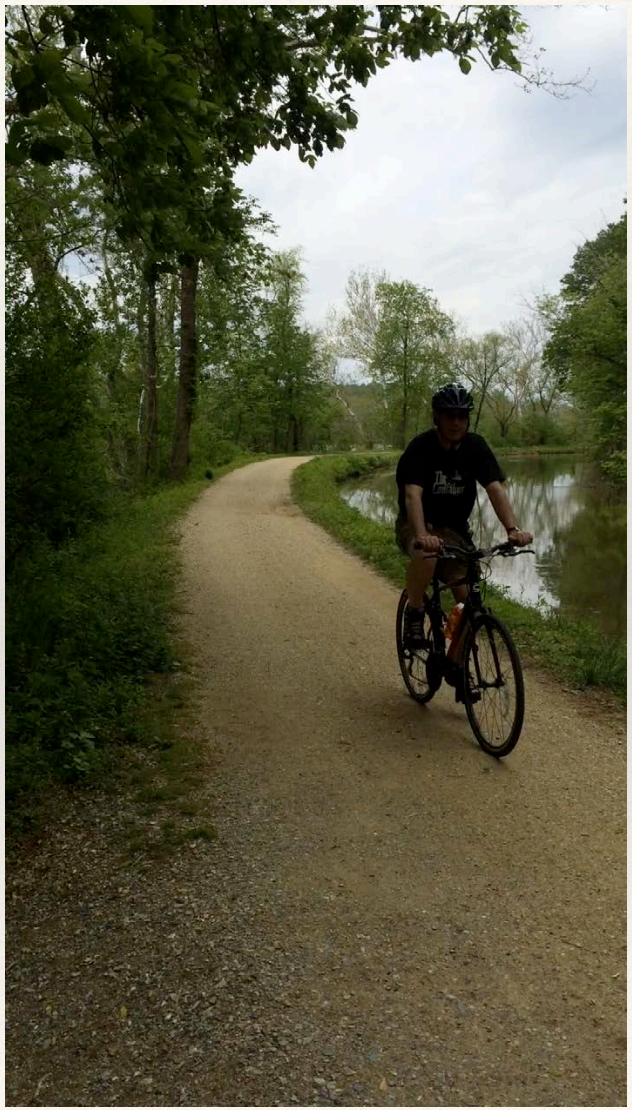
ARRA/HITECH relies on it

ACA relies on it

Usability depends on culverts

MU Certification and Attestation processes delayed or deferred investment in usability; so did implementation timelines

Here's hope.



Effortless Task Completion

The BIG Picture
Anatomy of a $63,000 Medical Bill

Usability Defined

Usability is "the extent to which a product can be
used by specified users to
achieve specified goals with
effectiveness, efficiency and satisfaction
in a **specified context of use**"

ISO 9241

A Universal Healthcare Challenge

- IHI Forum December 2009
  •IHI Improvement Map lists Core Healthcare Processes
- Red push pins = most severely broken processes
- Silver push pins = CPI successes
- Med Rec
- Only one 'possible best practice' noted: "One Patient: One List"
- Hospitals revert to paper processes : Don't try it in vapor 'til you can do it on paper!'
- No helpful hints

One hospital's conclusion: We are not alone!
Medication Reconciliation is ***the right thing to do***…
but how?

00:03:13 -00:57:29

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What Are the Most Common Causes of Abdominal Pain?

Whether it's a mild stomach ache, sharp pain, or stomach cramps, abdominal pain can have numerous causes. Some of the more common causes include:

- Indigestion
- Constipation
- Stomach virus
- Menstrual cramps
- Food poisoning
- Food allergies
- Gas
- Lactose intolerance
- Ulcers
- Pelvic inflammatory disease
- Hernia
- Gallstones
- Kidney stones
- Endometriosis

Source: http://www.webmd.com/pain-management/guide/abdominal-pain-causes-treatments

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- Kidney stones
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Source: http://www.webmd.com/pain-management/guide/abdominal-pain-causes-treatments

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Great Usability Is Indistinguishable from Magic

Let’s look at those Culverts

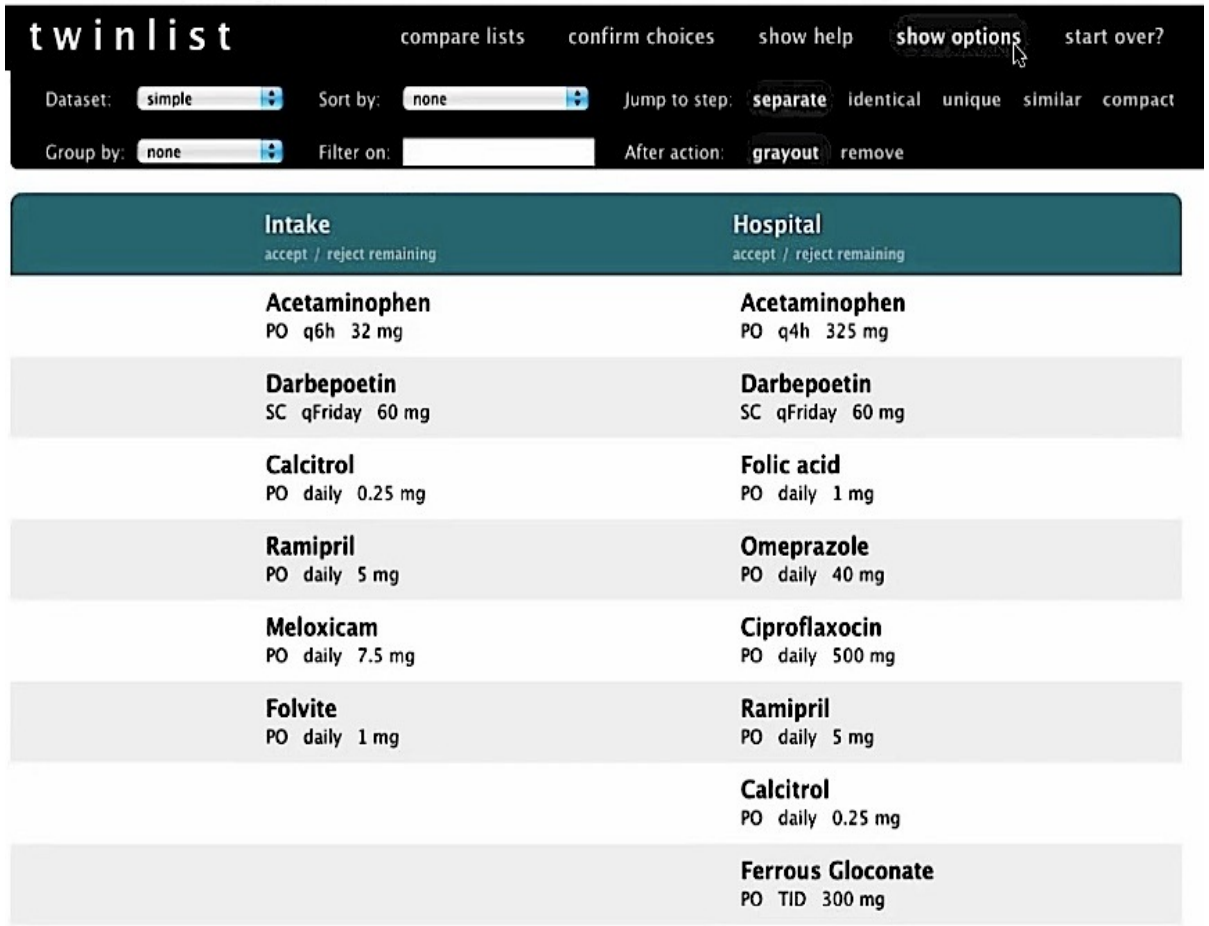
USABILITY IMPROVEMENT

VISUALIZATION

WORKFLOW SERIALIZATION

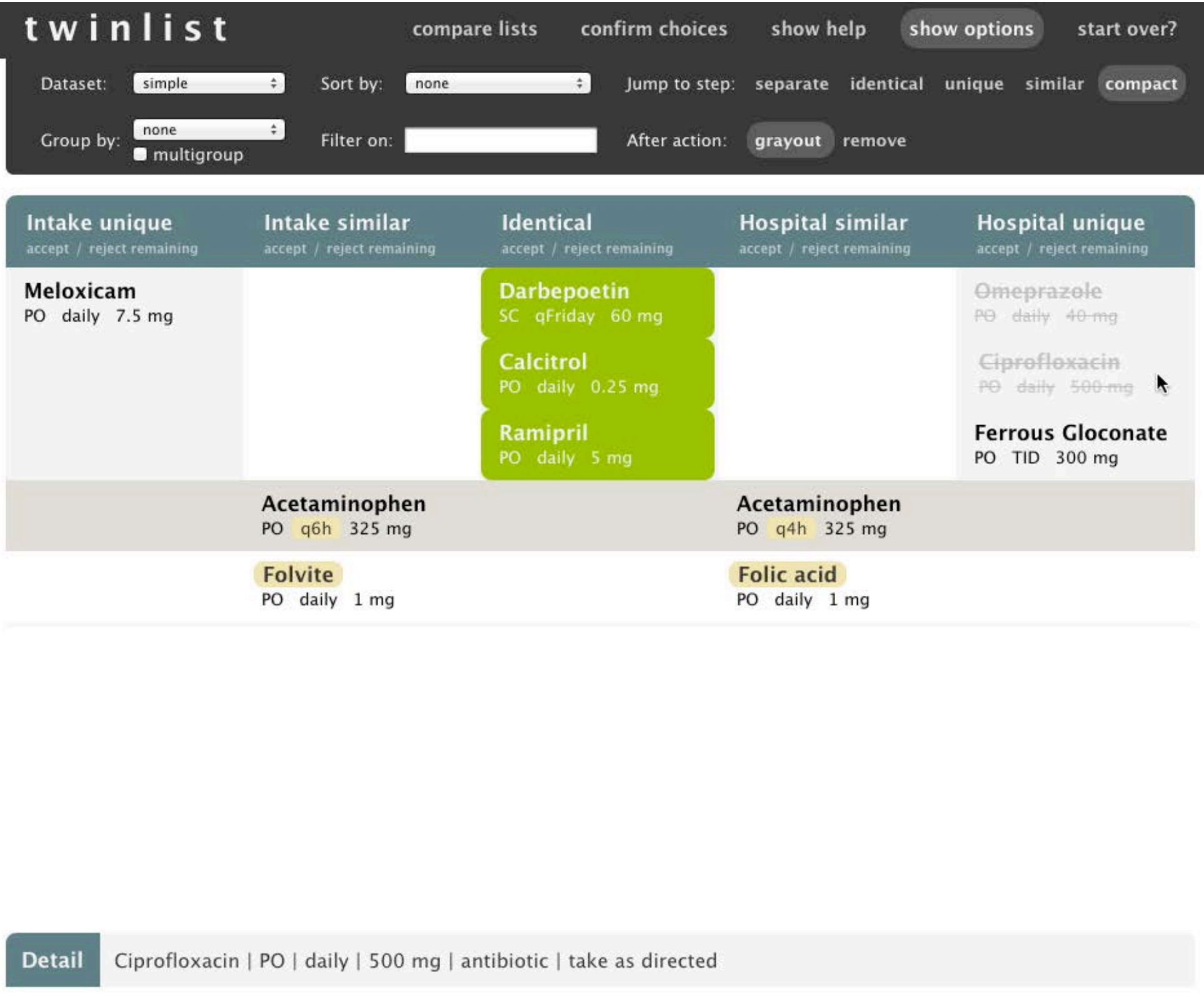
Medication Reconciliation Prototype (TwinList)

https://www.youtube.com/watch?v=YoSxlKl0pCo



Please note: **Compare Lists**

A button that does on the screen what the clinician would otherwise have to try to do in their head


twinlist
compare lists
confirm choices
show help
show options
start over?
Dataset: simple
Sort by: none
Jump to step: separate identical unique similar compact
Group by: none
multigroup
Filter on:
After action: grayout remove
Intake unique
accept / reject remaining
Intake similar
accept / reject remaining
Identical
accept / reject remaining
Hospital similar
accept / reject remaining
Hospital unique
accept / reject remaining
Meloxicam
PO daily 7.5 mg
Darbepoetin
SC qFriday 60 mg
Calcitrol
PO daily 0.25 mg
Ramipril
PO daily 5 mg
Omeprazole
PO daily 40 mg
Ciprofloxacin
PO daily 500 mg
Ferrous Gloconate
PO TID 300 mg
Acetaminophen
PO q6h 325 mg
Acetaminophen
PO q4h 325 mg
Folvite
PO daily 1 mg
Folic acid
PO daily 1 mg
Detail
Ciprofloxacin | PO | daily | 500 mg | antibiotic | take as directed

Impact

Conclusion: Cognitive support of medication reconciliation through interface design can significantly improve performance and safety.

FASTER - statistically significantly **faster** (211s vs 293s),

EASIER - requiring **fewer clicks** (47 vs 84) and scrolls (146 vs 549)

MORE RELIABLE

LESS SERIOUS ERRORS - **Serious errors** occurred (12 vs 31)

HIGHER USER SATISFACTION

"The **staged animation** helped clarify the steps in medication reconciliation making it valuable …"

Plaisant, Wu, Hettinger, Powsner & Shneiderman 2014, UMD HCIL Technical Report, (under revision for publication)

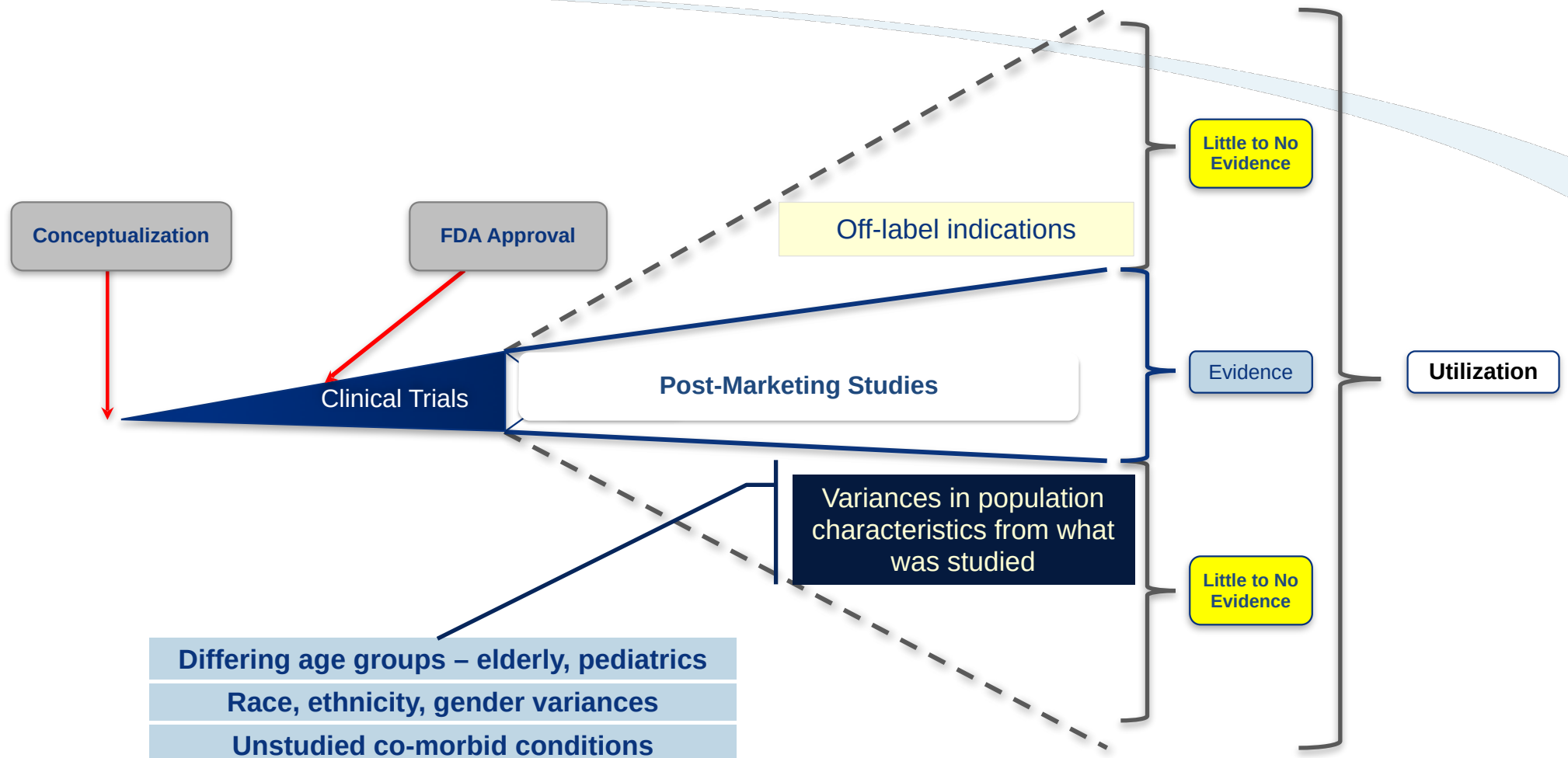
Culvert Thinking is Key

- Models of Care, Payment and workflow
- visualization and task serialization example (not shown)
  - Using Microsoft Outlook more effectively

