



Session 4.01.

# Physicians & Physician Organizations

Emerging Initiatives  
to Put Clinical Guidelines  
at the Point of Care

# Panelists

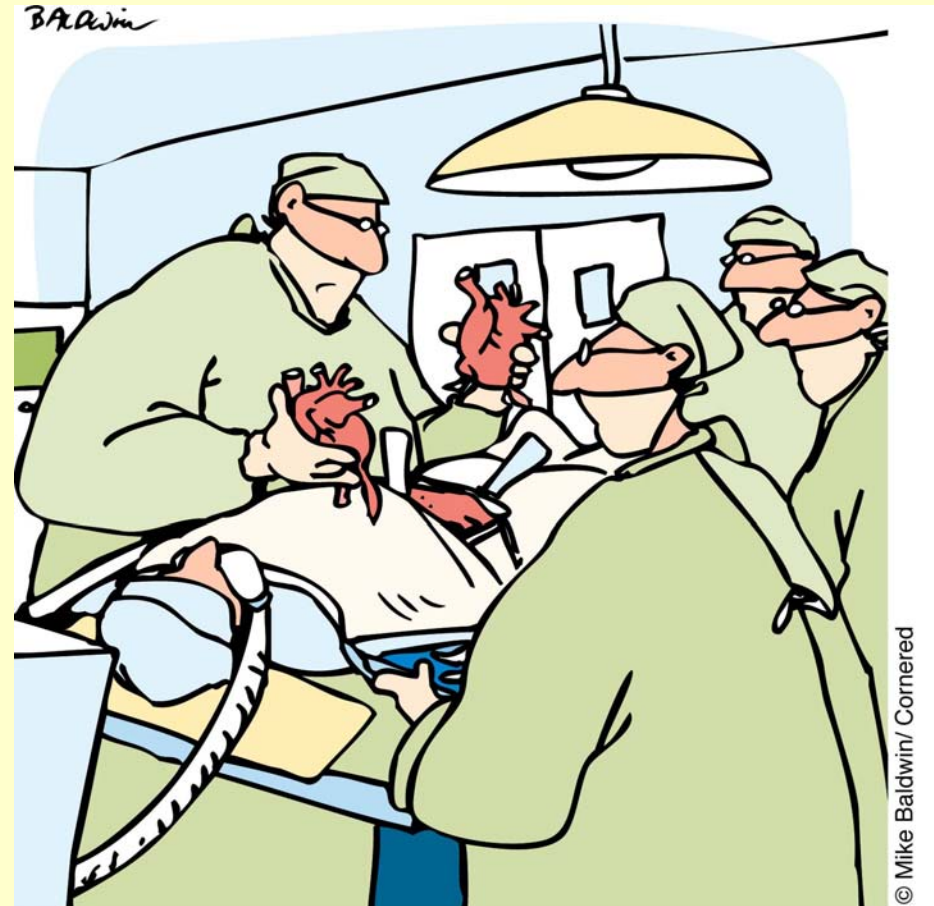
- ◆ Nick Beard, MD  
*IDX Systems Corp.*
- ◆ Stan Huff, MD  
*Intermountain Health Care*
- ◆ Bob Greenes, MD, PhD  
*Brigham & Women's Hospital,  
Harvard Medical School*



# Importance of decision support

- Error prevention/  
patient safety
- Encourage best  
practices
  - Quality
  - Reduced variability,  
disparity
- Efficiency
- Cost-effectiveness

*A key motivation for the  
EHR!*



"OK, the old one's in my right hand,  
the donor's in my left. Right?"



# We know how to do this

- ◆ Computerized alerts
  - Reduced errors
  - Faster response to problems
- ◆ Reminders
  - Improved compliance with guidelines
- ◆ CPOE
  - medication error & ADE reduction
  - cost savings
- ◆ ADE detection and monitoring
  - ... etc.

*→ So, why is use not more widespread?*

# Goal of this presentation is to explore that question

- ◆ Three case studies
  - Focus on lessons learned
- ◆ Generalization of experience
  - Key challenges
  - Recommendations



# Example: Partners Healthcare System

- ◆ Integrated healthcare delivery network in Eastern Massachusetts
- ◆ Founded in 1995
- ◆ Includes:
  - Mass. General Hospital
  - Brigham & Women's Hospital
  - Dana Farber Cancer Institute
  - several community hospitals
  - many practice groups



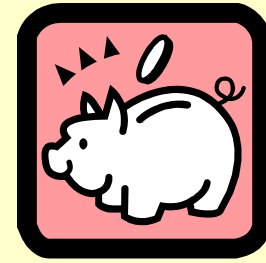
# Long tradition of computer-based decision support

e..g, Brigham system (BICS):

- ◆ Order entry
  - Drug-drug, drug-lab interaction checks
  - Redundancy/appropriateness checks
  - Dose ranges, contraindications, allergies, age, renal function
  - Order sets
- ◆ Alerts
- ◆ Reminders
- ◆ Lab result interpretation
- ◆ Adverse event detection
- ◆ Guideline recommendations



# Cost-effective



- ◆ 55% decrease in serious medication errors
  - Bates, JAMA 1998
- ◆ Decreased redundant labs
  - Bates, Am J Med, 1997
- ◆ More appropriate renal dosing
- ◆ No reduction in inappropriate x-rays
  - Harpole, JAMIA, 1997
- ◆ Minimal effect of charge display
  - Bates, Archives of Internal Medicine, 1995
- ◆ More appropriate dosing, substitutions accepted
  - Teich, Archives of Internal Medicine, 2000
- ◆ Decreased vancomycin use
  - Sojania, JAMIA, 1998



