

## HL7 Arden Syntax

Robert A. Jenders, MD, MS

Associate Professor, Department of Medicine

Cedars-Sinai Medical Center

University of California, Los Angeles USA

Co-Chair, Clinical Decision Support Technical Committee, HL7

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## Overview

### Part A (1400-1430)

- I. Justification for Clinical Decision Support Systems (CDSS)
- II. What is a CDSS?

### Part B (1430 - 1515)

- I. Details of Arden Syntax
  - A. Structure
  - B. Data types and operators
- II. Writing MLMs
- III. Tools

## Overview (continued)

### Part C (1530 - 1600)

- I. Arden Syntax v2.5
- II. Arden Syntax v3.0: XML, expression language, vMR

### Wrap-Up & Questions (1600 - 1630)

## Educational Objectives

- Characterize errors in medical practice.
- Cite examples of CDSS that improve care.
- Describe a CDSS.
- Identify different formalisms for KR in CDSS.
- Describe the Arden Syntax and know its role.
- Know future plans for Arden Syntax.

### Part A:

## I. Justification for CDSS: Medical Errors

### Estimated annual mortality

Air travel deaths	300
AIDS	16,500
Breast cancer	43,000
Highway fatalities	43,500
Preventable medical errors	44,000 -
(1 jet crash/day)	98,000

### Costs of Preventable Medical Errors

\$29 billion/year overall

1999 Institute of Medicine (IOM) Report




...180,000 people die each year partly as a result of iatrogenic injury. . .

Harvard Medical Practice Study (1991)

“

The problem facing decision-makers: from information underload to information overload.

Data [...] are plentiful. Understanding is rare.”



*Philadelphia Inquirer*  
September 12, 1999

**Medical Mistakes**

**Health care's deadly secret: Accidents routinely happen**



Helping **AVOID** costly clinical errors

**To Err Is Human: Building a Safer Health System**

- November, 1999
- Linda T. Kohn, Janet M. Corrigan, and Molla S. Donaldson, editors
- Committee on Quality of Health Care in America
- Institute of Medicine (312 pages).
- <http://books.nap.edu/catalog/9728.html>

**Definitions: What is an error?**

- **Error of execution:** Failure of an action to be completed as planned
- **Error of planning:** Use of a wrong plan to achieve an aim
- **Adverse event:** An injury caused by medical management (and not the result of the patient's condition)
- **Preventable adverse event:** An adverse event attributable to error
- **Negligent adverse event:** A preventable adverse event that satisfies criteria for malpractice

**Errors in Medicine**

- **Hospital admissions:** 2.9% (UT/CO, 1992) - 3.7% (NY, 1984) have an adverse event
- **Proportion of preventable adverse events:** 53% (CO/UT) - 58% (NY)
- **Extrapolate to USA** (33.6M admissions in 1997): 44,000 - 98,000 deaths

**Errors in Medicine**

- Types of adverse events (Harvard Medical Practice Study, 1991):
  - drug complications: 19%
  - wound infections: 14%
  - technical complications: 13%
- 50% associated with operations

## Converging Demands

- The Quality Interagency Coordination Task Force (QuIC) responded to the IOM report with specific initiatives “including an emphasis on the application of information systems and computer-based initiatives to improve patient safety.”

The QuIC is composed of representatives from multiple governmental agencies, including the Department of Defense, VA, Health and Human Services, Labor, Office of Personnel Management, etc.

## The Leapfrog Group

- Founded by the Business Roundtable
- Initiatives
  - POE with error-prevention software
  - Evidence-based hospital referral
  - ICU staffing with MD intensivists
- Potential
  - Save 58,300 lives/year
  - Prevent 522,000 medication errors.

## California Law Health & Safety Chapter 2.05

- SB 1875 became law in 9/2000.
- Health care facilities have until January, 2002 to submit plans to “eliminate or substantially reduce” medication-related errors.
- Mandates formal plans in hospitals to reduce errors
- Deleted from bill:
  - Mandatory reporting & central database of errors
  - Mandatory installation of technology

## Expert Predictions

Gartner Group:

*Predicts through 2002, >75% of healthcare organizations will implement rule-based technologies*

*Beginning in 2000, computer-based patient record systems and data repositories that do not support an Arden Syntax-based, user-definable rules-processing system will lose market share.*

*Vendors using Arden: Siemens  
McKessonHBOC  
Eclipsys  
IBM*

## Computerized Clinical Decision Support

Scientifically shown to help clinicians make better decisions

- Improve quality of care
- Reduce cost of care
- Improve workflow for health care providers

## Case Studies: Examples of CDSS Effectiveness

- Perioperative Antibiotic Administration (Pestotnik, LDS Hospital: Ann Intern Med 1996;124(10):884-90)
  - *intervention*: reminder re timing and type of abx
  - *period*: 1988 - 1994
  - *result*: perioperative wound infections dec 1.8% - > 0.9%
  - *avg # doses*: 19 -> 5.3
  - *overall antibiotic cost* (constant \$) per tx pt: \$123 -> \$52