- Self-checkout at Grocery Store

- Elevators

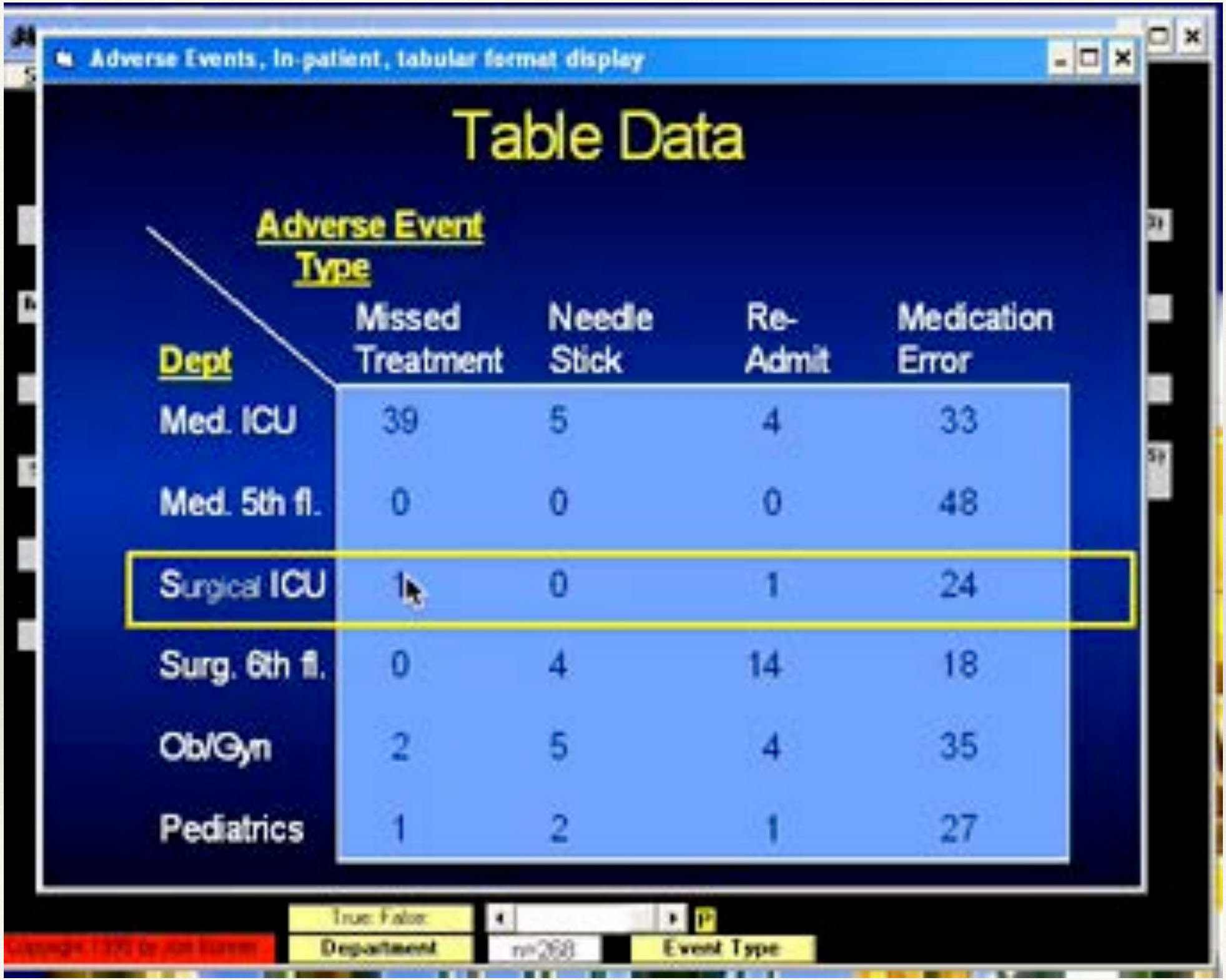
Key Contributors to Evidence Gaps

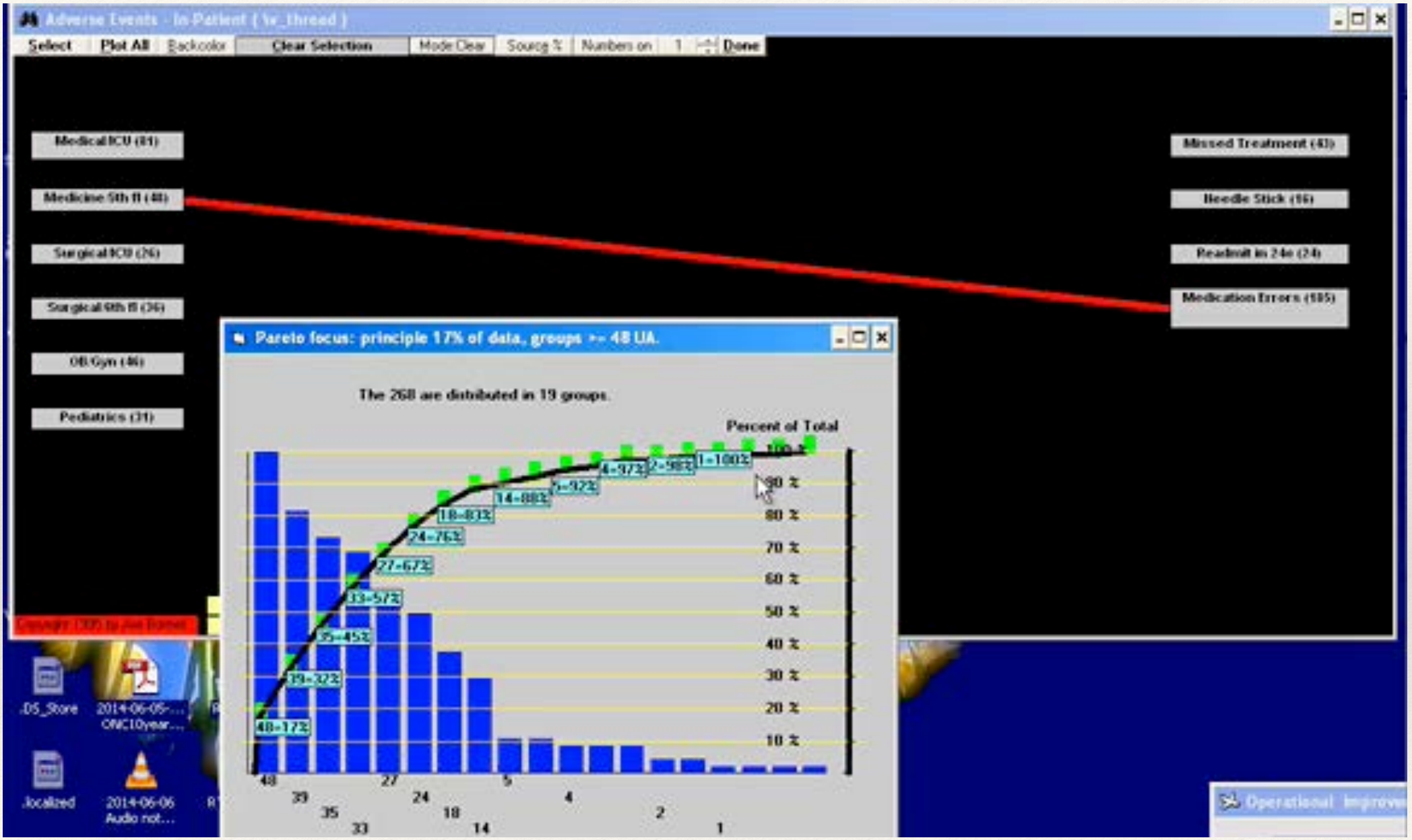


- **Differing age groups – elderly, pediatrics**
- **Race, ethnicity, gender variances**
- **Unstudied co-morbid conditions**
  Varying severity of disease
- **Differing concomitant medications**
- **Varying levels of compliance – i.e. < 80%**

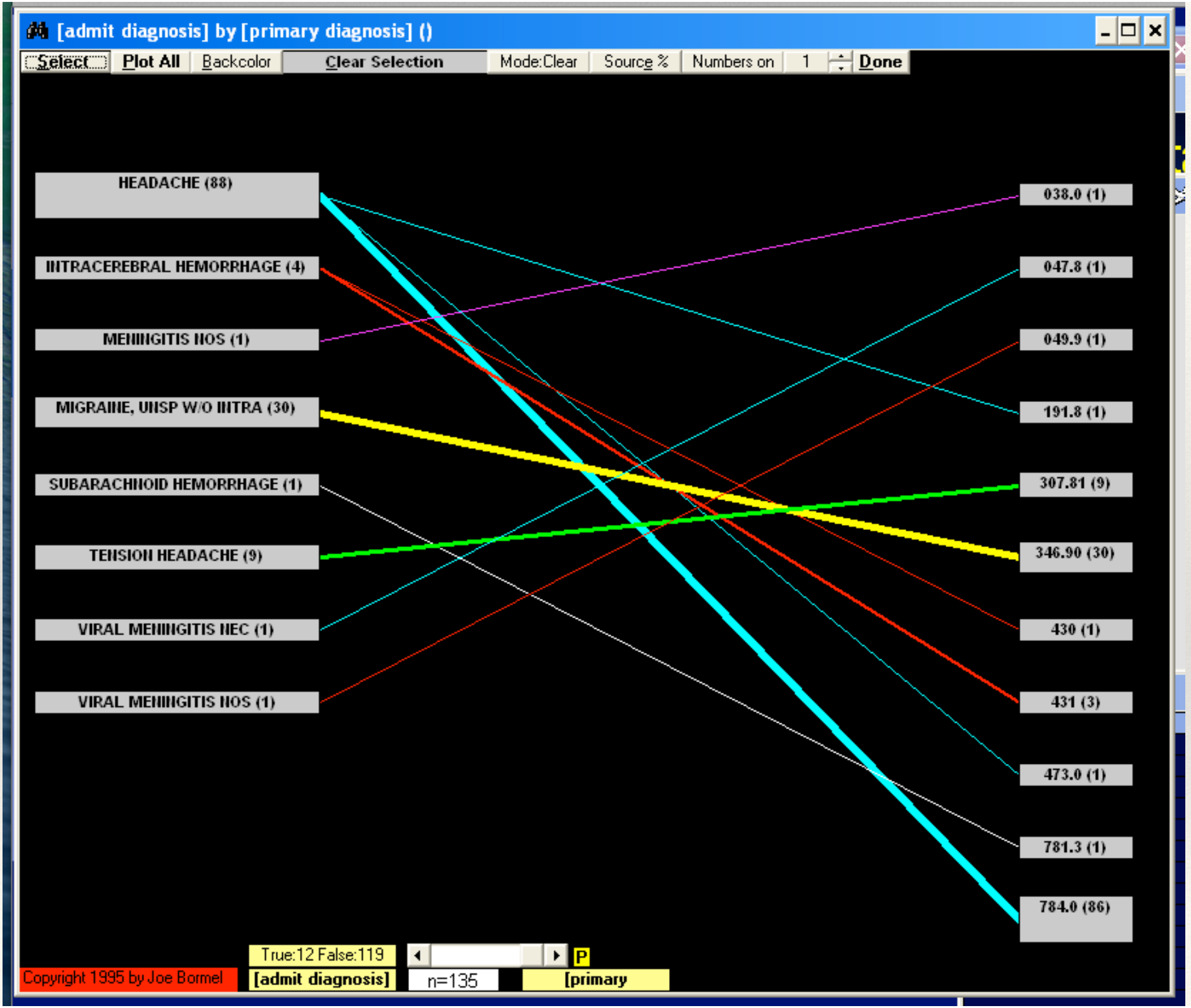
Company Confidential | For Internal Use Only | Do Not Copy

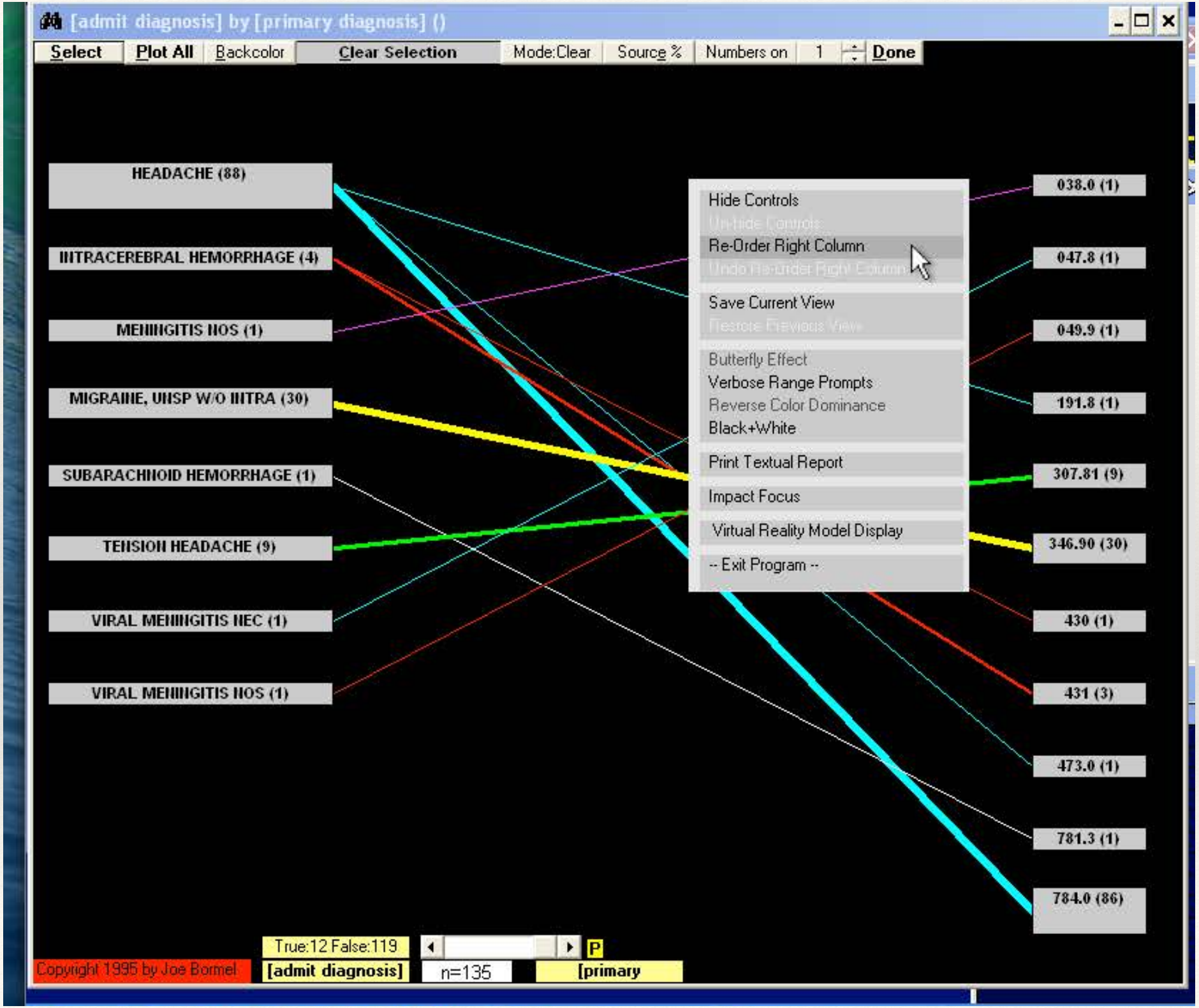
HealthCore


Adverse Events, In-patient, tabular format display
Table Data
Adverse Event Type
Dept
Missed Treatment
Needle Stick
Re-Admit
Medication Error
Med. ICU 39 5 4 33
Med. 5th fl. 0 0 0 48
Surgical ICU 1 0 1 24
Surg. 6th fl. 0 4 14 18
Ob/Gyn 2 5 4 35
Pediatrics 1 2 1 27
True: False
Department
Event Type


