

Slide 1

**Networking and Health  
Information Exchange**

Unit 7a  
Supporting Standards for EHR  
Application

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Slide 2

**Unit 7 Objectives**

- Understand the family of clinical decision support standards, including Arden Syntax, GELLO, and the Infobutton
- Understand Clinical Guideline standards
- Understand single sign-on standards and the HL7 Clinical Context Object Workgroup (CCOW) standard
- Understand regulatory standards and standards enhancing patient safety, including reporting requirements
- Understand Bar code standards
- Understand standards for master patient index, patient registries, and record locating standards

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Slide 3

**Clinical Decision Support  
(CDS)**

- **Apply information technology to address, in a systematic manner, questions** (and other information needs) that arise during patient care and clinical research.
- Developers and users of CDS systems seek to **improve clinical and public health outcomes**. CDS can inform and alter healthcare decisions, and standardize decisions and procedures for clinical research.

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Slide 4

**CDS (1)**

- Provides concise, accurate, and unambiguous factual information (accepted, scientific knowledge or consensus expert opinions) and advice containing evidence and recommendations
- Addresses information needs at the point and time of decision-making
- Requires computer-based representations of general medical knowledge (content or domain knowledge), application-specific decision logic (clinical algorithms), and accurate, standardized representations of current patient data and clinical states

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Slide 5

**CDS (2)**

- Uses knowledge bases derived primarily from the peer-reviewed, scientific literature; carefully derived expert consensus may suffice; and evidence-based knowledge obtained for clinical data with outcomes
- Data mining, including patient signs and symptoms, clinical data, decisions, treatment and outcome is rapidly becoming a major source of knowledge.

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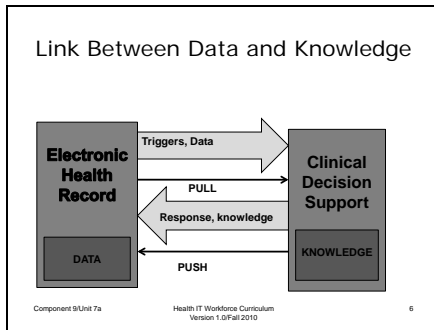
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Slide 7

Some Decision Support Tools

- Knowledge reference framework and knowledge representation
  - Arden Syntax, GELLO
- Clinical Guidelines
  - Guideline Interchange Format (GLIF) [HL7]
  - Guideline Elements Model (GEM) [ASTM]
- Disease Management Protocols
- Infobutton [HL7]
- Evidence-based Care Plans

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Slide 8

Arden Syntax

- Arden Syntax is an HL7/ANSI Standard
  - Current version is 2.7
- Arden Syntax arose from the need to make medical knowledge available for decision making at the point-of-care
- Make the knowledge and logic explicit
- Allow sharing within and between institutions
- Standardize the way medical knowledge is integrated into health information systems

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Slide 9

Medical Logic Module (MLM)

- MLM is a stream of text stored in an ASCII file in statements called slots.
- Slots are made up of a slotname and slotbody.
- Slots are grouped into three categories: maintenance, library and knowledge

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**Categories of Slots**

- Maintenance
- Library
- Knowledge

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**Maintenance Example**

maintenance:  
 title: Contrast CT study in patient with renal failure;;  
 filename: ct\_contr.nlm;;  
 version: 1.00;;  
 institution: Duke Medical Center;;  
 author: John Doe, MD;;  
 specialist: Jane Doe, MD;;  
 date: 2010-09-11;;  
 validation: testing;;

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**Library Example**

library:  
 purpose: To alert the health care provider of new or worsening serum creatinine level.;;  
 explanation: If the creatinine is at or above a threshold (1.35 mg/dl), then an alert... ;;  
 keywords: renal insufficiency; renal failure ;;  
 citations: Proceedings of the Fifteenth Annual Symposium on Computer Applications in Medical Care; 1991 Nov 17-20; Washington, D.C. New York: IEEE Computer Society Press, 1991.  
 links: URL "NLM Web Page", <http://www.nlm.nih.gov/> ;;

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Slide 13

**Knowledge Example**

- Type – coded and required
  - Presently only one type slot defined
    - type: data\_driven
- “data\_driven” implies that these slots follow:
  - Data
  - Priority
  - Evoke
  - Logic
  - Action
  - Urgency

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Slide 14

**Data Slot**

- Terms in the MLM that are matched to terms in the database
- Use of { } implies flexibility in mapping to the institution’s local database
- Mapping terms in this way separates the logic in the MLM from institution-specific information

