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The archetype-enabled EHR system ZK-ARCHE – Integrating the ISO/EN 13606 standard and IHE XDS profile

Kohler M, Rinner C, Hübner-Bloder G, Saboor S, Ammenwerth E, Duftschmid G

Section for Medical Information Management and Imaging
Center for Medical Statistics, Informatics and Intelligent Systems
Medical University of Vienna, Austria

UMIT-University for Health Sciences, Medical Informatics and Technology
Hall in Tirol, Austria
About us

• Medical University of Vienna

• Section for Medical Information Management and Imaging

• Research topics: EHRs, EHR standards, semantic interoperability
The EHR-ARCHE Project

• 2 year project funded by Austrian Science Fund
• Cooperation between UMIT and Medical University of Vienna

• Goal: Can dual model approach help avoid EHR information overload?
  – Focus on diabetes treatment

• Project work packages:
  1. Analyse clinicians’ information needs and model them as archetypes
  2. EHR Framework and EHR test data
  3. Evaluate

http://www.meduniwien.ac.at/msi/arche/
IHE XDS Profile

Focus of ZK-ARCHE
Dual Model Approach

Reference Model + Archetype → Standardized EHR content

ENTRY
name=blood pressure measurement

ELEMENT
name=comment
value.SIMPLE_TEXT.originalText=Ceterum censeo...

CLUSTER
name=measurement
  ELEMENT
  name=systolic
  value.PQ.value=150
  value.PQ.unit=mm[Hg]
  value.PQ.property=pressure
  ELEMENT
  name=diastolic
  value.PQ.value=90
  value.PQ.unit=mm[Hg]
  value.PQ.property=pressure
EHR system ZK-ARCHE

• Integrates ISO/EN 13606 and IHE XDS
  – Derives forms automatically from Archetypes and Reference Model
  – Stores data as archetyped ISO/EN13606 EHR extracts
  – Persists EHR extracts via IHE XDS
ZK-ARCHE - Overview

1. generate

Reference Model

2. enter data and store

Form

3. retrieve meta data and register

archetypes EHR extract

IHE-XDS Framework

Neurological status
- Tuning fork test
  - Left
  - Right
- Sense of position
  - Test name
  - Eyes open/closed
  - Outcome
- Temperature-based discrimination
  - Location

archetype EHR extract

Reference Model

Archetype
ZK-ARCHE - Overview

1. generate Archetype
2. enter data and store
3. retrieve meta data and register

Reference Model
Form
archetyped EHR extract

IHE-XDS Framework

Neurological status
- Tuning fork test
  - Center of head
  - Left
  - Right
- Sense of position
  - Test name
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  - Outcome
  - Location
- Temperature-based discrimination

<xref extract>
... items xsi:type="ELEMENT">
  <name xsi:type="SIMPLETEXT">Tuning fork test</name>
  <originaltext>Tuning fork test</originaltext>
</name>

... value xsi:type="SIMPLETEXT">
  <originaltext>Center of head</originaltext>
  <value>
    <items>
      ...
    </items>
  </value>
</xref extract>
Generation of forms

• Archetype extended to Comprehensive Archetype
  – Mandatory RM fields added
  – Object Identifiers added
  – Relative XPaths associated with Archetype nodes
Generic mapping

Reference Model

• Structure elements
  – Composition
  – Section
  – Entry
  – Cluster

• Data element
  – Element

Form

General medical history

General condition

- Lifestyle
- Family history
- Weight and Height status
- Vital Signs
- Pregnancy

- ECG
- Bruits
- Heart rate
  ○ No
  ○ Yes
  ○ Empty: Heart rate present

- Rate
  - value
  - unit

- Rhythm pattern

blood pressure

- time

- Type of blood pressure measurement
- Systolic
  - value
  - unit
- Diastolic
  - value
  - unit

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Archetype excerpt

```plaintext
definition
COMPOSITION[at0000] occurrences matches (1..1) matches { -- puls_blutdruck
  content existence matches (0..1) cardinality matches (0..*; unordered) matches {
    SECTION[at0001] occurrences matches (0..1) matches { -- Puls und Blutdruck
      members existence matches (0..1) cardinality matches (0..*; unordered; unique) matches {
        ENTRY[at0002] occurrences matches (0..5) matches { -- Puls
          items existence matches (0..1) cardinality matches (0..*; unordered; unique) matches {
            ELEMENT[at0012] occurrences matches (0..2) matches { -- Puls
              value existence matches (0..1) matches {
                PQ[at0013] occurrences matches (0..1) matches { -- PQ
                  unit matches (*)
                  value matches (*)
              }
            }
          }
        }
      }
    }
  }
}

ENTRY[at0003] occurrences matches (0..5) matches { -- Blutdruck
  items existence matches (0..1) cardinality matches (0..*; ordered; unique) matches {
    CLUSTER[at0016] occurrences matches (0..1) matches { -- Systolisch
      parts existence matches (0..1) cardinality matches (0..*; unordered; unique) matches {
        ELEMENT[at0019] occurrences matches (0..1) matches { -- Referenzbereich
          value existence matches (0..1) matches (*)
      }
    }
  }
}

ELEMENT[at0022] occurrences matches (0..1) matches { -- Wert
  value existence matches (0..1) matches {
    PQ[at0027] occurrences matches (0..1) matches { -- PQ
      unit matches {
        CS[at0024] occurrences matches (0..1) matches { --
          codeValue existence matches (0..1) matches (/.*/)
          codingSchemeName existence matches (0..1) matches (/.*/)
        }
      }
      value matches (*)
    }
}
```
Form excerpt
ZK-ARCHE - Overview

1. generate

Archetype

Reference Model

Form

2. enter data and store

Neurological status
Tuning fork test
Center of head
Tuning fork test
Left
Center of head
Right
Tuning fork test
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3. retrieve meta data and register

archetyped EHR extract

IHE-XDS Framework

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Generation of EHR extracts

• Input of Data into forms
• Data is stored as key-value pairs
• Only with key-value pairs the EHR extract is created
• Resulting EHR extract is well formed and archetype compliant
ZK-ARCHE - Overview

1. generate

Reference Model

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archetyed EHR extract

IHE-XDS Framework

archetyped EHR extract

<xref ref-type="equation" rid="Eq.1"></xref>

Reference Model

<xref ref-type="equation" rid="Eq.2"></xref>

Form

<xref ref-type="equation" rid="Eq.3"></xref>

Archetype

<xref ref-type="equation" rid="Eq.4"></xref>
Registration of EHR extracts

• Necessary metadata are obtained from the system (e.g. patient info)
• Metadata information is extracted from the EHR extract
• EHR extract + Metadata-set are persisted and registered via IHE-XDS Document Repository
Results

• Tested with 128 ISO/EN 13606 Archetypes
• Most extensive Archetype contains 119 Slots
  -> Form with 745 input fields, additional input fields are possible as table rows
• Mobile Application through use of Web-Technology
Discussion

• Usability of forms
  – Forms directly derived from comprehensive Archetype
  – Complex Archetype results in complex form
  – Forms used by project-internal MD
Discussion

• Upcoming Austrian EHR system ELGA
  – IHE XDS
  – HL7 CDA
  – Currently no plans for application of Archetypes
Michael Kohler
michael.kohler@meduniwien.ac.at
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