Adverse Events - In-Patient (\w_thread)
Select
Plot All
Backcolor
Clear Selection
Mode Clear
Source %
Numbers on
1
Done
Medical ICU (81)
Medicine 5th fl (48)
Surgical ICU (26)
Surgical 6th fl (36)
OB/Gyn (46)
Pediatrics (31)
Missed Treatment (43)
Needle Stick (16)
Readmit in 24h (24)
Medication Errors (185)
Pareto focus: principle 17% of data, groups >= 48 UA.
The 268 are distributed in 19 groups.
Percent of Total
48-17%
39-32%
35-45%
33-57%
27-67%
24-76%
18-83%
14-88%
5-92%
4-97%
2-98%
1-100%
90 %
80 %
70 %
60 %
50 %
40 %
30 %
20 %
10 %
48
39
35
33
27
24
18
14
5
4
2
1
.DS_Store
2014-06-05-...
ONC10year...
.localized
2014-06-06
Audio not...
Operational Improve

Disease Course From Study Entry to Exit
Select
Plot All
Backcolor
Clear Selection
Mode:Clear
Source %
Numbers on
1
Done
Rheumatoid Arth. (35)
Entry 2 (28)
Entry 3 (7)
Entry 4 (9)
Entry 5 (26)
Entry 6 (33)
Entry 7 (9)
Entry 8 (54)
Entry 9 (13)
Entry 10 (1)
Entry 11 (1)
Entry 12 (1)
Entry 13 (2)
Entry 14 (29)
Entry 15 (17)
Early UCTD/Arth (40)
Entry 17 (5)
Entry 18 (1)
Exit 1 (1)
Rheumatoid Arth. (30)
Exit 3 (1)
Exit 4 (30)
Exit 5 (3)
Exit 6 (2)
Exit 7 (17)
Exit 8 (1)
Exit 9 (38)
Exit 10 (1)
Exit 11 (33)
Exit 12 (1)
Exit 13 (4)
Exit 14 (2)
Exit 15 (1)
Exit 16 (1)
Exit 17 (3)
Exit 18 (19)
Exit 19 (13)
Exit 20 (1)
UCTD / Arth (20)
Exit 22 (1)
Remission (39)
Exit 24 (1)
Exit 25 (2)
22
85%
1
3%
1
3%
5
14%
True:34 False:2
EntryGrp
n=273
Exit Grp


[admit diagnosis] by [primary diagnosis] ()
Select
Plot All
Backcolor
Clear Selection
Mode:Clear
Source %
Numbers on
1
Done
HEADACHE (88)
INTRACEREBRAL HEMORRHAGE (4)
MENINGITIS NOS (1)
MIGRAINE, UNSP W/O INTRA (30)
SUBARACHNOID HEMORRHAGE (1)
TENSION HEADACHE (9)
VIRAL MENINGITIS NEC (1)
VIRAL MENINGITIS NOS (1)
038.0 (1)
047.8 (1)
049.9 (1)
191.8 (1)
307.81 (9)
346.90 (30)
430 (1)
431 (3)
473.0 (1)
781.3 (1)
784.0 (86)
True:12 False:119
P
Copyright 1995 by Joe Bormel
[admit diagnosis]
n=135
[primary


[admit diagnosis] by [primary diagnosis] ()
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Mode:Clear
Source %
Numbers on
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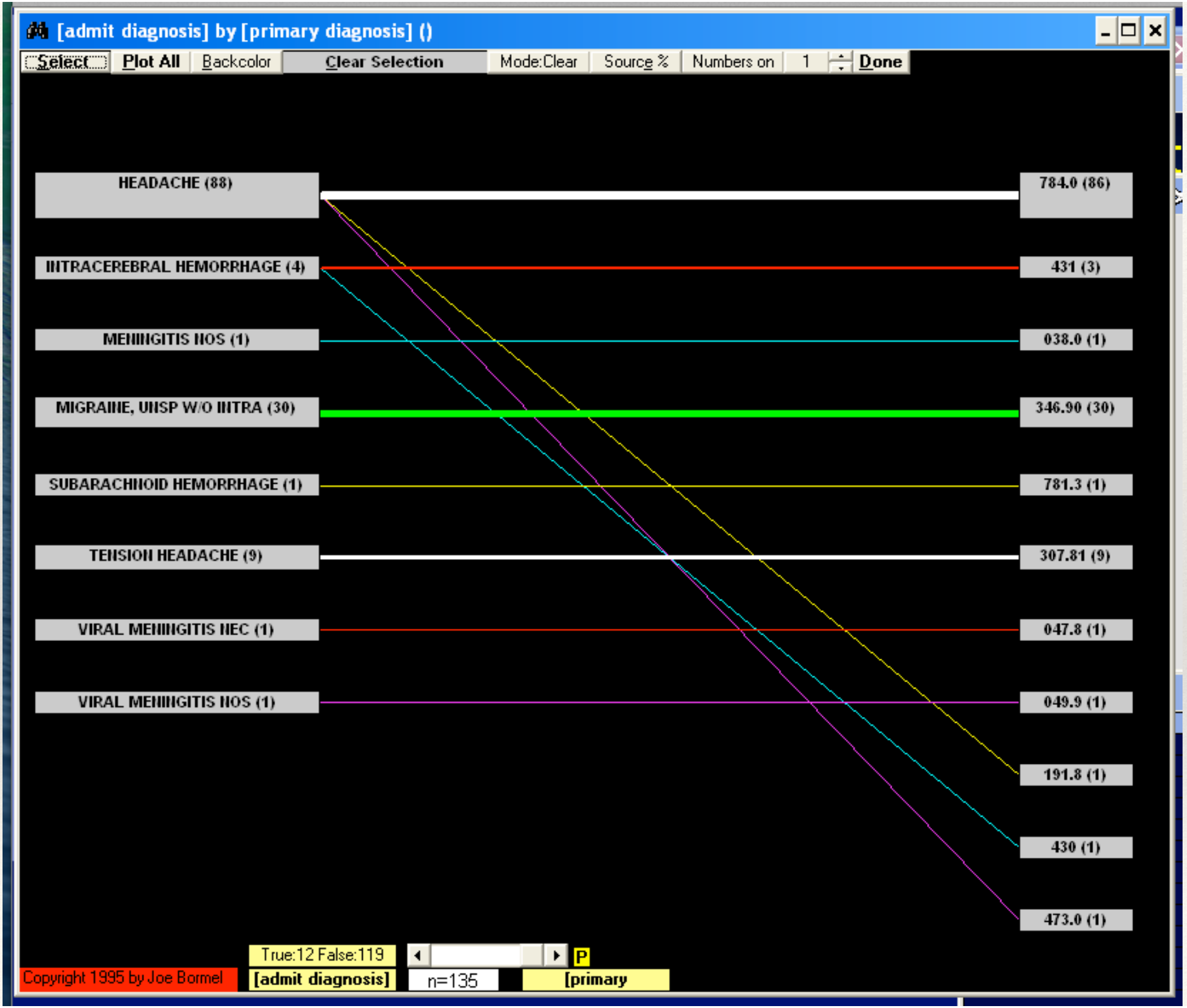
Done
HEADACHE (88)
INTRACEREBRAL HEMORRHAGE (4)
MENINGITIS NOS (1)
MIGRAINE, UNSP W/O INTRA (30)
SUBARACHNOID HEMORRHAGE (1)
TENSION HEADACHE (9)
VIRAL MENINGITIS NEC (1)
VIRAL MENINGITIS NOS (1)
Hide Controls
Un-hide Controls
Re-Order Right Column
Undo Re-order Right Column
Save Current View
Restore Previous View
Butterfly Effect
Verbose Range Prompts
Reverse Color Dominance
Black+White
Print Textual Report
Impact Focus
Virtual Reality Model Display
-- Exit Program --
038.0 (1)
047.8 (1)
049.9 (1)
191.8 (1)
307.81 (9)
346.90 (30)
430 (1)
431 (3)
473.0 (1)
781.3 (1)
784.0 (86)
True:12 False:119
P
Copyright 1995 by Joe Bormel
[admit diagnosis]
n=135
[primary


[admit diagnosis] by [primary diagnosis] ()
Select
Plot All
Backcolor
Clear Selection
Mode:Clear
Source %
Numbers on
1
Done
HEADACHE (88)
INTRACEREBRAL HEMORRHAGE (4)
MENINGITIS NOS (1)
MIGRAINE, UNSP W/O INTRA (30)
SUBARACHNOID HEMORRHAGE (1)
TENSION HEADACHE (9)
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784.0 (86)
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038.0 (1)
346.90 (30)
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307.81 (9)
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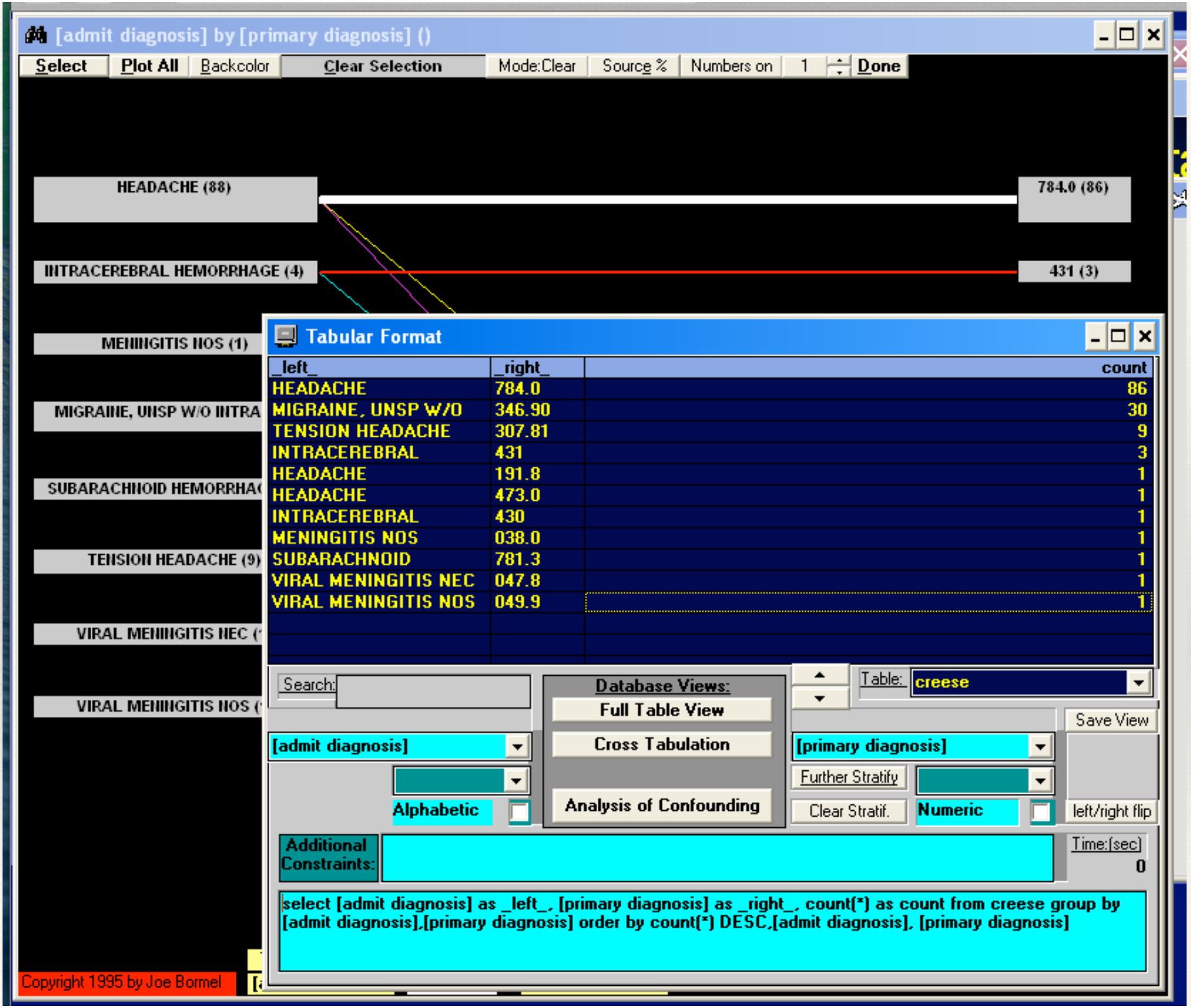
049.9 (1)
191.8 (1)
430 (1)
473.0 (1)
True:12 False:119
P
Copyright 1995 by Joe Bormel
[admit diagnosis]
n=135
[primary


[admit diagnosis] by [primary diagnosis] ()
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Clear Selection
Mode:Clear
Source %
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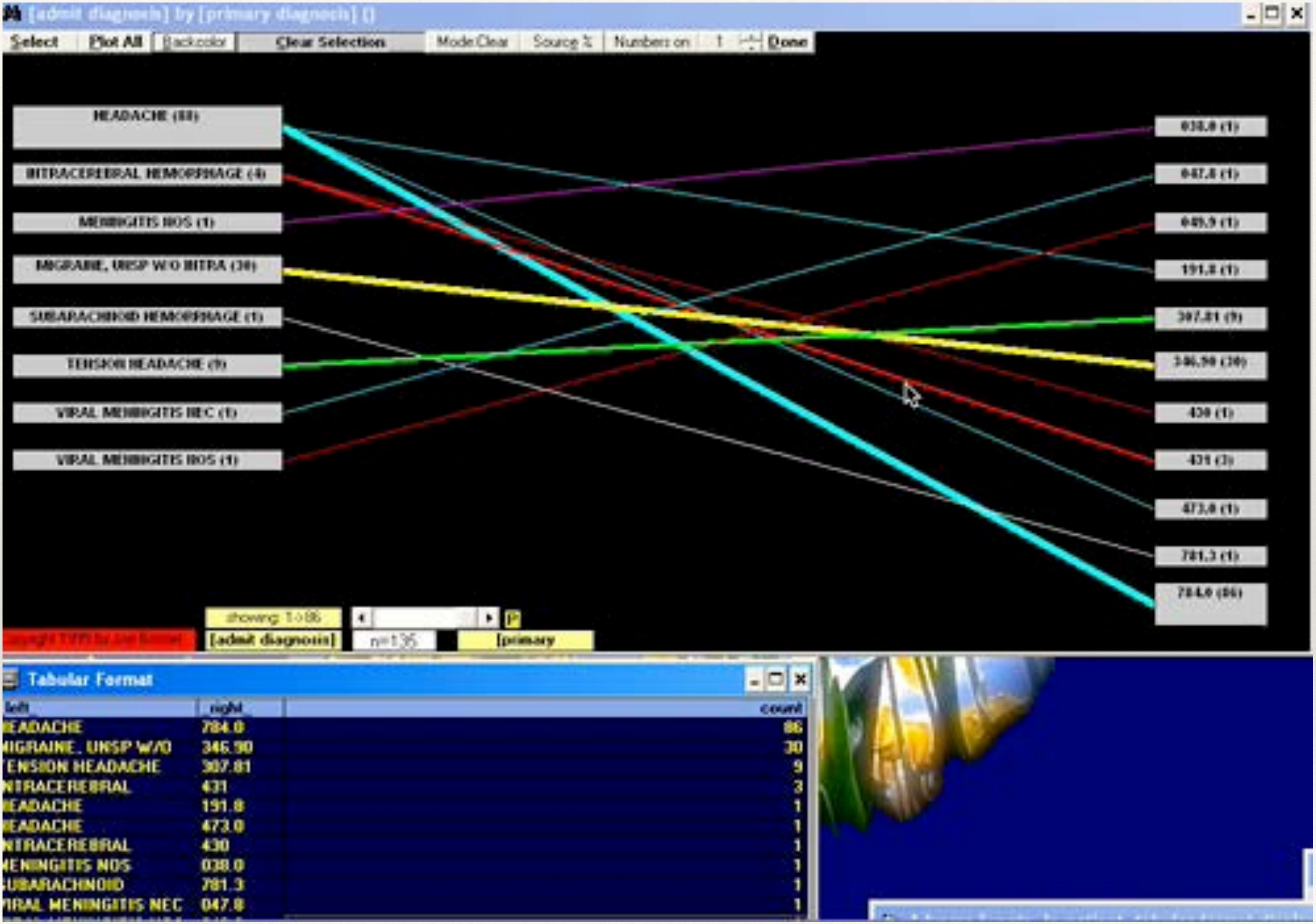
HEADACHE (88)
INTRACEREBRAL HEMORRHAGE (4)
MENINGITIS NOS (1)
MIGRAINE, UNSP W/O INTRA
SUBARACHNOID HEMORRHA
TENSION HEADACHE (9)
VIRAL MENINGITIS NEC
VIRAL MENINGITIS NOS
784.0 (86)
431 (3)
Tabular Format
left _right_ count
HEADACHE 784.0 86
MIGRAINE, UNSP W/O 346.90 30
TENSION HEADACHE 307.81 9
INTRACEREBRAL 431 3
HEADACHE 191.8 1
HEADACHE 473.0 1
INTRACEREBRAL 430 1
MENINGITIS NOS 038.0 1
SUBARACHNOID 781.3 1
VIRAL MENINGITIS NEC 047.8 1
VIRAL MENINGITIS NOS 049.9 1
Search:
Database Views:
Full Table View
Cross Tabulation
Analysis of Confounding
Table: creese
Save View
[admit diagnosis]
[primary diagnosis]
Further Stratify
Clear Stratif.
Alphabetic
Numeric
left/right flip
Additional Constraints:
Time:[sec]
0
select [admit diagnosis] as _left_, [primary diagnosis] as _right_, count(*) as count from creese group by [admit diagnosis],[primary diagnosis] order by count(*) DESC,[admit diagnosis], [primary diagnosis]
Copyright 1995 by Joe Bormel