## Examples (continued): Preventable ADEs

- POE Implementation (Bates, BWH: J Am Med Inform Assoc 1999;6(4):313-321)
  - Population: hospitalized patients over 4 years
  - Non-missed-dose medication error rate fell 81%
  - Potentially injurious errors fell 86%

## Examples (continued)

- Reminders of Redundant Test Ordering (Tierney, Indiana U)
  - *intervention*: reminder of recent lab result
  - *result*: reduction in hospital charges (13%)
  - Tierney WM et al. JAMA 1993;263:379.
- Preventive Health Reminders in HIV (Safran, Harvard)
  - *intervention*: reminders to perform screening tests or vaccination (e.g., pap smear, HBV)
  - *result*: sig decreased time to documentation

## Examples (continued)

- Systematic review (Hunt DL, McMaster U: JAMA 1998;280(15):1339-46)
  - 68 studies
  - 66% of 65 studies showed benefit on physician performance
    - 9/15 drug dosing
    - 1/5 diagnostic aids
    - 14/19 preventive care
    - 19/26 other
  - 6/14 studies showed benefit on patient outcome

## Summary: Justification

- Medical errors are costly
  - Charges/Costs
  - Morbidity/Mortality
- CDSS technology can help reduce
  - errors (though not proven for complex guidelines)
  - costs
- Increasing focus on implementing this technology
  - Regulatory agencies/Law
  - Private initiatives

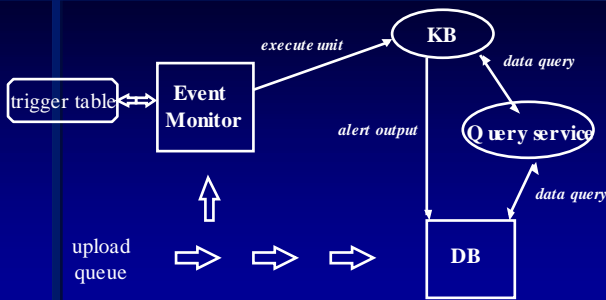
## II. What is Clinical Decision Support? Different Levels

- Organization of Data: the CIS
  - “checklist effect”
- Stand-Alone Expert Systems
  - often require redundant data entry
- Data Repository: Mining
- CDSS Integrated into Workflow
  - push information to the clinician at the point of care
  - examples: EMR, CPOE

## Key Architectural Elements

- data capture/display/storage
  - EMR
  - central data repository
- controlled, structured vocabulary
- knowledge representation (Arden)
- knowledge acquisition
- clinical event monitor: integrate the pieces for many different uses (clinical, research, administrative)

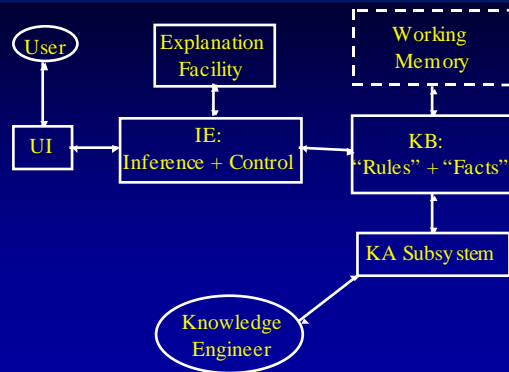
## Event Monitor Architecture



## Knowledge Representation Formalisms: Their Role

- Express policies (institutional, national, international) in computable format
- Formulate interventions in medical practice
- Make local variations in guidelines
- Provide "intelligence" to a clinical expert system

## KR: Role in CDSS Architecture



## Forms of Knowledge Representation

- Bayesian/probabilistic = Decision Analysis
- Special Issues: Guidelines & GLIF
- Case-based reasoning
- Ontologies
- Decision Tables
- Artificial Neural Networks
- Bayesian Belief Networks
- Procedural → Arden Syntax
- Production rules → Arden Syntax

## Types of MLMs

- Clinical MLMs: notification via results review display (1100+ messages / month)
  - anomalies in data (e.g., hypokalemia on digoxin; abnormal CXR using NLP)
  - reminders (e.g., perform indicated tests)
  - recommendations (e.g., Warfarin dosing)

## Types of MLMs

- Research MLMs
  - identifying patients for study enrollment
  - notifying investigators of particular events
  - notification via email or fax
- Administrative MLMs (ALMs)
  - reduce cost by identifying administrative anomalies (e.g., inappropriate bed classification)
  - notification via email or fax

## Arden Syntax: Assessment

- Incorporated into several vendors' products
- Growing number of installation sites
- Facile for simple alerts/reminders
- May not be sufficiently expressive for complex guidelines

## Summary: Part A

- I. Justification for Clinical Decision Support Systems (CDSS)
- II. What is a CDSS?

END PART A