CRICS 9
eHealth
Reaching the universal access to health
October 22 - 24, 2012 | Washington, DC - USA

openEHR- knowledge driven eHealth Platform

Jussara M. P Rötzsch

*open*EHR Foundation- Director

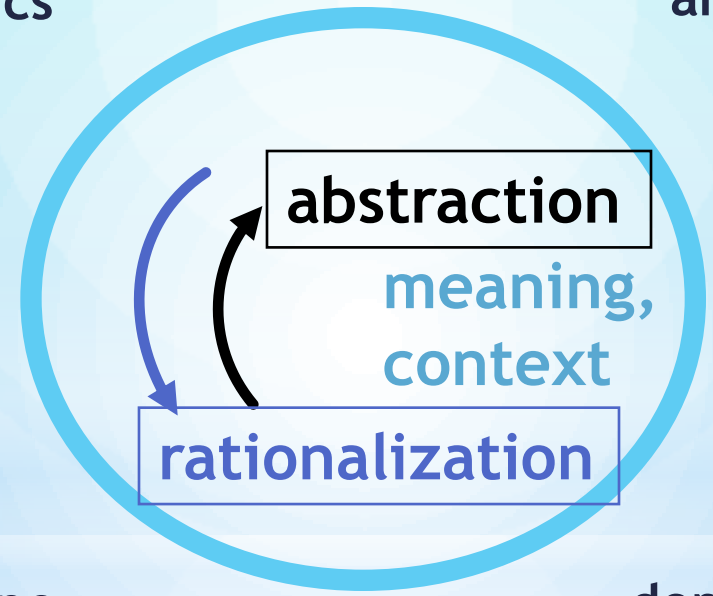
Agenda

- Drivers for Semantic Interoperability
- Health Knowledge Complexity
- Current situation
- openEHR knowledge driven platform

Drivers for Semantic Interoperability within Health Information Systems

- Manage increasingly **complex clinical** (multi professional) care
- Support collaboration between **multiple locations** of care delivery
- Deliver **evidence based** health care
- Need for intelligent **decision support** in medicine
- Better exploit **biomedical research**
- Improve safety and cost effectiveness of health care
- Enrich **population health management** and **prevention**
- Empower and **involve citizens**