[admit diagnosis] by [primary diagnosis] ()
Select
Plot All
Back color
Clear Selection
Mode Clear
Source %
Numbers on
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HEADACHE (88)
INTRACEREBRAL HEMORRHAGE (4)
MENINGITIS NOS (1)
MIGRAINE, UNSP W/O INTRA (30)
SUBARACHNOID HEMORRHAGE (1)
TENSION HEADACHE (9)
VIRAL MENINGITIS NEC (1)
VIRAL MENINGITIS NOS (1)
showing 1-86
[admit diagnosis]
n=135
[primary
Tabular Format
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right
count
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86
IGRAINE, UNSP W/O
346.90
30
ENSION HEADACHE
307.81
9
NTRACEREBRAL
431
3
EADACHE
191.8
1
EADACHE
473.0
1
NTRACEREBRAL
430
1
ENINGITIS NOS
038.0
1
UBARACHNOID
781.3
1
IRAL MENINGITIS NEC
047.8
1

3D Visualization of Health Data

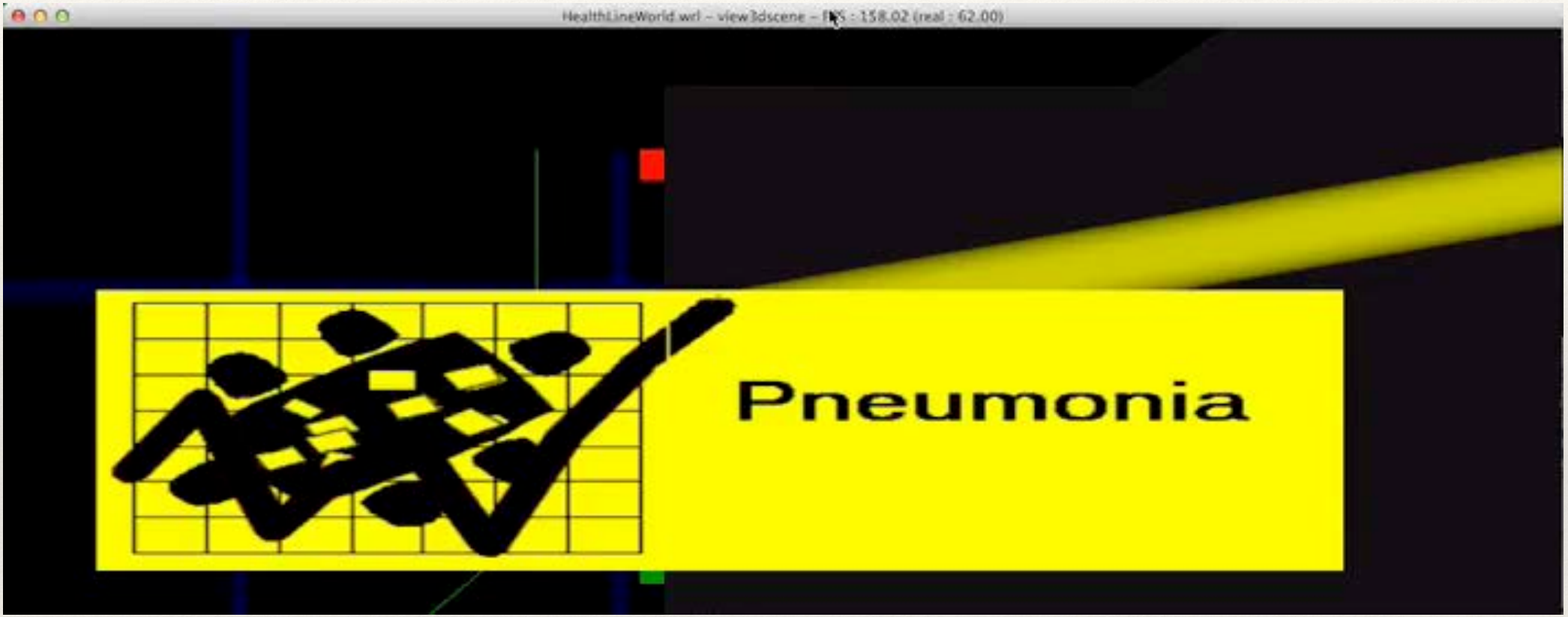
Successive, prioritized disclosure of clarified relationships

EDA, CFA, FCA

Clarified world where Time (x), Snapshot (y), and Synchronized Events (z) are brought together

Usability-Enhanced

Value-service offering incorporation (e.g. ETG, CAM, etc)


HealthLineWorld.wrl – view3dscene – FPS : 158.02 (real : 62.00)
Pneumonia

What creates or destroys Usability?

Reference Usability Model, RUM

Reference Usability Model
Sociotechnical Contexts of Usability

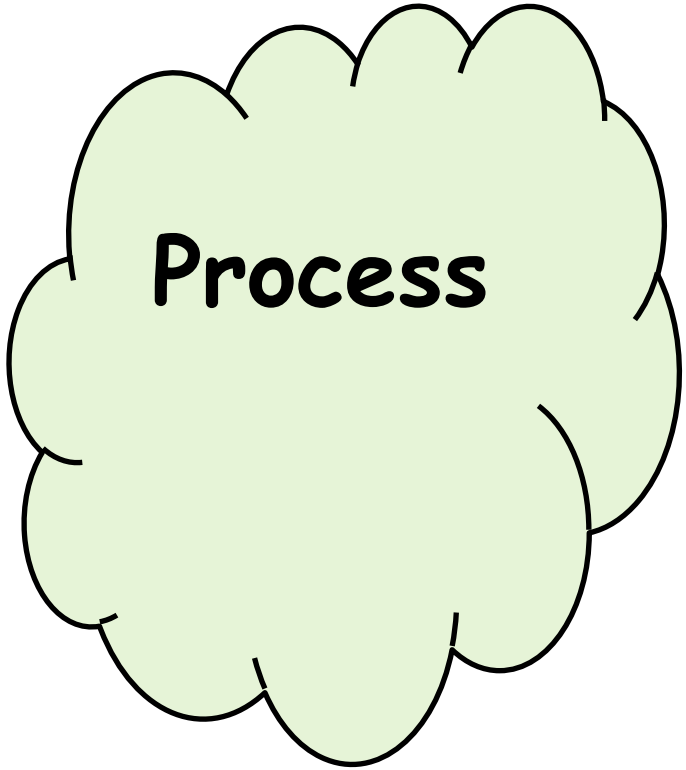
http://www.ricekrispies.com/snap-crackle-pop

Workplace

Modified from Thomas Tinstman and Mitch Galloway

Modified from Thomas Tinstman and Mitch Galloway

Modified from Thomas Tinstman and Mitch Galloway



Modified from Thomas Tinstman and Mitch Galloway

ONC HIT Certification Program

Test Results Summary for 2014 Edition EHR Certification

Allscripts Enterprise Electronic Health Record

Meaningful Use 2
User-Centered Design Report

NISTIR 7742

Customized Common Industry Format Template for Electronic Health Record Usability Testing

3 User-Centered Design Methods 6
3.1 Chapter §170.314(a)(1) Computerized Provider Order Entry (CPOE) 7
Computerized Provider Order Entry Criteria 7
UCD Process Employed 7
Reference 7
3.2 Chapter §170.314(a)(2) Drug-Drug, Drug-Allergy Interaction Checks - Interventions 8
Drug-Drug, Drug-Allergy Interaction Checks - Interventions 8
UCD Process Employed 8
Reference 9
3.3 Chapter §170.314(a)(6) Medication List 9
Medication List 9
UCD Process Employed 9
Reference 10
3.4 Chapter §170 314(a)(7) Medication Allergy List 10
Medication Allergy List 10
UCD Process Employed 10
Reference 11
3.5 Chapter §170.314(a)(8) Clinical Decision Support (CDS) 11
Clinical Decision Support (CDS) 11

Source: Amy Franklin, PhD

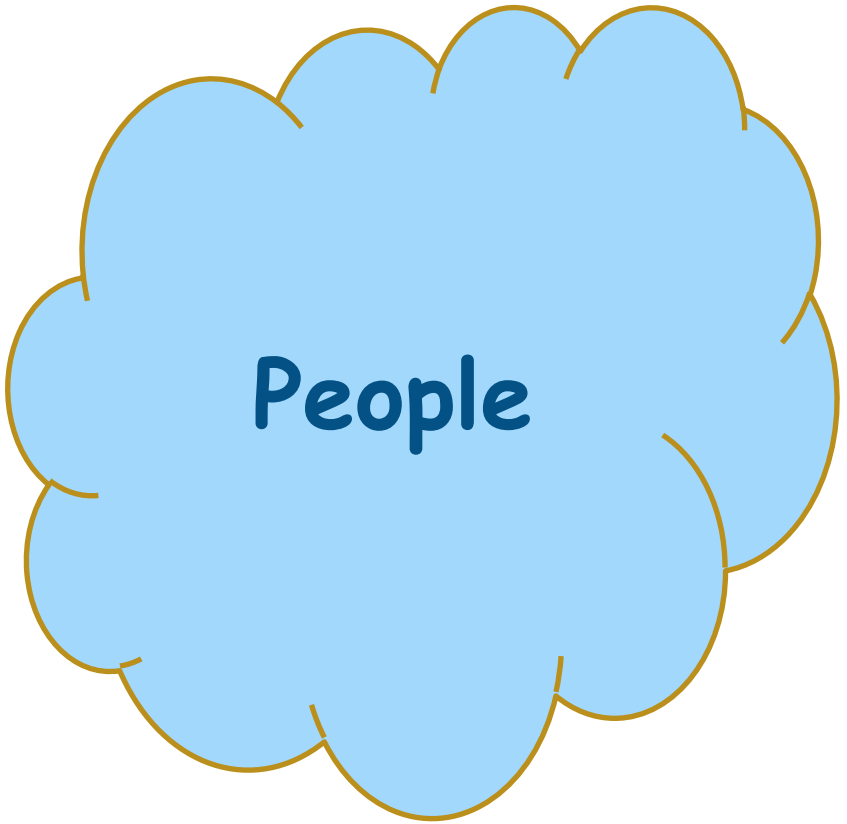
http://www.uthouston.edu/sbmi/faculty-and-staff/amy-franklin.htm

Table 9. Usability Test Results for Each Subtask in the Medication List Task.

Measure / Subtask	N that Attempted Task	Task Success				Task Time (sec)	Click Path Notes: Areas Impacting Efficiency
	#	% Pass	% Pass with Help	% Fail	% Pass + Pass with Help	Mean (SD) n Contributing to Mean	
Change an existing medication	19	95%	0%	5%	95%	Time reflects all tasks B-G of Scenario 1. 433.8 (215.2) 13	Choose a font size that optimizes readability.
Record medication from another doctor	18	89%	11%	0%	100%	Time reflects all tasks A-F of Scenario 4. 350.0 (111.0) 12	
Renew previous prescription	18	100%	0%	0%	100%		
Review previous medications	18	100%	0%	0%	100%		

Reference Usability Model

Sociotechnical Contexts of Usability



Morphine

- HIT, safety, efficiency, and opposites

RUM

- Ingredients of usability

Magic

- How we make HIT much better

Modified from Thomas Tinstman and Mitch Galloway

RUM – Reference Usability Model

Modified from Thomas Tinstman and Mitch Galloway

Thank You

Morphine, Magic and RUM

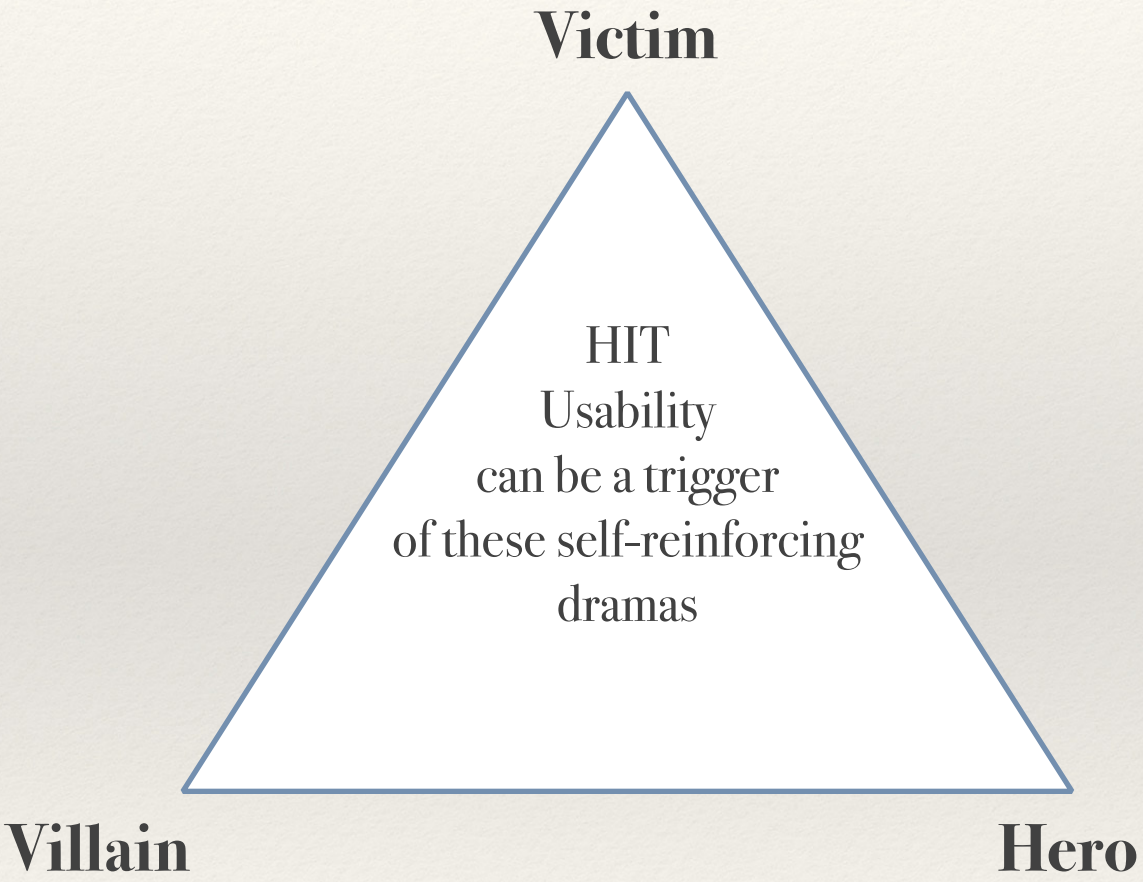
Keys to improving healthcare data use to achieve the triple aim