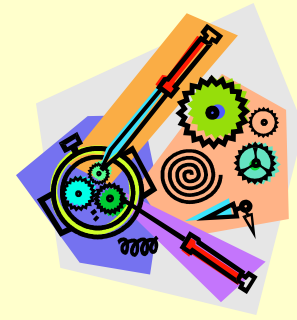


# CDM Modeling

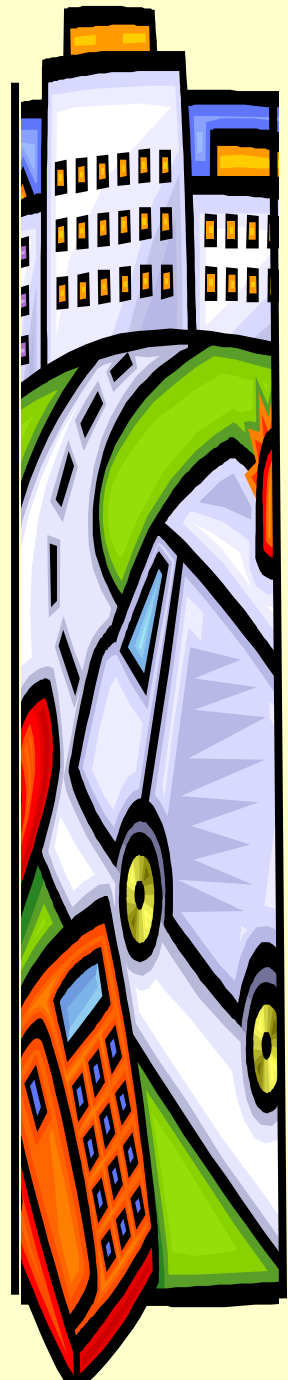
- ◆ Decision Systems Group R&D
  - Data mining/predictive modeling
  - Technology assessment
  - Guideline modeling (GLIF)
  - Expression language development (GELLO)



# So what's broken?



- ◆ Gap between models and practice
- ◆ Generic slowness of technology diffusion
- ◆ Specific issues relating to our environment



# Converting research to care





# Knowledge Inventory Study

- ◆ Conducted spring/summer, 2002
- ◆ Findings: KI Report
  - Many PHSIS apps/subsystems use embedded knowledge for decision support
    - If...then rules
      - IF labtest\_result\_type < value AND medication\_class THEN send textpage
    - Tabular data
      - (Drug\_a, drug\_b, interaction\_type)
      - can be thought of as if...then rules
    - Knowledge-Element Groupings (“KEGs”)
      - Order sets, structured documents, data entry forms, ...
    - Other...

# Major findings

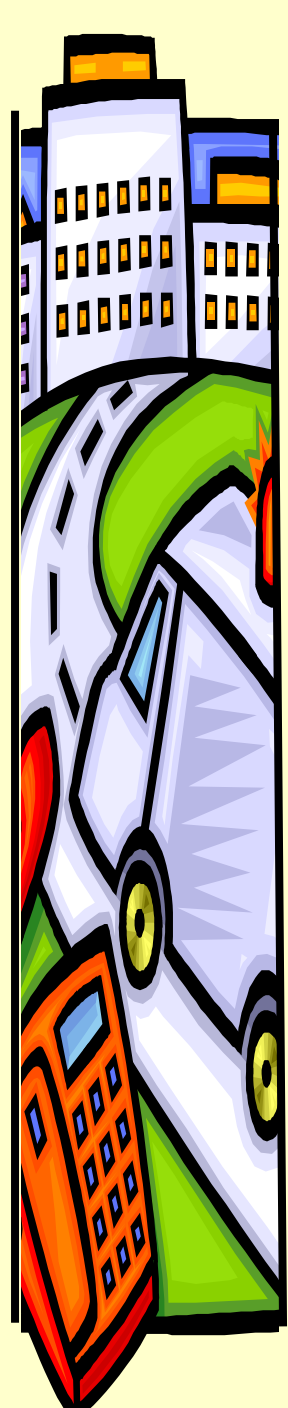
- ◆ Multiple systems/application w/ CDS
  - Multi-vendor environment
  - Many apps as result of academic projects
    - Main goal to demonstrate effectiveness
    - One-of-a-kind implementations
  - Not standards-based
  - Knowledge embedded in systems
    - Difficult to extract, generalize, replicate



# Rules knowledge, as example:

- ◆ Widely used:
  - Alerting
    - Drug-lab interactions
    - Panic lab alerts
  - CPOE
    - Order-entry rules
    - Drug dictionary (incl. interactions, Gerios, Nephros)
    - Order sets
    - Relevant labs when ordering medications
    - Redundant tests
    - Use and impact
  - Adverse event monitor
  - LMR Outpatient reminders
  - LMR Result manager
  - P-CAPE (guideline implementation)