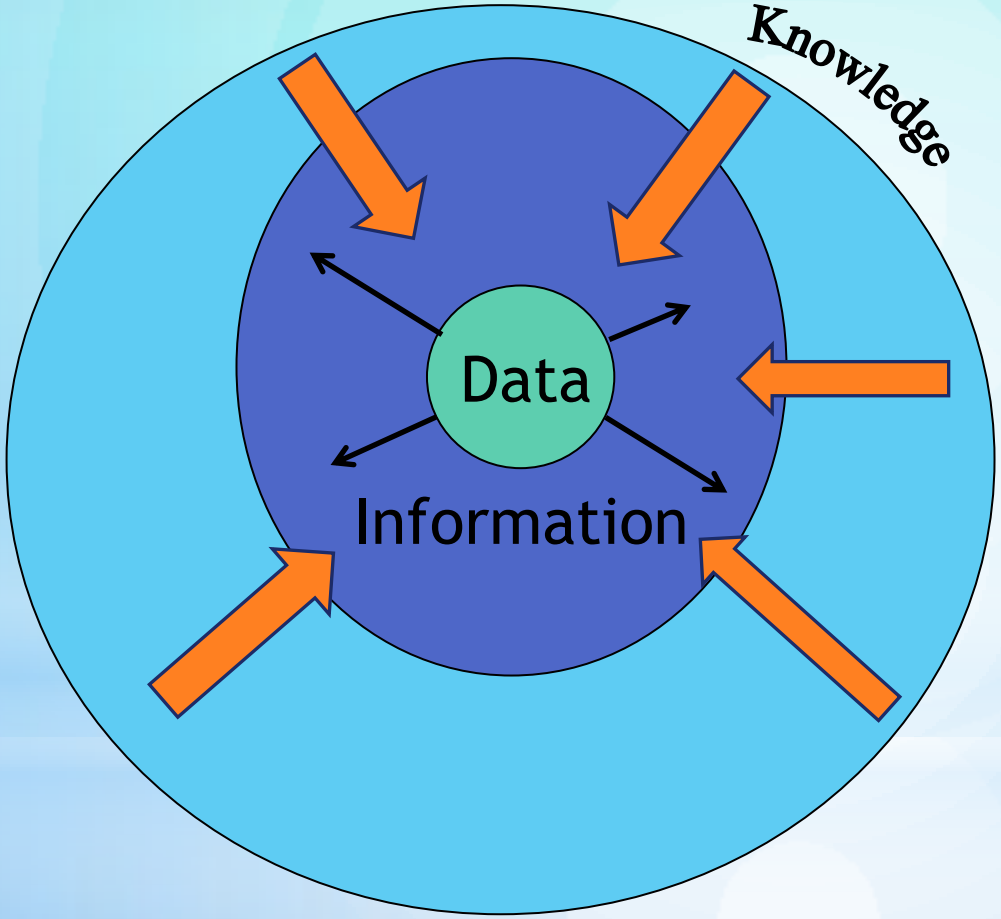
What we need is …. Knowledge



philosophy
religion
mathematics
arts
information sciences
language, literature
systems, measurement
industry, commerce
physical science
economics
life science
law
environment
politics
medicine
demography
education
social structure

The Circle of Knowledge: encyclopaedia, Ranganarthan, 1950
UNESCO, The Basic System of Order

Records capture and organize **knowledge** and **data** to represent and communicate facts, opinions and events, in context and with implied meaning



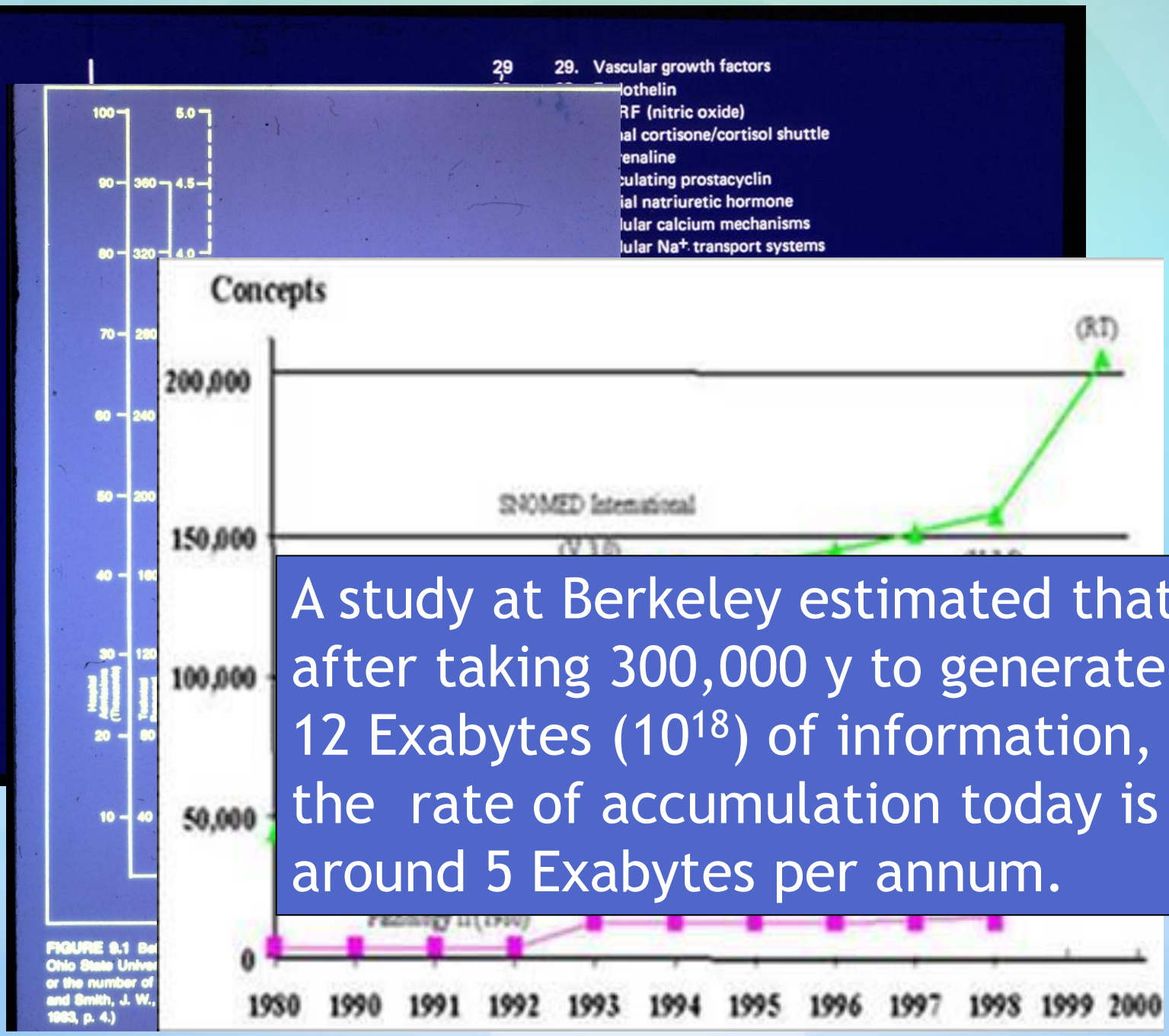
The purposes for which the record is captured, organized and communicated, reflect in both its structure and its meaning