Joe Bormel, MD, MPH

jbormel@gmail.com

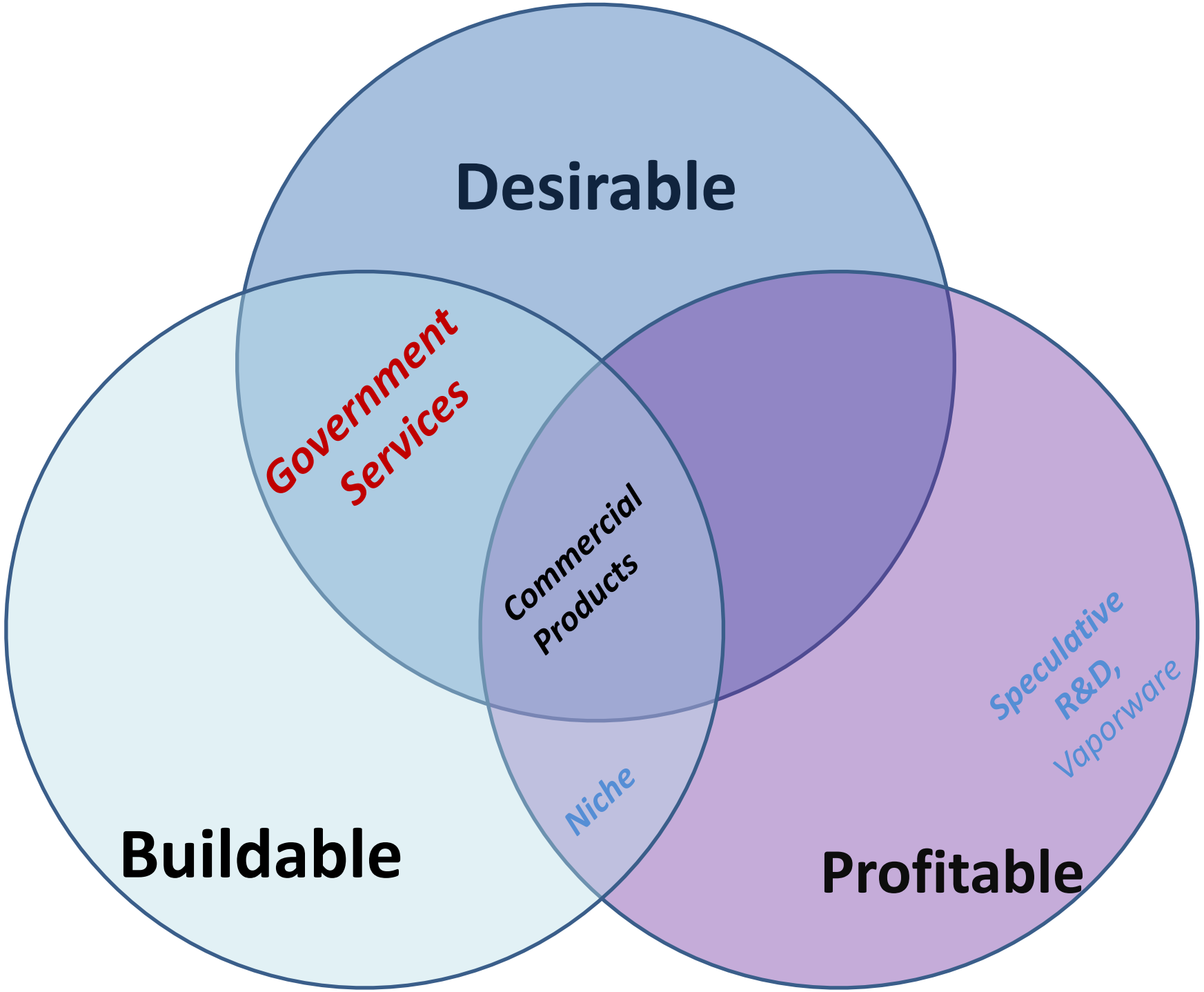
June 18, 2014

Resentment Triangle



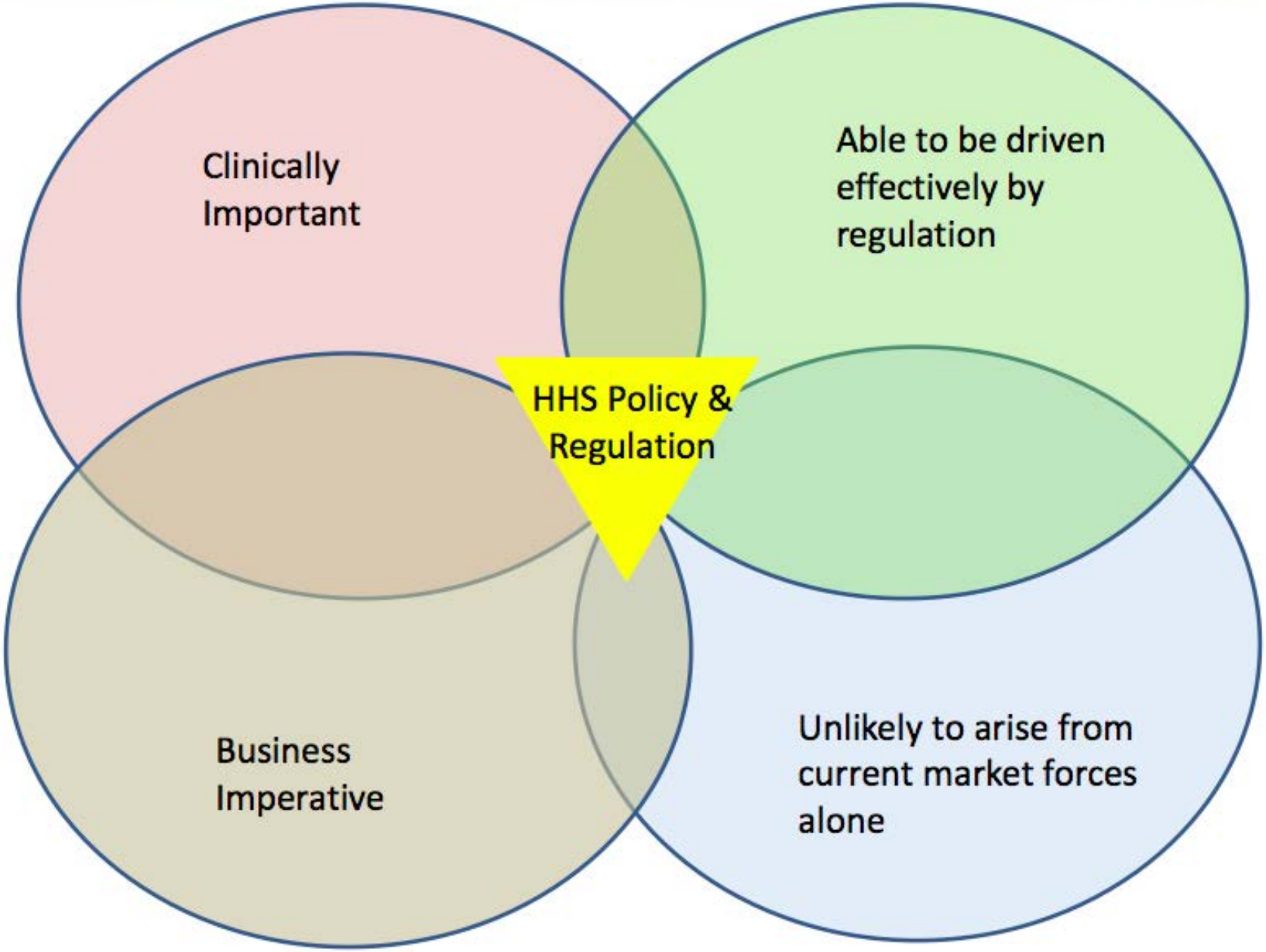
Across industries, usability is often a work-in-progress.

Legitimate trade-offs means that usability improvements may require years longer than we expect.


Desirable
Buildable
Profitable
Government Services
Commercial Products
Niche
Speculative R&D,
Vaporware

Optimum Strategic Position for ONC to Leverage its Regulatory Authority for Change

Health IT Policy Committee
A Public Advisory Body on Health Information Technology to the National Coordinator for Health IT

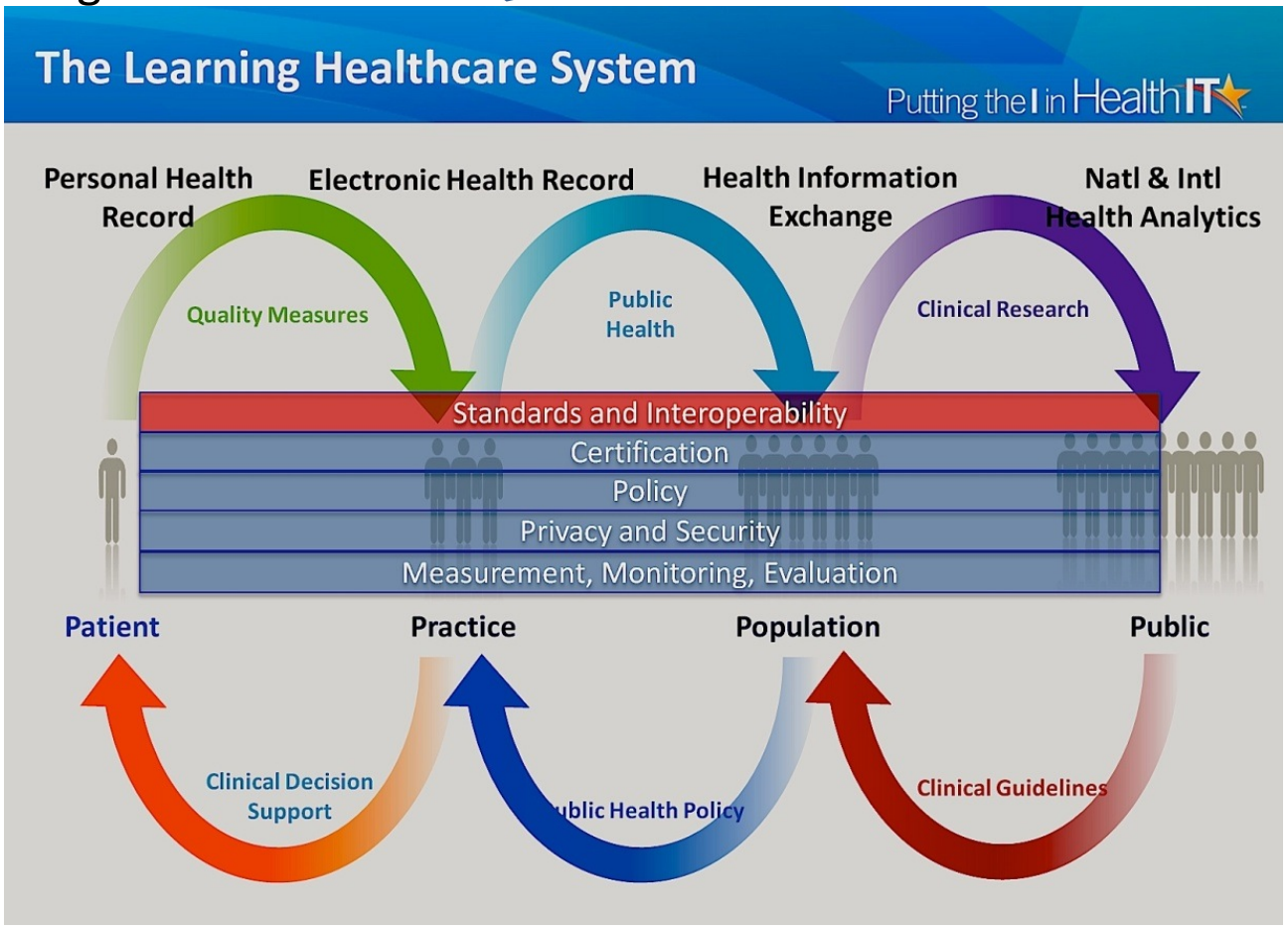


Knowledge and the Learning Health System

Standardized Knowledge

Table 1: Standard PCA Parameters for Opioid Naïve Adult Patients

Standard PCA Parameters for Opioid Naïve Adult Patients			
	morphine	HYDROmorphone	fentaNYL
1x (single strength)	1mg/ml	0.2 mg/ml (200 mcg/ml)	10 mcg/ml
Loading Bolus	2 mg	0.4 mg (400 mcg)	20 mcg
Clinician Bolus	2 mg	0.4 mg (400 mcg)	20 mcg
Number of Clinician Boluses Per Hour	1	1	1
PCA Dose	1 mg	0.2 mg (200 mcg)	10 mcg
Lockout	10 minutes	10 minutes	10 minutes
Total Drug Over Time	Optional	Optional	Optional
Max Number of Patient Demand Doses Per Hour	Optional	Optional	Optional
Basal	Not recommended for starting PCA		



Validated & Improved Knowledge

Morphine, Rum and Magic

Standardized Knowledge

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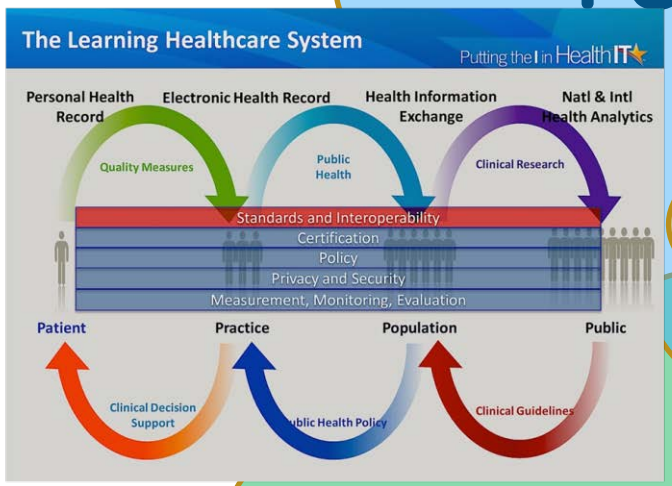
Clinician Bolus	2 mg	0.4 mg (400 mcg)	20 mcg
Number of Clinician Boluses Per Hour	1	1	1
PCA Dose	1 mg	0.2 mg (200 mcg)	10 mcg
Lockout	10 minutes	10 minutes	10 minutes
Total Drug Over Time	Optional	Optional	Optional
Max Number of Patient Demand Doses Per Hour	Optional	Optional	Optional
Basal	Not recommended for starting PCA		



Improved & Validated Knowledge

People

Process

Skills

Tools

Workplace

Models Of Usability

SUBJECTIVE / QUALITATIVE
Focused on
Experiences
(People, Activities, Context)
Meaningful
Has personal significance
Pleasurable
Memorable experience worth sharing
Convenient
Super easy to use, works like I think
Usable
Can be used without difficulty
Reliable
Is available and accurate
Functional (Useful)
Works as programmed
Focused on
Tasks
(Products, Features)
OBJECTIVE / QUANTIFIABLE

Key to Improving Usability
Example: Medication Reconciliation

- Start with definition: '… specific user, specific task, specific context, specific expected result…'
  - write down a narrow definition of that user, task and context, e.g. triage nurse, triage, presentation to ED, completion or documented classification
- Homework first: If someone else has figured out "what is wanted, needed, and possible," start with that {artifact: elaboration of options}
  - e.g. Vickie Kamataris' Novaces video
- Homework second: Locally and visibly survey "what people say they do, think they do, and actually do" {artifact: incubate and commit to who will make the decision, be informed, motivators in play, linkage to people/org structure and processes}
  - e.g. present back to any interested audience what the local local volumes and results of that survey. (Current State)
- Homework turned in:
  - e.g. accountable person reports to accountable sponsor the current state and planned dashboard, update frequency, and committed actions, including resilience and key process changes (e.g. complex med profile designation)

Key Process Improvements

Criteria for Complex Medication Profile designation:

1. High-risk Medications: Anticoagulants (Coumadin, Heparin), Insulin, Digoxin
2. Greater than 10 home meds
3. Medication list unknown at admission
4. Patients with diminished LOC
5. Patients with End Organ Failure (CHF, ESRD)

Patients who meet the criteria for Complex Med Profile are assessed and monitored by a Medication Reconciliation Specialist. The Med Rec Specialist is a specially trained RN or Pharmacy Technician.

One Form - the Medication Reconciliation form and functionality within the EMR and other software applications was updated and integrated to simplify and reduce duplicative documentation and to meet the CTQs of end users (physicians and nurses).

The Discharge Med Lists of patients who meet the criteria for Complex Med Profile are reviewed by a Discharge Pharmacist ***prior*** to discharge..

Providers utilize the hospitalist approach to Med Rec: assume you ***don't*** know!