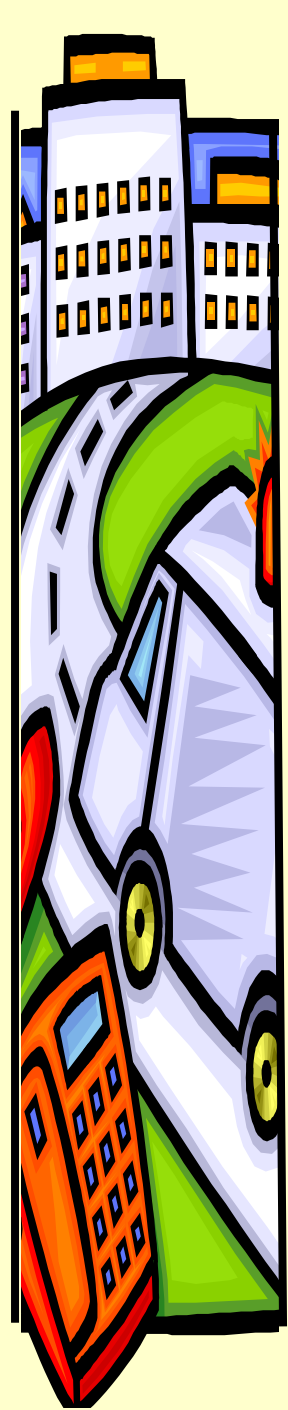


# Varied authoring approaches

- ◆ Direct encoding in host language
  - e.g., MUMPS
- ◆ Creation of tables
- ◆ Application-specific authoring tools & DBs
- ◆ Representation varied accordingly
- ◆ Also apps have counterparts
  - e.g., CPOE

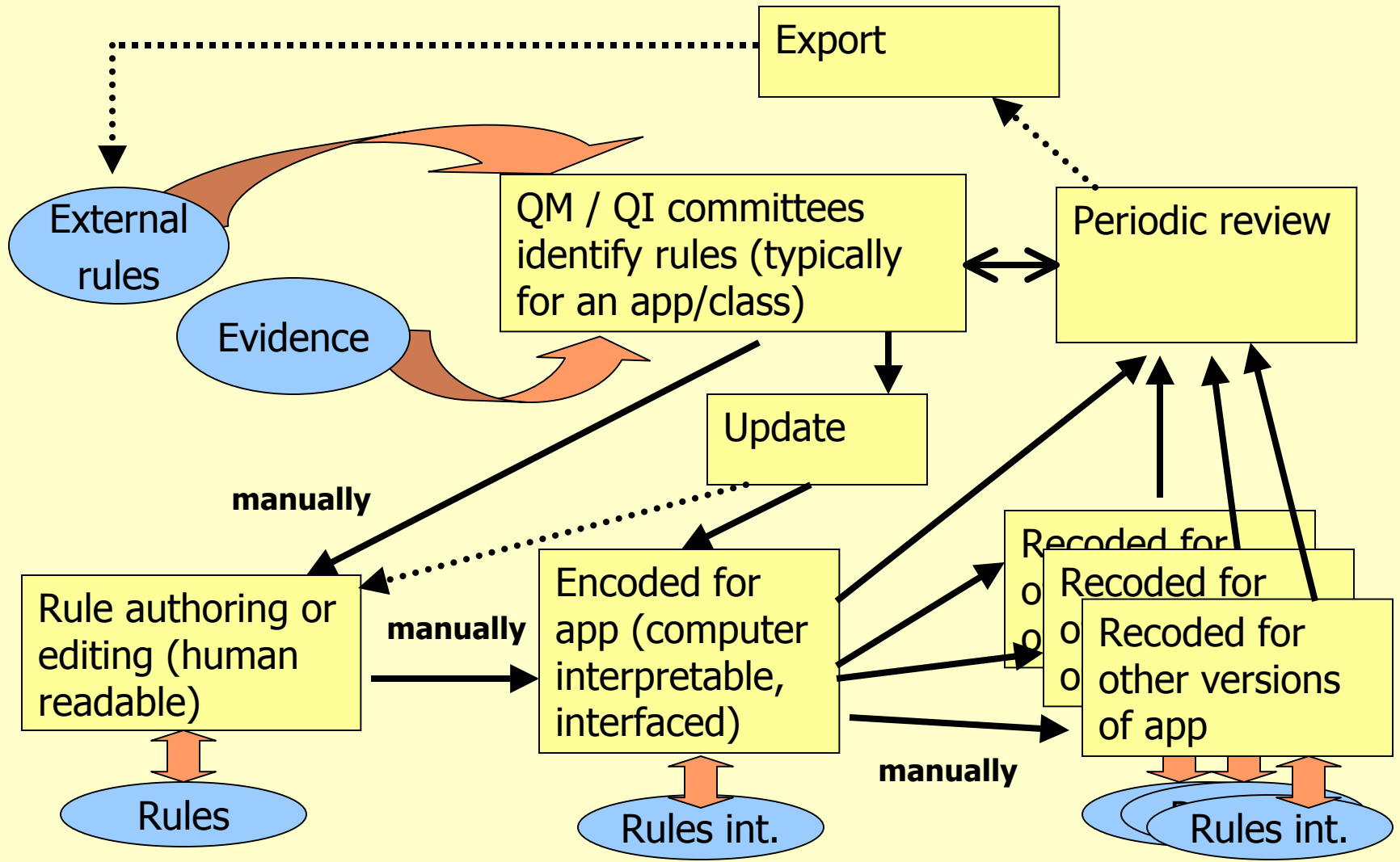
# Common rules engine feasibility study

- ◆ Explore requirements for KM
  - Externalizing the knowledge from the application
  - Making it transparent
- ◆ Particular focus on rules knowledge
  - Feasibility of a common representation
  - Implications for authoring/updating and execution