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**Data Slot**

- Read statement without an operator obtains a list of values from the database
- Read statement with an operator obtains a single value from the database
- Examples of operators
  - First, last, min, max, count, average, sum

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**Evoked Slot**

- The evoked slot triggers an MLM
- Example
  - The occurrence of an event
  - Timed execution after an event
  - Periodic repetition after an event
  - Direct call from another MLM

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Slide 17

**Evoke Slot - Example**

```
data:
  creatinine_storage := event
  {'32506','32752'; /* isolated creatinine
  */...'32506','33801'; /* chem 20 */};

evoke:
  creatinine_storage;;
```

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**Evoked Slot – More Examples**

- Evoke: 3 days after time of creatinine storage;
- Evoke: every q day for 7 days starting at time of creatinine storage;
- Evoke: every 1 day starting at time of K\_storage until K >= 3;

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Slide 19

### Logic Slot

- Set of medical criteria
- Logical algorithm
- Ends with a “conclude statement”

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Slide 20

### Logic slot: If ...Then ...

```

If <expr1> then
<block1>
endif;

```

```

If <expr1> then
<block1>
elseif <expr2> then
<block2>
elseif <expr3> then
<block3>
...
elseif <exprN> then
<blockN>
else
<blockE>
endif

```

```

If <expr1> then
<block1>
else
<block2>
endif;

```

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Slide 21

### Logic Slot – Looping Statements

```

While <expr> do
<block>
enddo;

```

```

for <expr> do
<block>
enddo;

```

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## Slide 22

**Logic Slot – Call Statements**

- var1 := call my\_mlm with param1, param2;
- var1 := call my\_event with param1, param2;
- var1 := call my\_interface\_function with param1, param2;

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## Slide 23

**Example – Call Statements**

```
/* Define find_allergies external function */
find_allergies := INTERFACE
  (!RuleServerAllergyRules/my_institution/find_allergies.exe);
/* Lists two medications and their allergens */
med_orders:= ("PEN-G", "aspirin");
med_allergens:= ("penicillin", "aspirin");
/* Lists three patient allergies and their reactions */
patient_allergies:= ("milk", "codeine", "penicillin");
patient_reactions:= ("hives", NULL, "anaphylaxis");
/* Passes 4 arguments and receives 3 lists as values */
(meds, allergens, reactions):= call find_allergies with
med_orders, med_allergens, patient_allergies, patient_reactions;
```

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## Slide 24

**Conclude Statement**

- conclude true;
  - terminate the rule
  - go to the action slot
- conclude false;
  - terminate the rule
  - do not go to the action slot

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## Slide 25

### Logic Slot - Example

```
logic:
  if last_creat is not present then
    alert_text := "No recent creatinine available.
    Consider ordering creatinine before giving IV
    contrast.";
    conclude true;
  elseif last_creat > 1.5 then
    alert_text := "No recent creatinine available.
    Consider ordering creatinine before giving IV
    contrast.";
    conclude true;
  else conclude false;
endif;
```

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## Slide 26

### Action Slot

- Carries out action if logic slot concludes true
  
- Examples of actions
  - Write message to screen
  - Store a message in a file
  - Call another medical logic module

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## Slide 27

### Action Slot - Example

```
action:
write "Last creatinine: " || last_creat
" on: " || time of last_creat;
```

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Slide 28

### Action Slot - Example

```

data:
ed_email := destination 'ed@duke.edu';

action:
write at ed_email "Patient who may qualify for
study registered today. Pt #: "| patient_no;
  
```

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Slide 29

### Urgency Slot

- Determines importance of action if MLM concludes true
- Coded slot with value from 1 (low urgency) to 99 (high urgency)

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Slide 30

### MLM – Time and Duration

- Time data refers to points in time (time stamp)
- Duration is an interval of time
  - Duration expressed as years, months, days, hours, minutes, seconds
- Comparisons using time and duration
  - <time> is before <time>;
  - <time> is after <time>;
  - <time> is equal <time>;
  - <time> is within <time> to <time>;
  - <time> is within <duration> preceding <time>;
  - <time> is within the past <duration>

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**Operators**

- Assignment: potassium := 3.3;
- Comparison:  
= (EQ), > (GT), < (LT), >= (GE), <= (LE),  
< > (NE)
- Logical and, or, not
- Mathematical + - \* / () abs int sqrt  
log exp sine cosine tangent arcsin  
arccos arctan

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Slide 32

**Summary**

In this subunit, we introduced the Arden Syntax which has been around for a long period of time. The Arden Syntax is easy to use and has considerable power. One of the complaints of Arden Syntax is that it does not handle complex expressions, particularly those involving timing such as intervals after other events.

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