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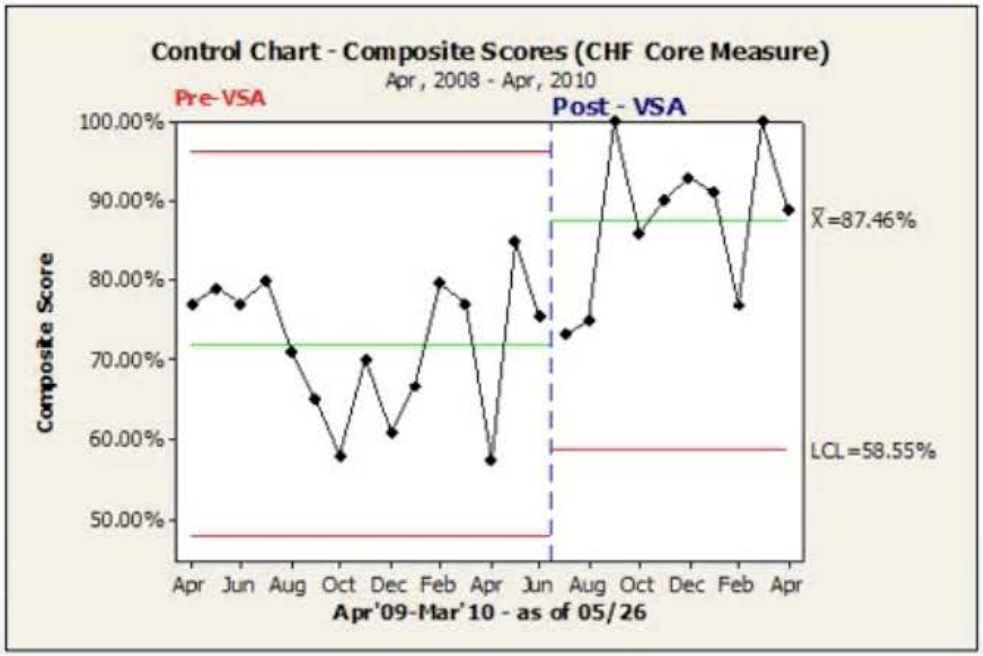
The Problem

- Mediation errors are the leading cause of injury to hospitalized patients
- Med Rec is linked to ADEs and poor clinical outcomes
- Readmission rate = 15.4%
- 30-60 minutes of re-work per admission to correct Med Rec discrepancies
- 46% of medication errors occur at admission and discharge
- In a sample of CHF Core Measure HF1d failures (n=68; June 2009), 29.1% were due to Medication Reconciliation discrepancies. Since April of 2008, 100% of CHF Core Measure failures had been due to Medication Reconciliation errors.



The ProcessVSA had identified and eliminated waste and managed constraints in the CHF Discharge Process. *Impressive Results!*

…But still not good enough.

The Six Sigma methodology and toolset was needed to reduce variation and to identify and eliminate the root cause of defects.

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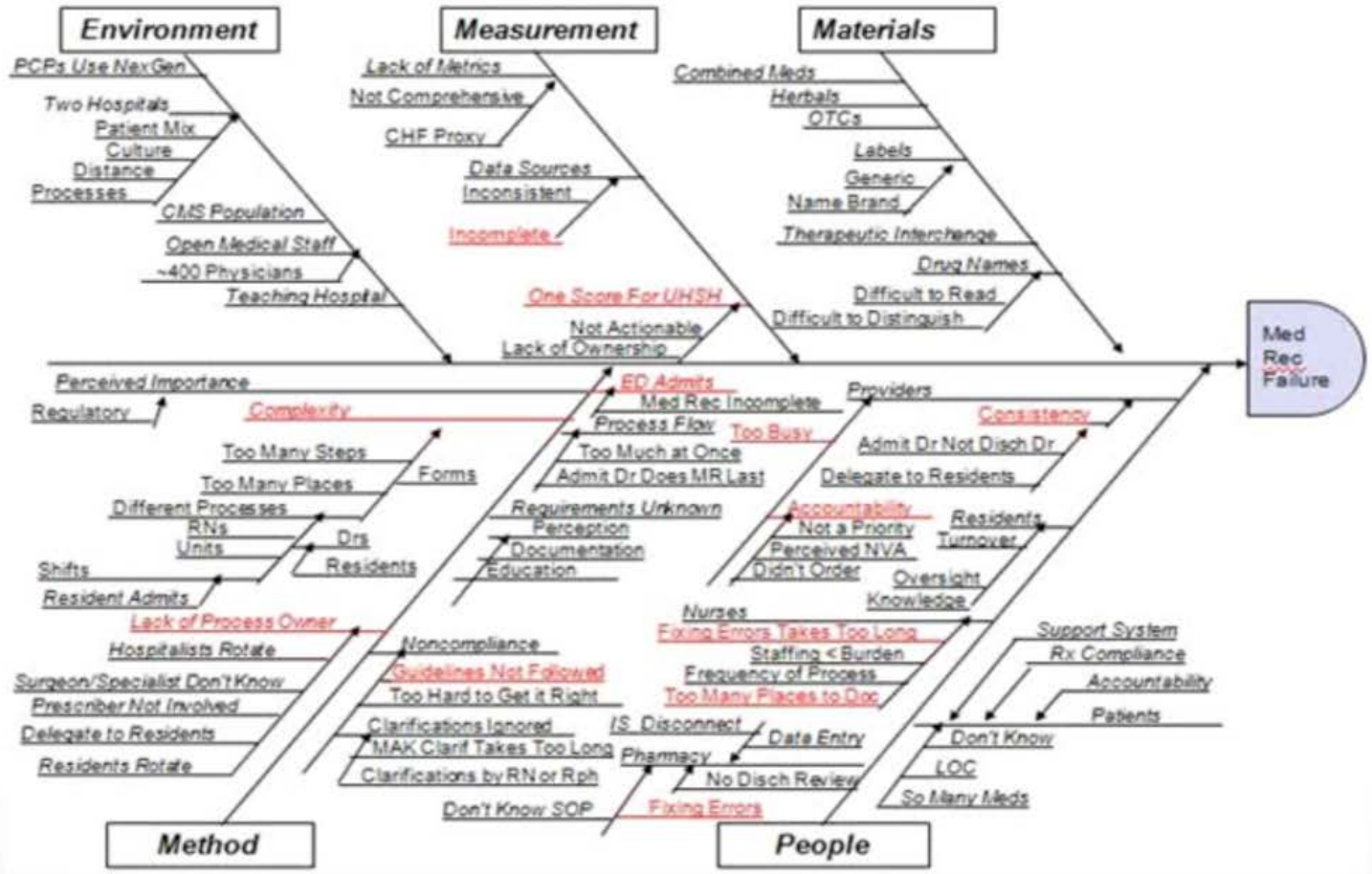
Medication Reconciliation: Measure

An Ishikawa or Fishbone Diagram was used to brainstorm and capture potential causes of Medication reconciliation discrepancies:



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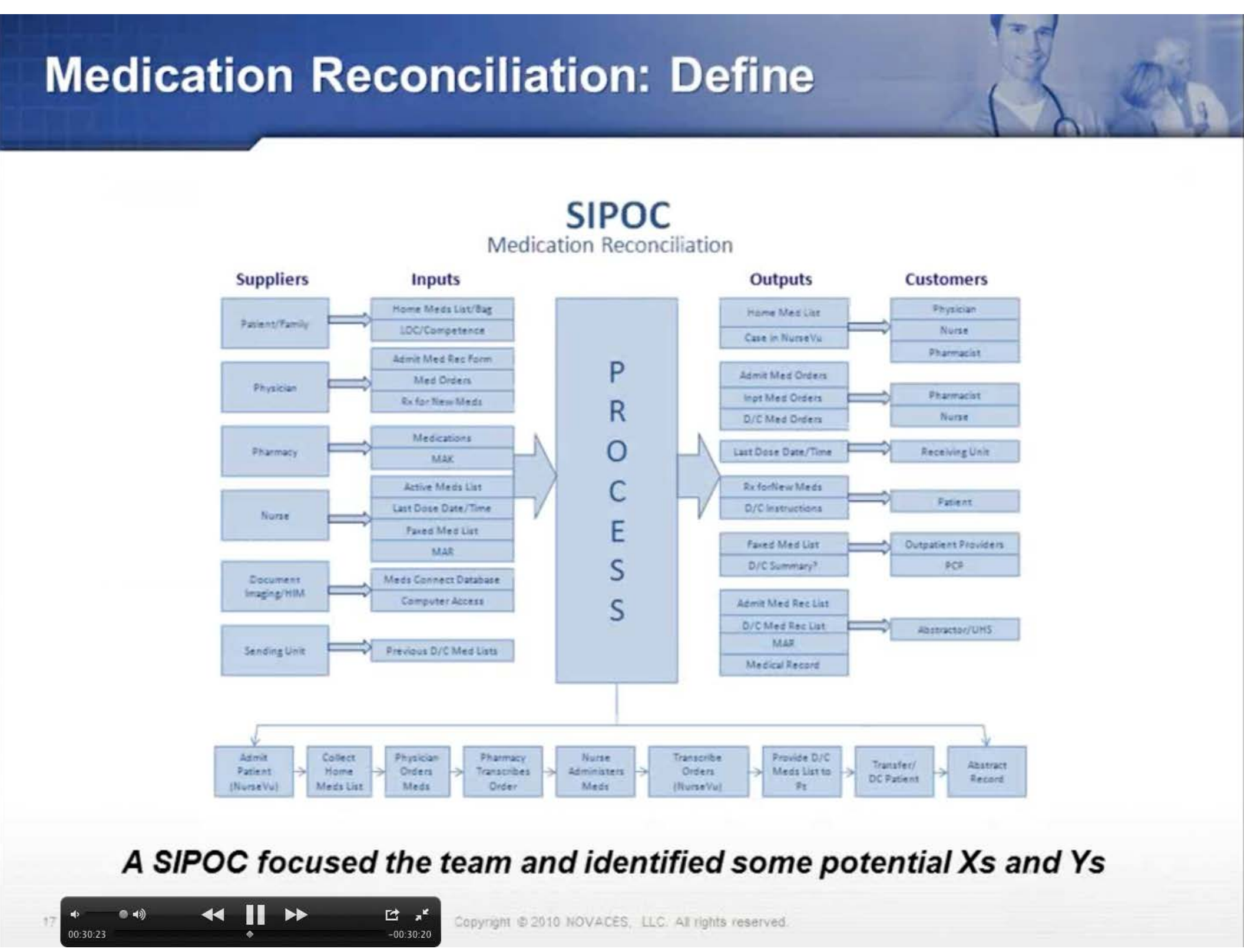
Medication Reconciliation: Define



A SIPOC focused the team and identified some potential Xs and Ys

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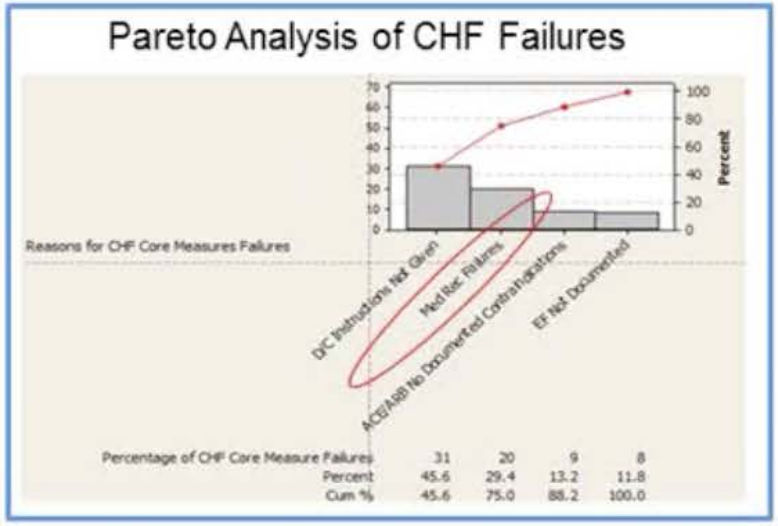
From Parking Lot to Front and Center

Inaugural Lean Events:

#1: CHF Discharge
#2: Patient Transfer
#3: ED Critical Labs
#4: Patient Holds

- For *three out of four* inaugural events, Medication Reconciliation was identified as a significant factor

- Because the opportunity is *defects* and because the scope of the problem is LARGE, Med Rec was relegated to the Parking Lot



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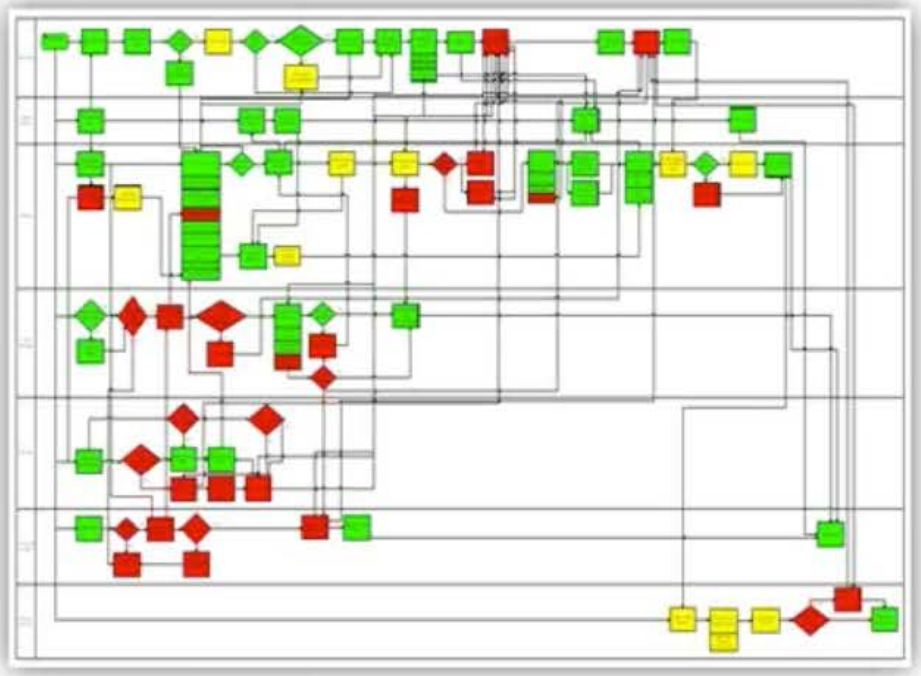
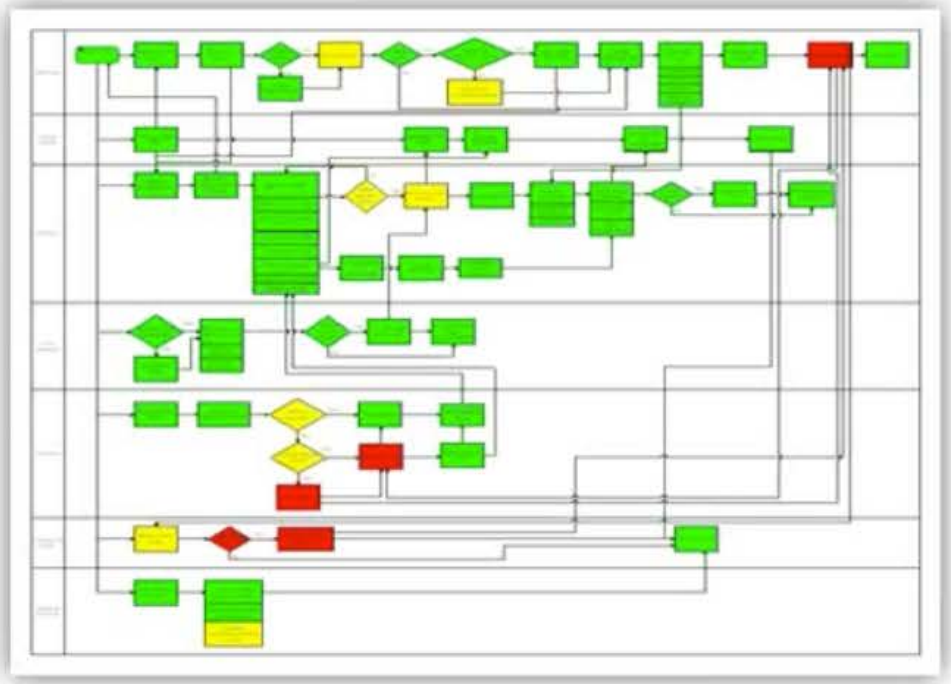
Lean Improvements