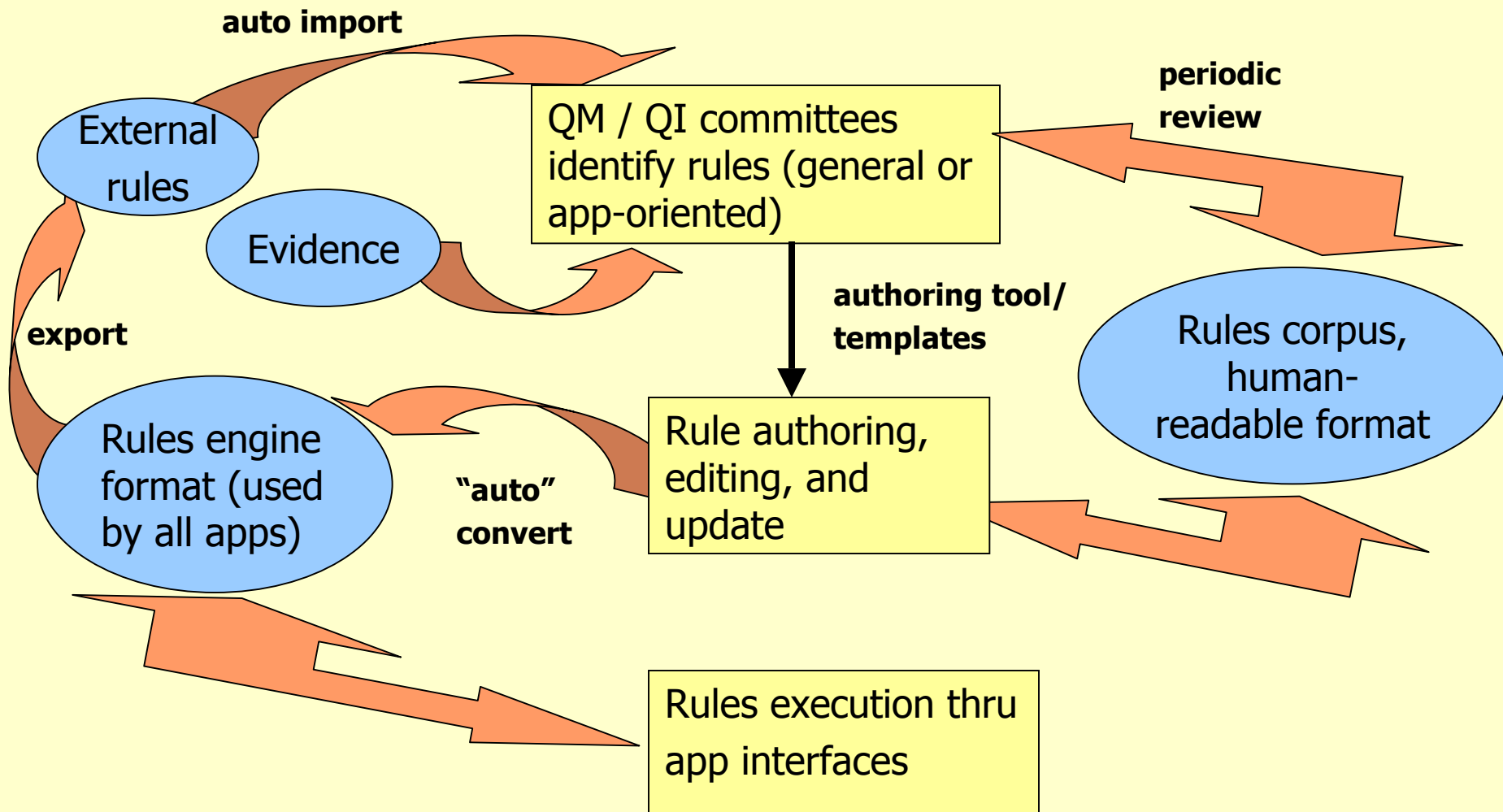




# Rules development and management (extant process)



# Rules development and management (goal process)



# Main findings

- ◆ Parsimony
  - Hundreds of rules, used in many apps
  - Yet only 13 data classes represented
    - Mappable to HL7 RIM
  - Only 41 unique primitive expression types
  - Few action types
    - Mainly types of notification or scheduling
- ◆ Common representation feasible
- ◆ Limited touch points with applications
- ◆ Template/wizard-based authoring feasible

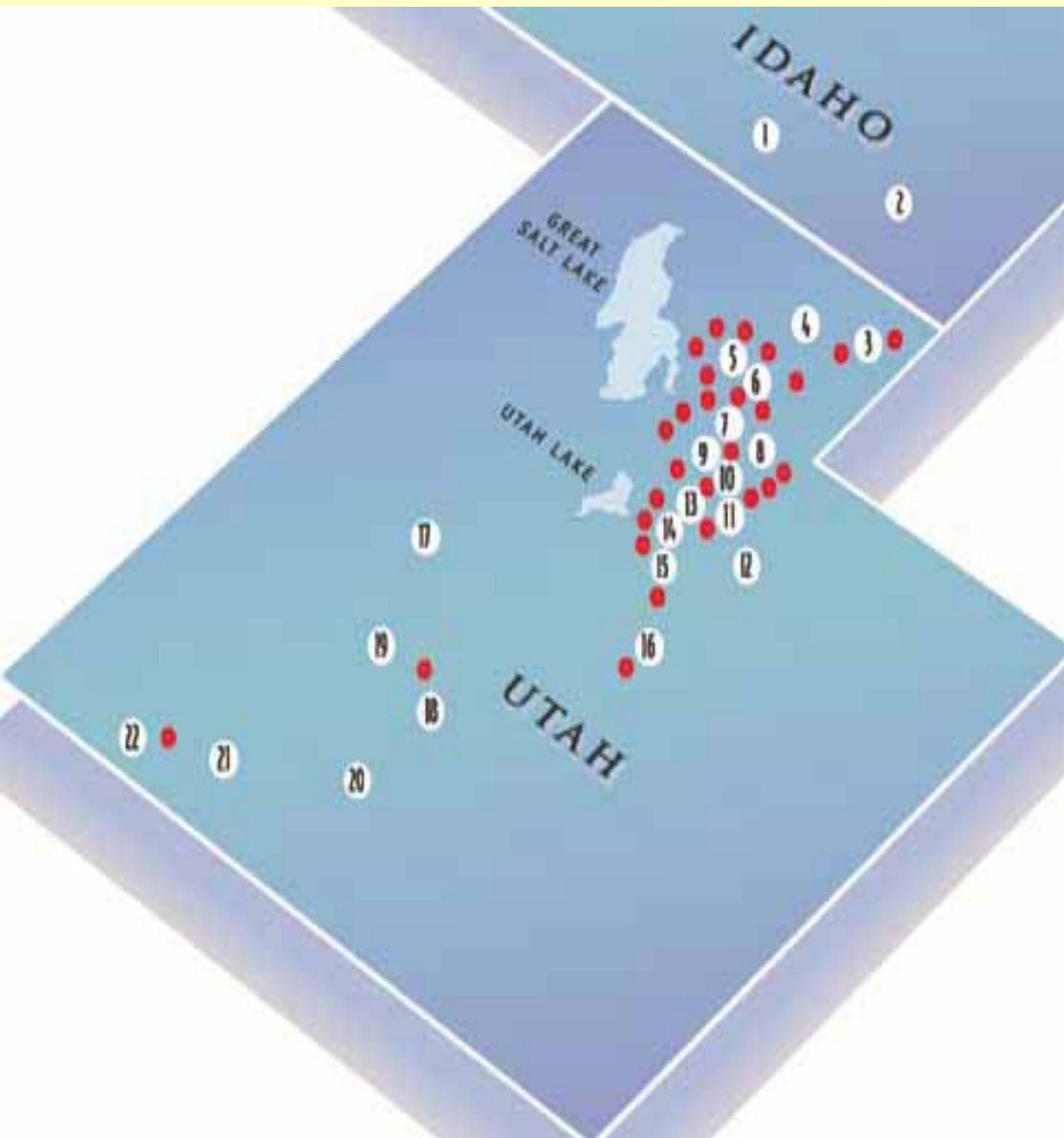




# Next steps (now ongoing)

- ◆ Focus on front-end of knowledge authoring/  
knowledge management process
  - transition from reference knowledge to executable *if...then* format
  - Common repository / portal
  - Ability to locate related or similar knowledge
  - Version control, update control
- ◆ Expansion beyond rules knowledge
  - knowledge element groups (“KEGs”)
    - order sets, reports, forms, ...

# Intermountain Health Care (IHC)



- ◆ Not for profit corporation
- ◆ 22 Hospitals
  - 500 to 25 beds
  - ~ 1.8 million patients/members
- ◆ Ambulatory Clinics
- ◆ 14 Urgent Care Centers
- ◆ Health Plans Division (Insurance)
- ◆ Physician's Division (~450 employed physicians)



# Clinical Info Systems at IHC

(Roberto Rocha)

## ◆ HELP System

- Comprehensive HIS with **extensive** collection of decision support modules (“frames”)
  - Operational for the past **30+** years
  - **13,382** unique users (Aug 2004)

## ◆ HELP<sup>2</sup> System

- New **EMR** (replace core HELP functions)
  - Operational for the past 5+ years (initial outpatient focus)
  - **5,224 (Web) + 2,519 (CW)** unique users (Aug 2004)



# HELP System (frames) – 1/2

## ◆ Laboratory

– Critical lab and blood gases \_\_\_\_\_ 2

## ◆ Pharmacy

– Drug dosing checking \_\_\_\_\_ 100+

– Drug-food and drug-lab \_\_\_\_\_ 17

– Drug-drug interaction \_\_\_\_\_ (FDB source) \_\_\_\_\_ 1

– Allergies \_\_\_\_\_ 1

– Duplicated therapy \_\_\_\_\_ 1

– Drug monitoring \_\_\_\_\_ 3

– Drug route \_\_\_\_\_ 4



# HELP System (frames) – 2/2

- ◆ Protocols \_\_\_\_\_ 7
  - Ventilator, ARDS, TICU, Pressure ulcer, etc.
- ◆ Infectious diseases \_\_\_\_\_ 22
  - Antibiotic assistant, Pre-op, positive cultures, etc.
- ◆ ADE \_\_\_\_\_ 10
- ◆ Nurse charting \_\_\_\_\_ 8
- ◆ Nutrition (TPN and nutritional value) \_\_\_\_\_ 2
- ◆ Others \_\_\_\_\_ 9
  - Blood ordering, ER drug cards, Apache scores, etc.