Current State



Future State



Total Steps	=	*99*
NVA Steps	=	*30*
Handoffs	=	*36*

Total Steps	=	*69*
NVA Steps	=	*5*
Handoffs	=	*21*

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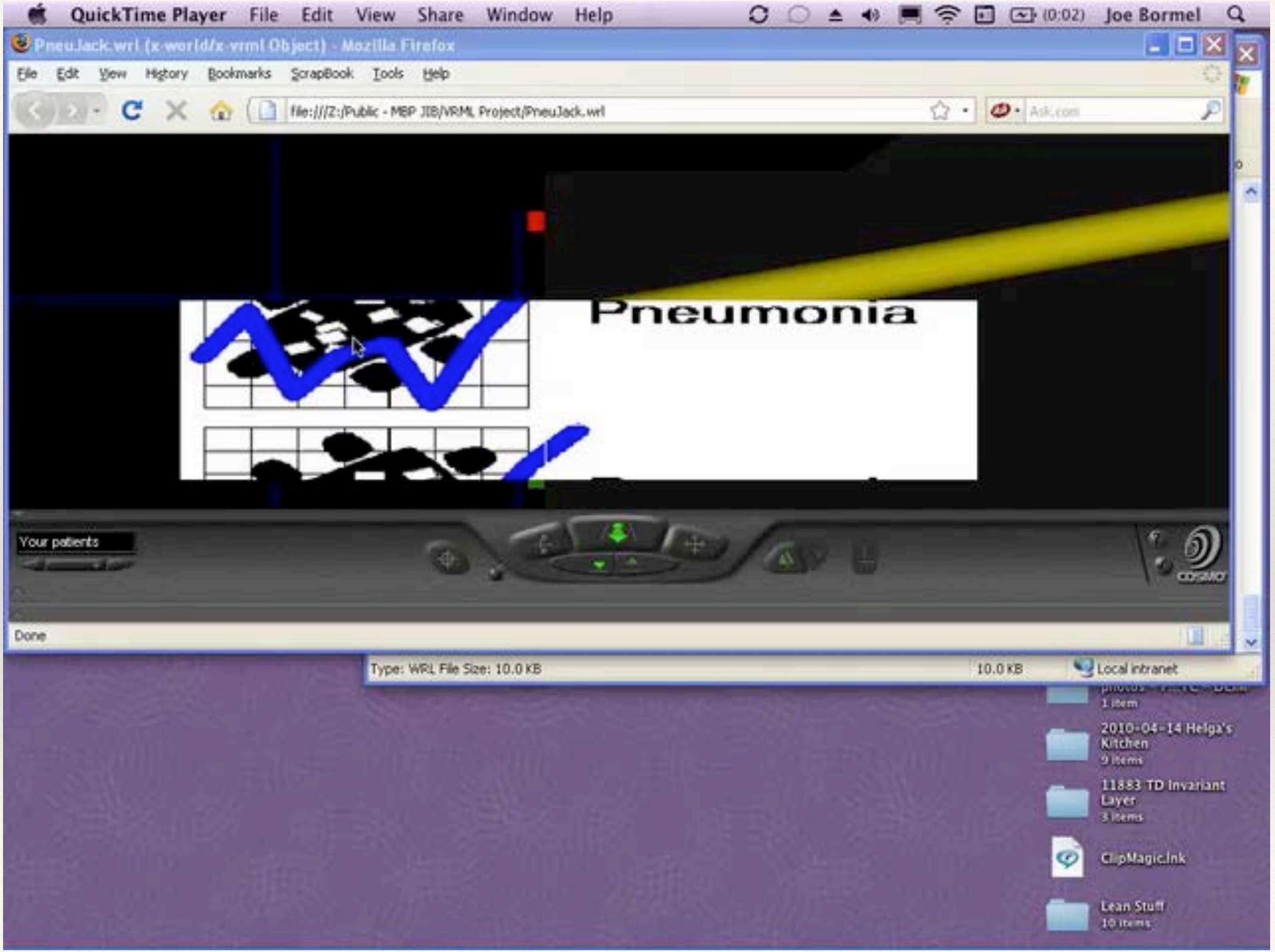
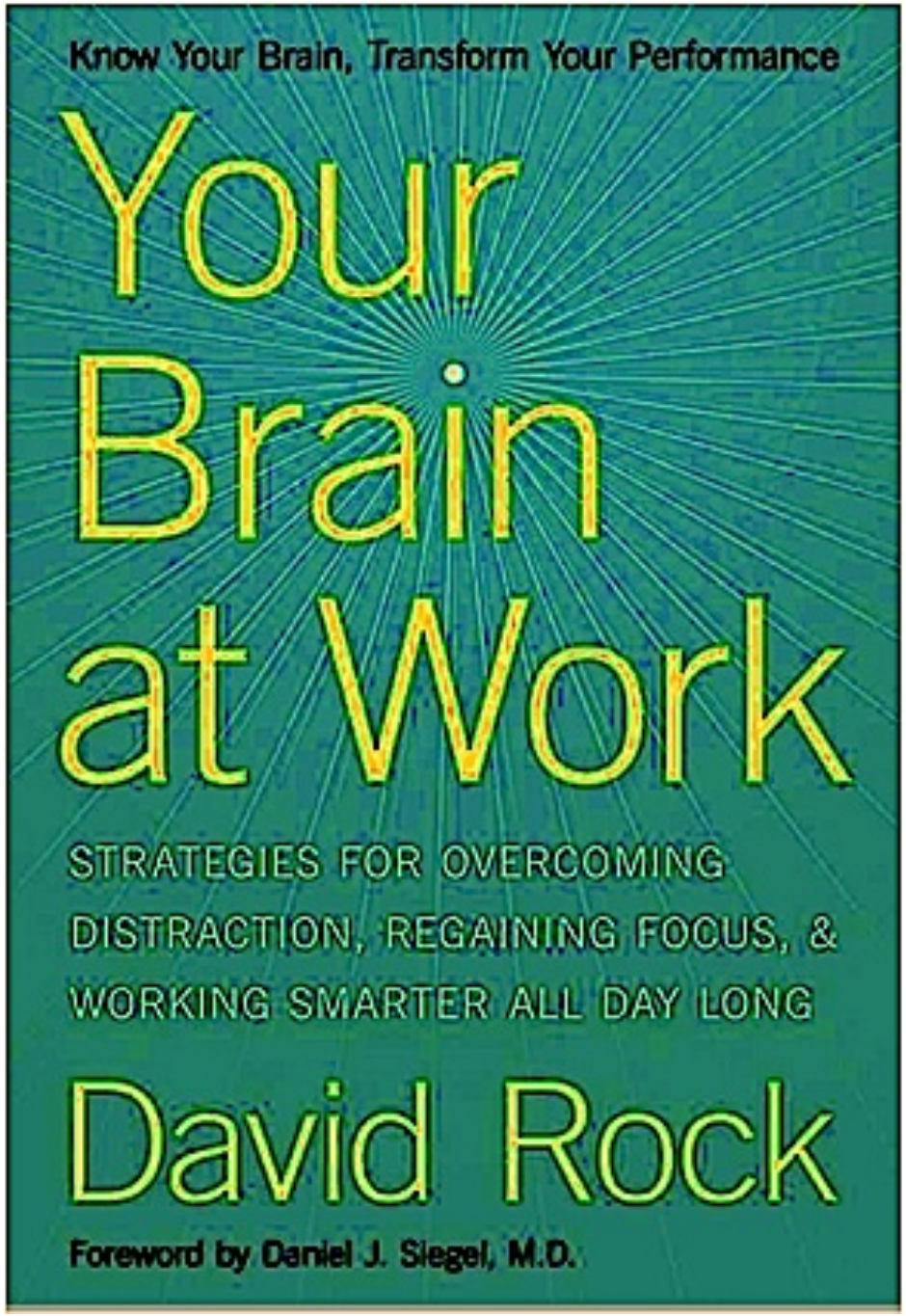
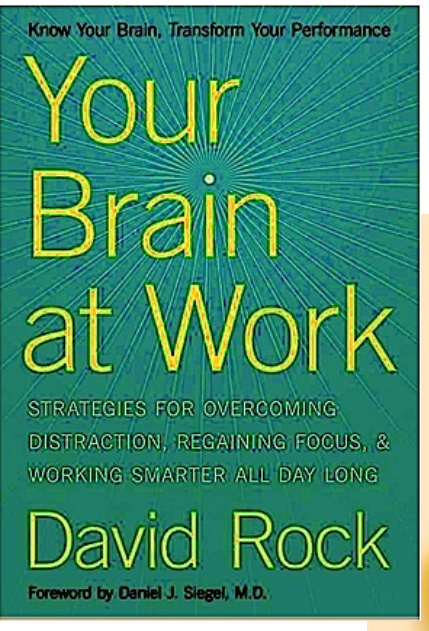
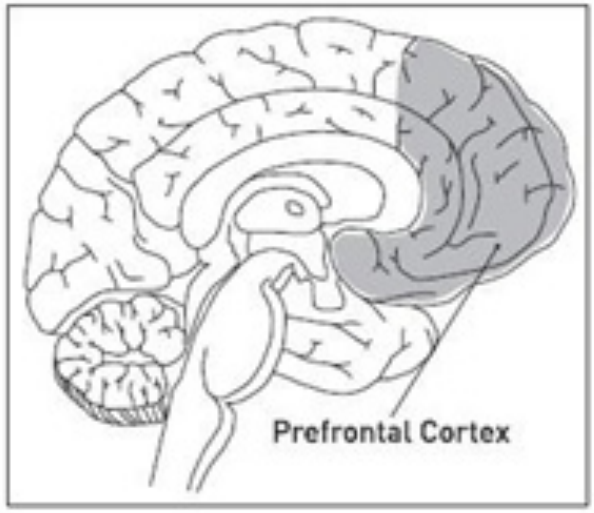

QuickTime Player File Edit View Share Window Help (0:02) Joe Bormel
PneuJack.wrl (x-world/x-vrml Object) - Mozilla Firefox
File Edit View History Bookmarks ScrapBook Tools Help
file:///Z:/Public - MBP JIB/VRML Project/PneuJack.wrl
Pneumonia
Your patients
Done
Type: WRL File Size: 10.0 KB
10.0 KB
Local intranet
1 item
2010-04-14 Helga's Kitchen
9 items
11883 TD Invariant Layer
3 items
ClipMagic.lnk
Lean Stuff
10 items

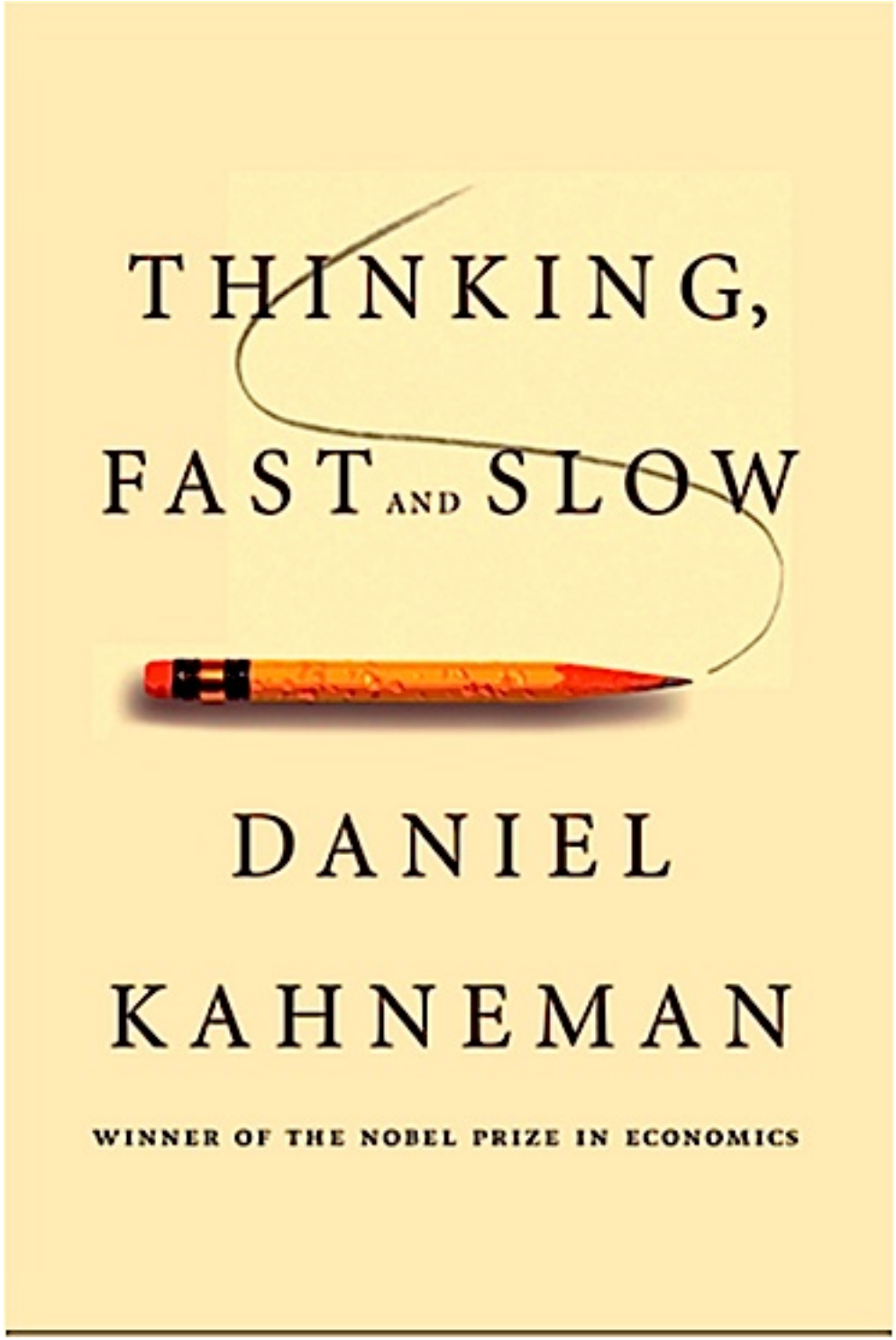

Know Your Brain, Transform Your Performance
Your Brain at Work
STRATEGIES FOR OVERCOMING DISTRACTION, REGAINING FOCUS, & WORKING SMARTER ALL DAY LONG
David Rock
Foreword by Daniel J. Siegel, M.D.