# HELP<sup>2</sup> System (rule sets)

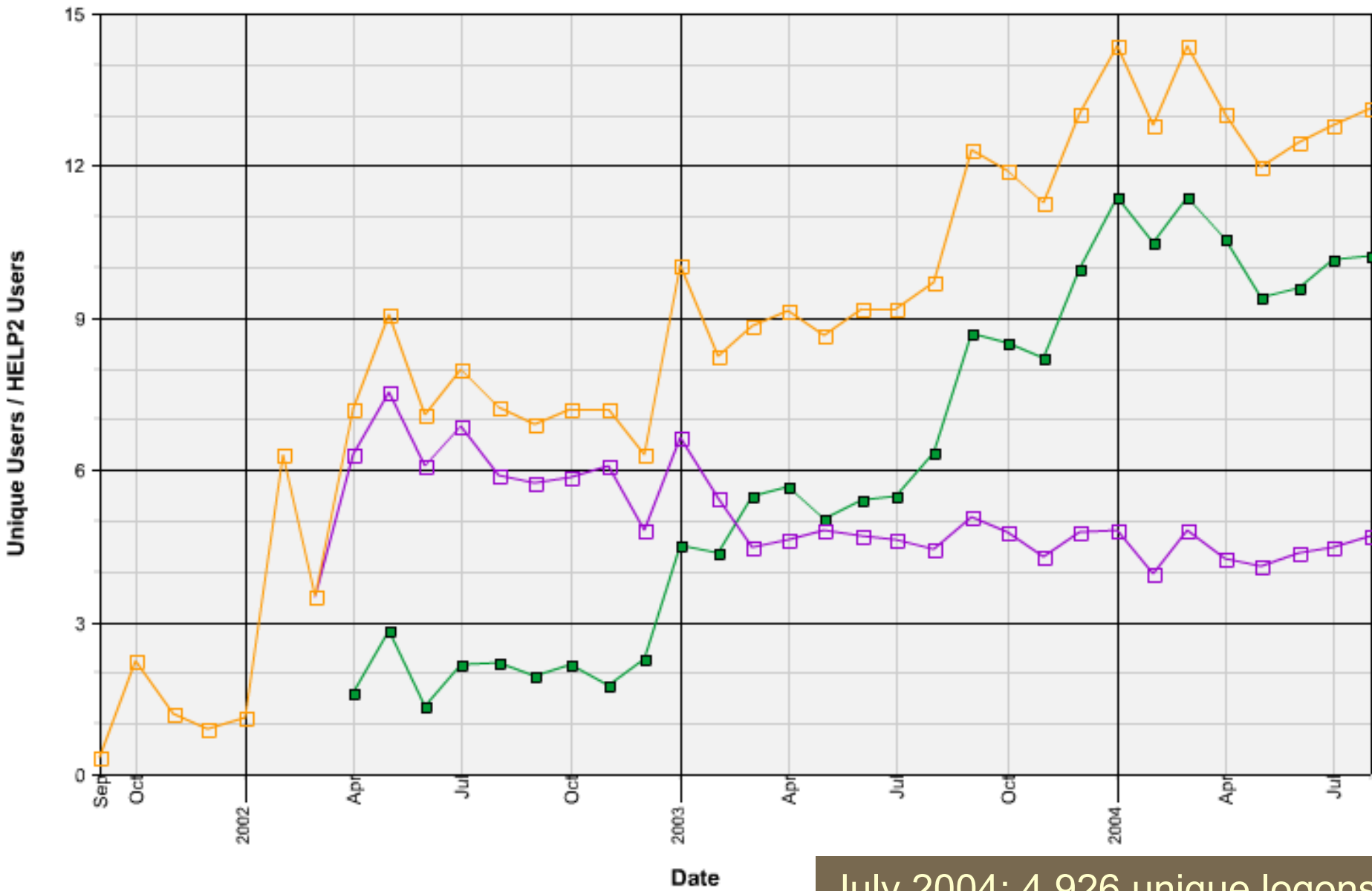
- ◆ Protocols 6
  - Chronic anticoagulation (live)
  - Pediatric ventilator weaning (live)
  - Post Liver transplant management (live)
  - Neonatal Bilirubin management (live)
  - Possible ADE based on Creatinine (live)
  - Glucose management (dev)
- ◆ Care Process models 2
  - Outpatient Community Acquired Pneumonia (dev)
  - Abnormal Uterine Bleeding (dev)



# HELP<sup>2</sup> System (ordering)

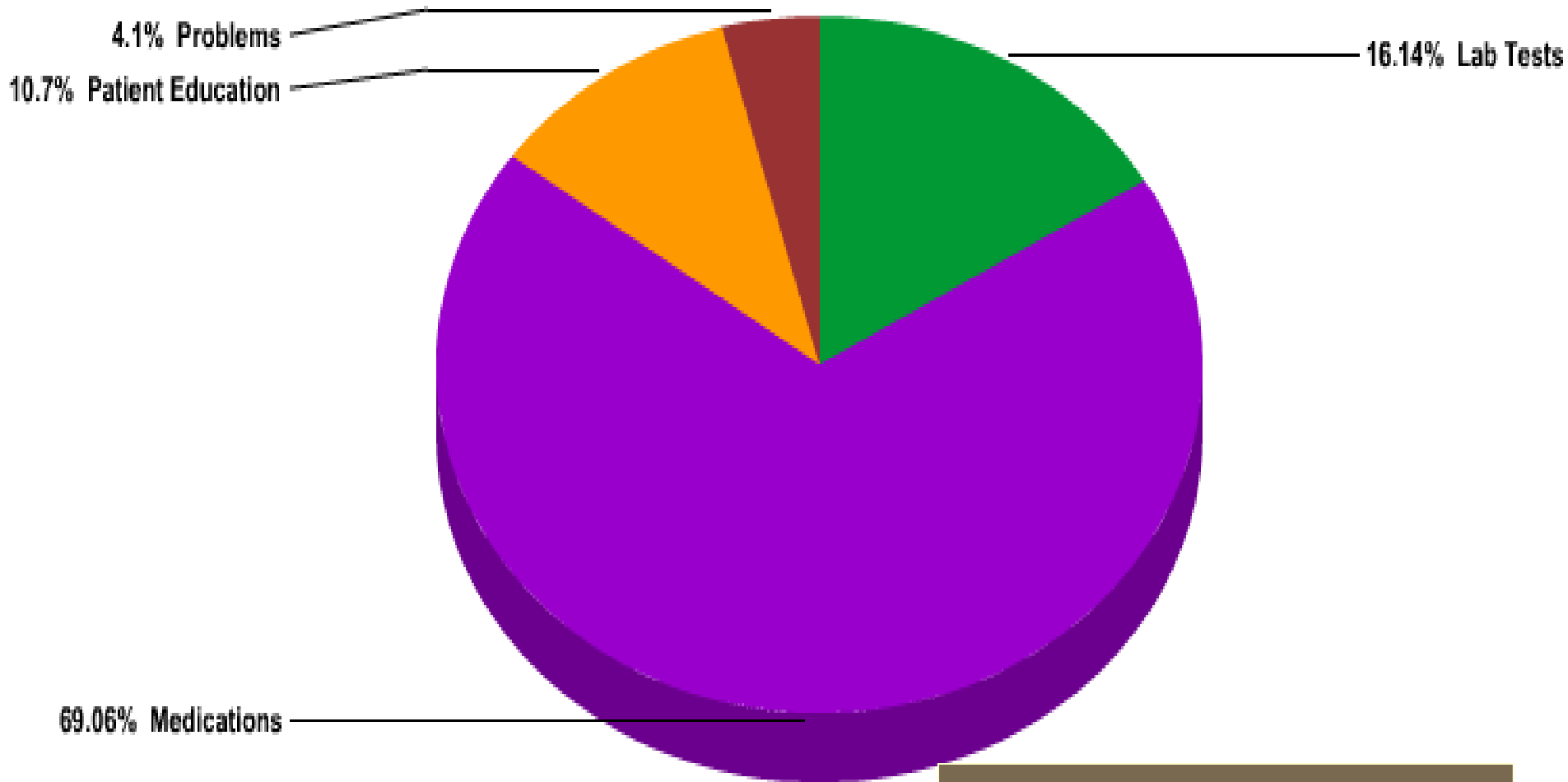
- ◆ Outpatient medication orders – 750+ users
  - Drug-drug interactions (FDB) (live)
- ◆ Inpatient Order sets (live) \_\_\_\_\_ 88
  - 30+ MDs using POE (pilot phase)
- ◆ Neonatal dosing calculations (dev) \_\_\_\_\_ 13
- ◆ Allergies (dev)
- ◆ Nursing Order sets (dev) \_\_\_\_\_ 193
  - 60+ RN care standards

Percentage of HELP2 Users that clicked on the Infobutton / E-resources at least once