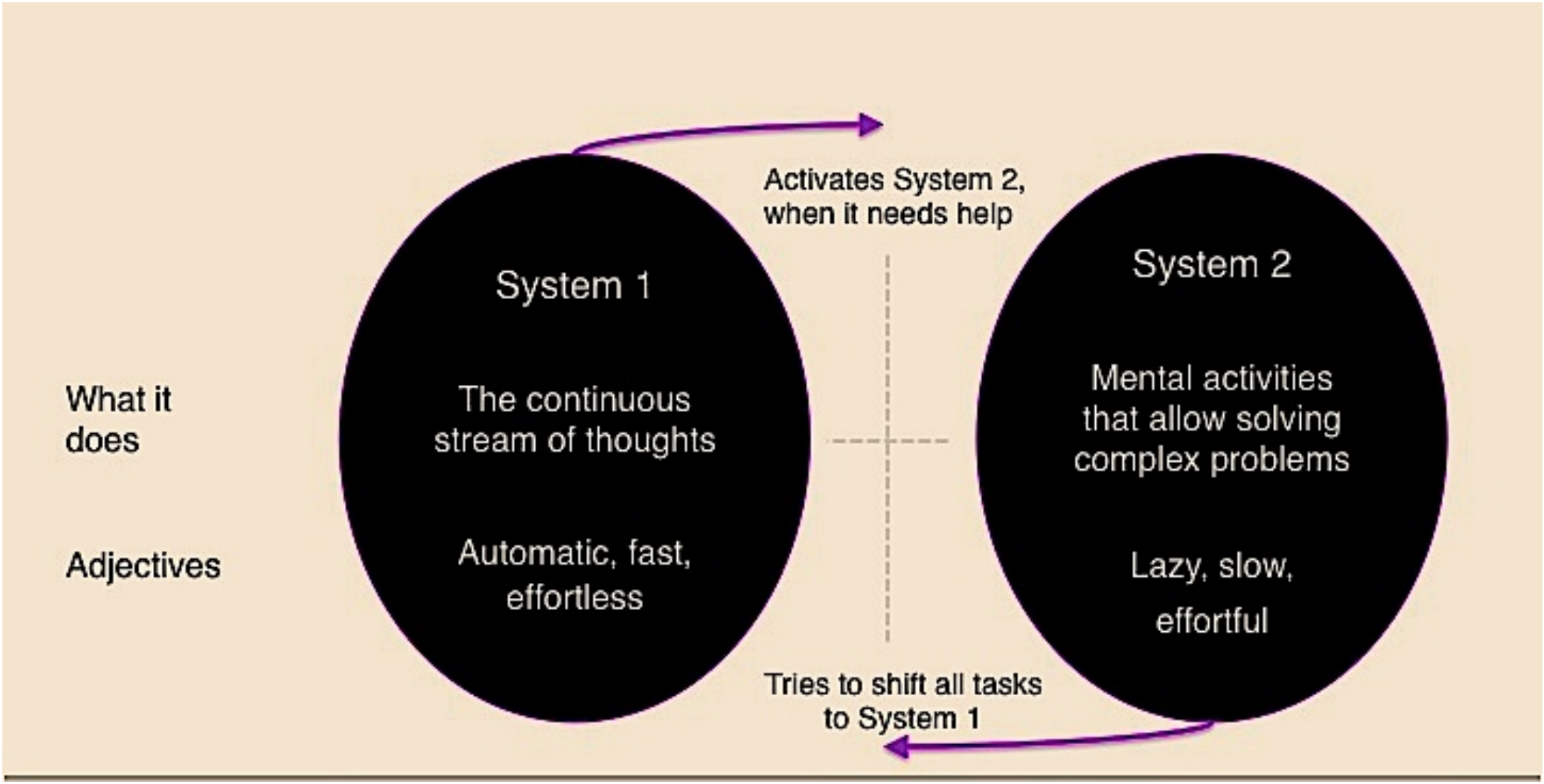


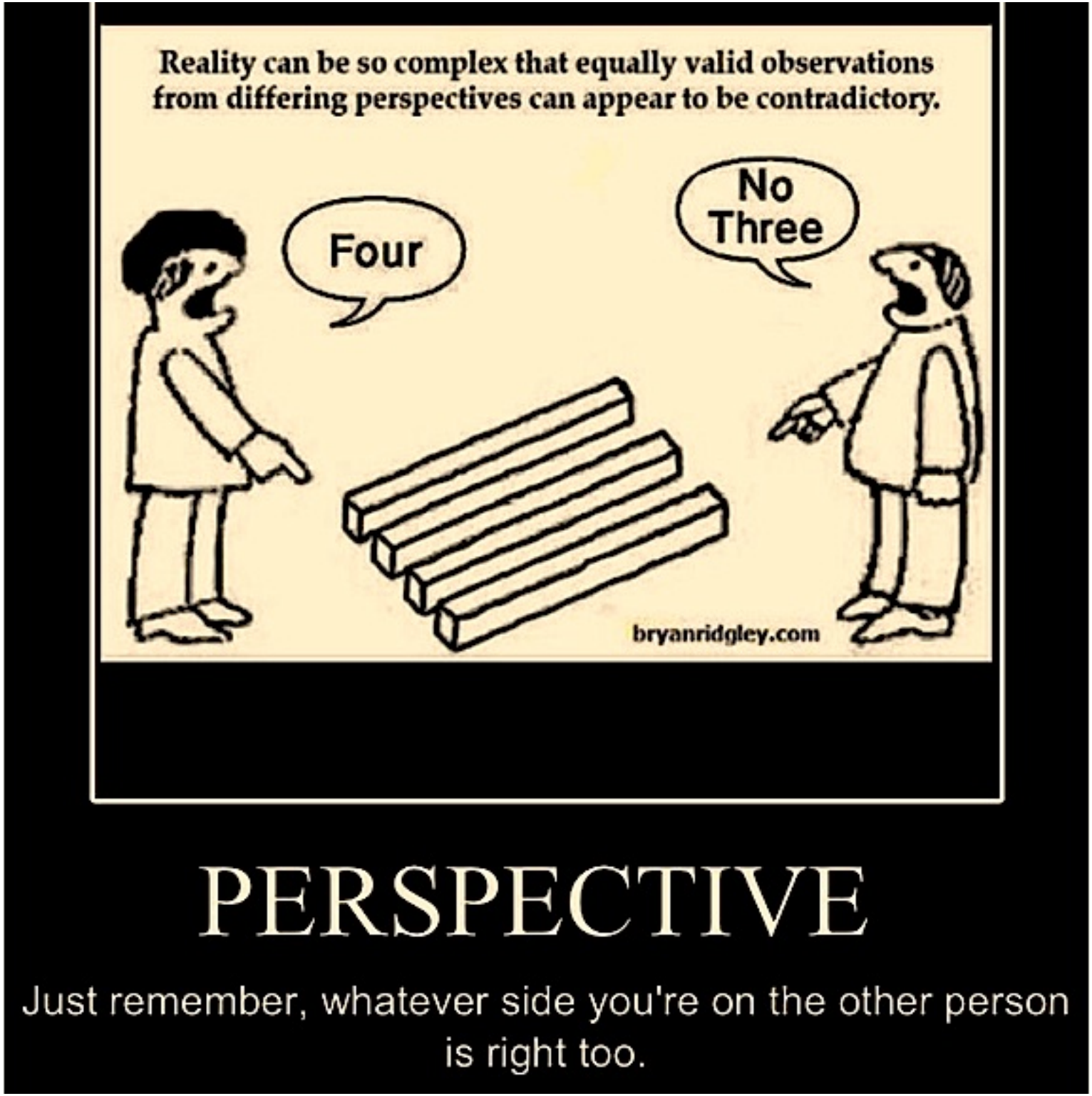


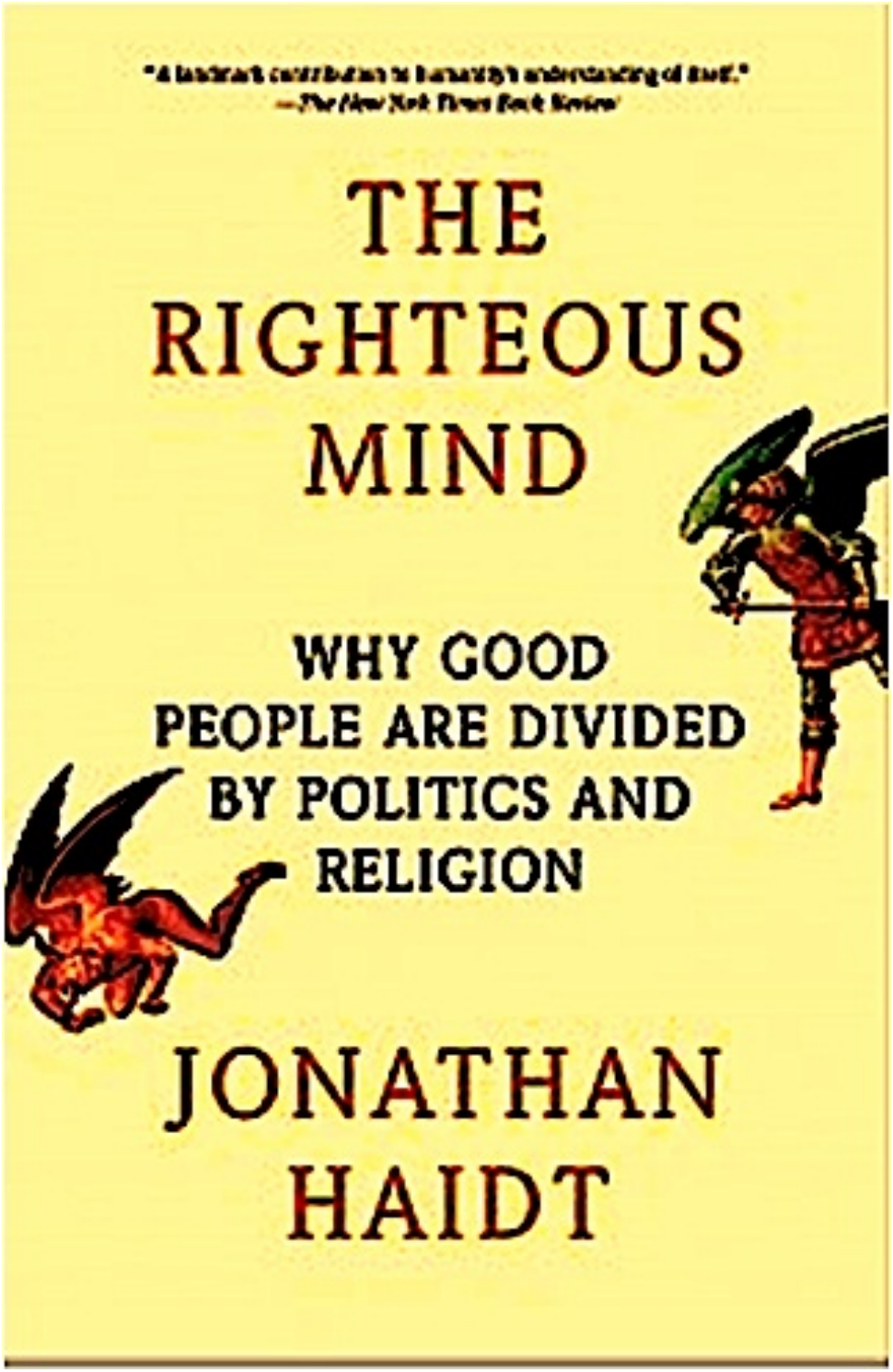
Some Things to Try

- Think of conscious thinking as a precious resource to conserve.
- Prioritize prioritizing, as it's an energy-intensive activity.
- Save mental energy for prioritizing by avoiding other high-energy-consuming conscious activities such as dealing with emails.
- Schedule the most attention-rich tasks when you have a fresh and alert mind.
- Use the brain to interact with information rather than trying to store information, by *creating visuals for* complex ideas and by listing projects.
- Schedule blocks of time for different modes of thinking.


THINKING,
FAST AND SLOW
DANIEL
KAHNEMAN
WINNER OF THE NOBEL PRIZE IN ECONOMICS


Activates System 2,
when it needs help
System 1
System 2
What it
does
The continuous
stream of thoughts
Mental activities
that allow solving
complex problems
Adjectives
Automatic, fast,
effortless
Lazy, slow,
effortful
Tries to shift all tasks
to System 1


Reality can be so complex that equally valid observations from differing perspectives can appear to be contradictory.
Four
No Three
bryanridgley.com
PERSPECTIVE
Just remember, whatever side you're on the other person is right too.


THE
RIGHTEOUS
MIND
WHY GOOD
PEOPLE ARE DIVIDED
BY POLITICS AND
RELIGION
JONATHAN
HAIDT

Usability Oriented?

Novelty-seeking genes

People don't adopt their ideologies at random, or by soaking up whatever ideas are around them. People whose genes gave them brains that get a special pleasure from novelty, variety, and diversity, while simultaneously being less sensitive to signs of threat, are predisposed

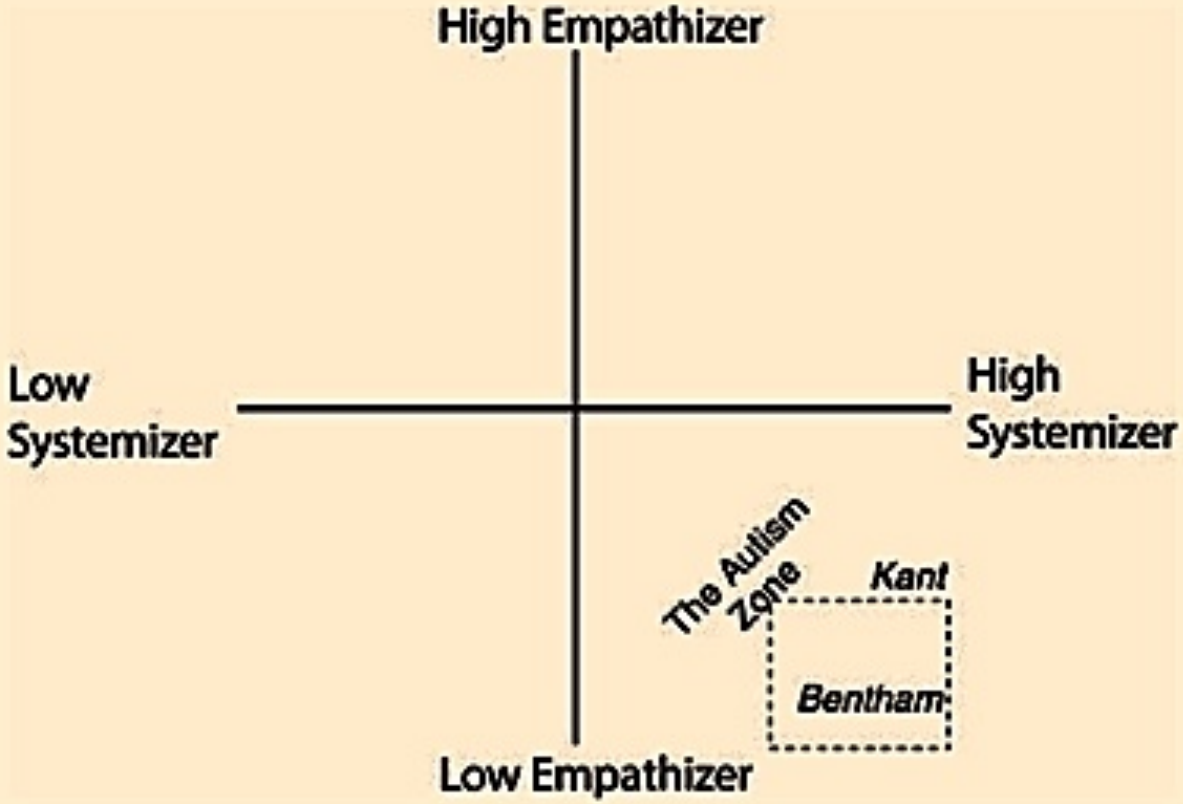
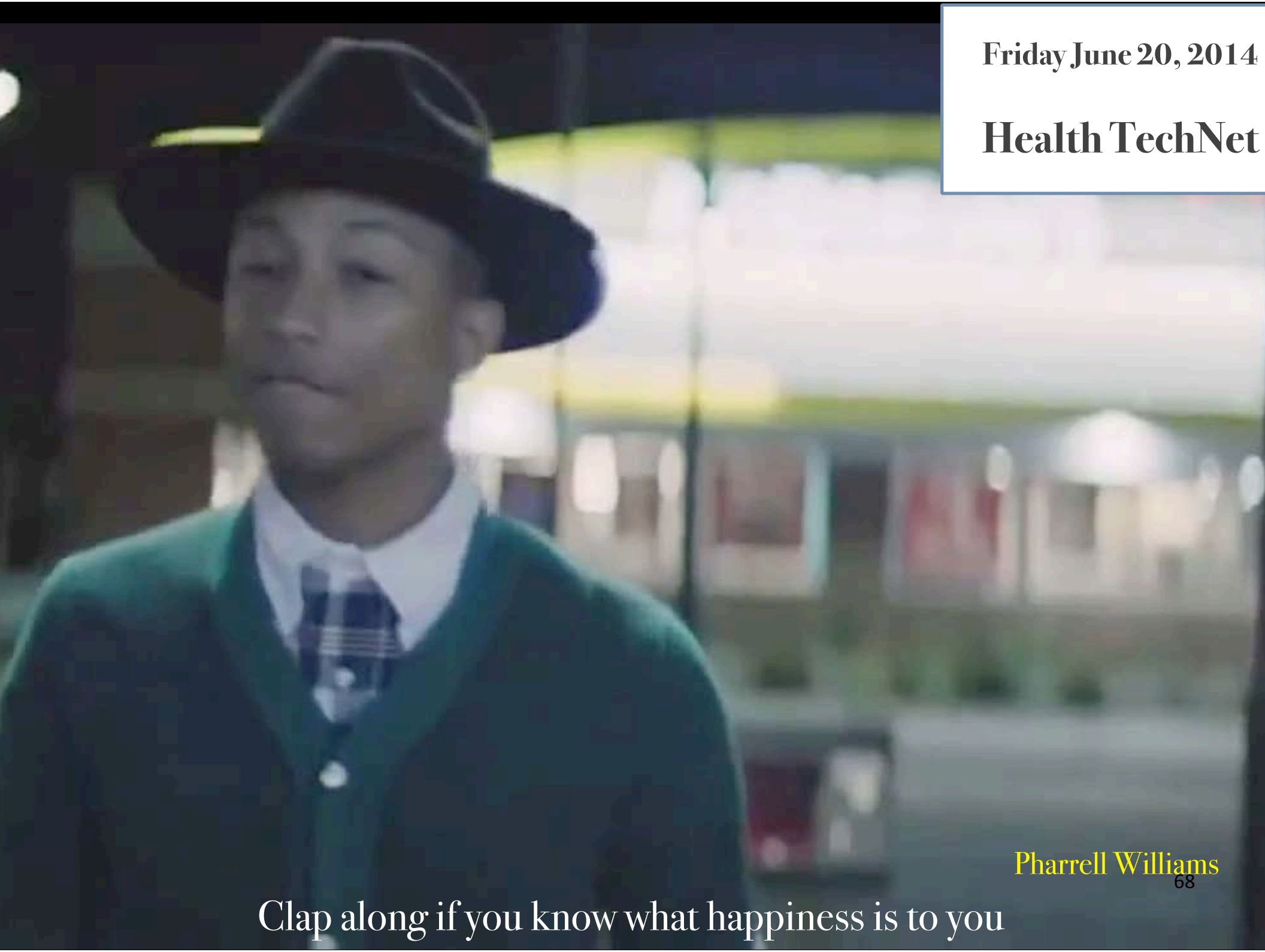


FIGURE 6.1. Two dimensions of cognitive style. People with autism are very high on systemizing and very low on empathizing. So were some important moral philosophers. (Adapted from Baron-Cohen 2009.)


Pharrell Williams
Clap along if you know what happiness is to you