July 2004: 4,926 unique logons

## Total Hits by Content Type

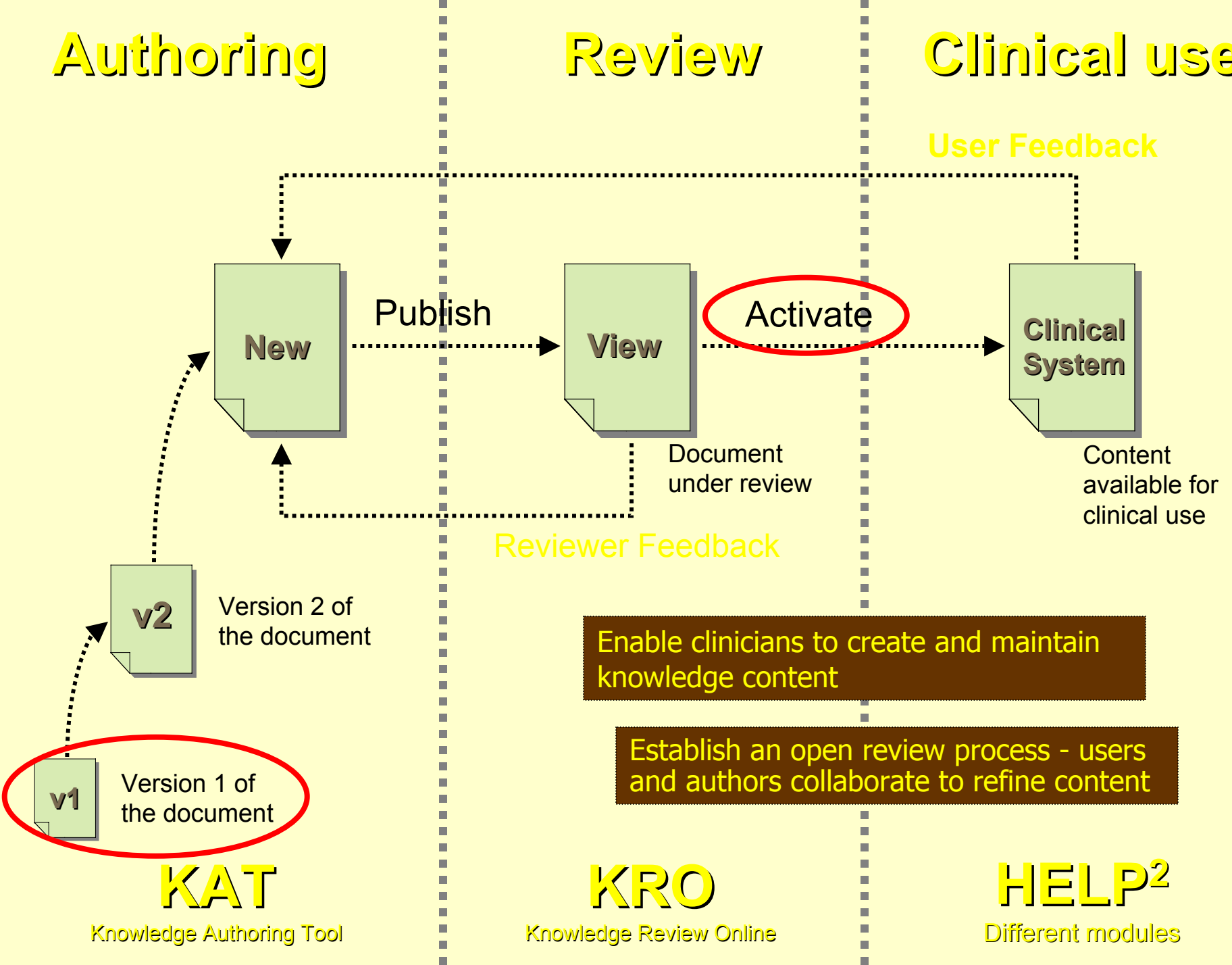


“Infobuttons” only

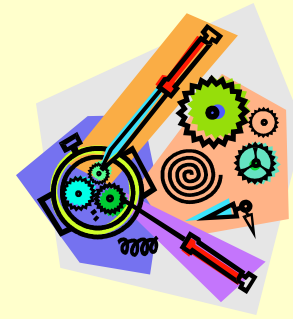
# Authoring

# Review

# Clinical use

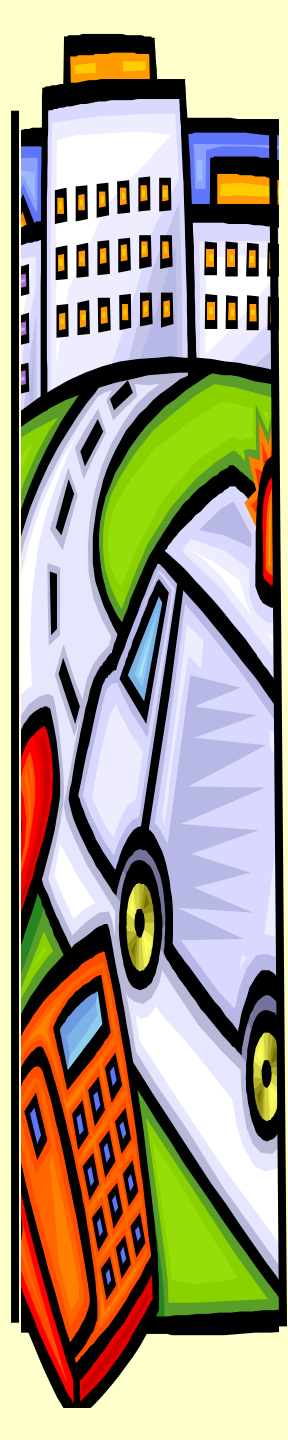


# What are the issues?



- ◆ People
  - NIH syndrome (not invented here)
- ◆ Commercial knowledge bases
- ◆ Integration with workflow
  - Expert systems - not in clinical use
  - Community Acquired Pneumonia Protocol
    - Different environment in different clinicals
  - EHR functions
    - Alerts
    - Flowsheets
    - Data drive, time drive, “ask drive”
- ◆ The “Curly braces” problem
  - Al Pryor and George Hripcsak experiment





## Too many ways to say the same thing (2)

- ◆ A single name/code and value
  - *Weight at birth* is 3500 g
- ◆ Combination of two names/codes and values
  - *Weight* is 3500 g
    - *Weight circumstance* is at birth

# Relational database implications

Patient Id	DateAndTime	Weight	Units	Circumstance
1234567	1/22/01 01:15:00 AM	3500	g	Birth
1234567	1/24/01 10:20:00 AM	3650	g	Discharge

Patient Id	DateAndTime	Birth Weight	Discharge Weight	Units
1234567	1/22/01 10:20:00 AM	3500	3650	g

How would you calculate the weight gain during the hospital stay?





# SAGE experience

- ◆ Nick Beard to present



# Conclusions & Recommendations - Greenes

- ◆ Three principal foci needed
  1. Accelerate standardization of CDS components in HL7
    - Expression language, data model, vocabulary model, process/flow representation, guideline modeling
  2. Adopt common knowledge management & dissemination approach
    - Content, tools, examples, other resources
  3. Encapsulate key functionality as services
    - Expression evaluation, data model instantiation, action invocation, ...



# Conclusions & Recommendations - Huff

## ◆ Three suggestions

1. Accelerate standardization of CDS components in HL7
  - NLM contract to link CHI vocabularies to HL7 data models and messages
2. Establish EHR content and infrastructure
  - Data entry, interfaces, data drive, time drive
3. We don't need "artificial intelligence"  
(A little natural intelligence would be a good start!)
  - Reports, order sets, alerts, reminders



# Conclusions & recommendations - Beard

- ◆ To be added