Acknowledgement: David Ingram

* Health Knowledge Complexity

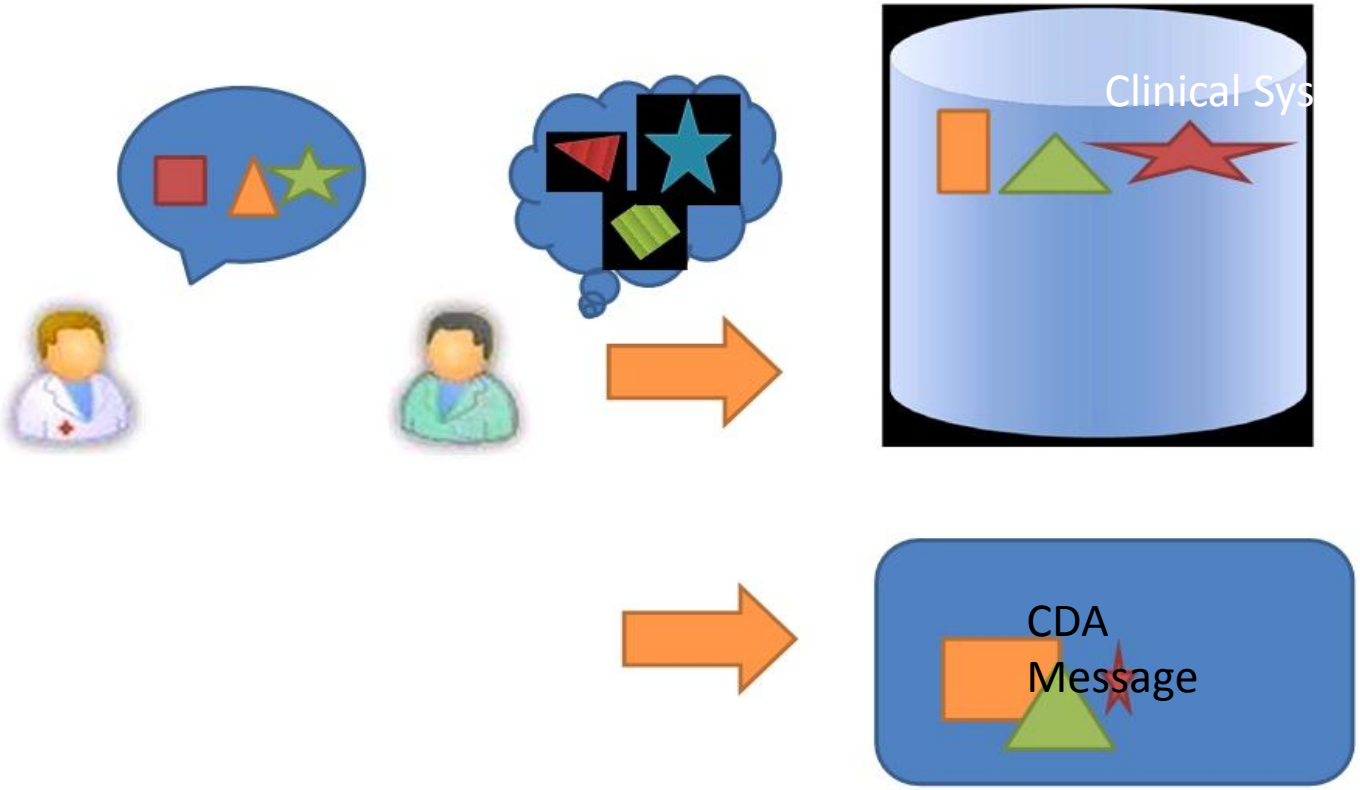
* Health care big, it is open-ended:
  * ***In breadth***, because new information is always being discovered or becoming relevant
  * ***In depth***, because finer-grained detail is always being discovered or becoming relevant
  * ***In complexity***, because new relationships are always being discovered or becoming relevant

Acknowledgement: Sam Heard



A study at Berkeley estimated that after taking 300,000 y to generate 12 Exabytes (10^{18}) of information, the rate of accumulation today is around 5 Exabytes per annum.

The clinical content dilemma



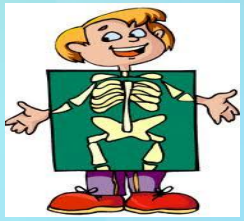
Acknowledgment: Hugh Leslie

The analogic vs digital

001101010
010101001
011110101
011010010
101010100
111101001
100101001
100010011
001010011
010101011
000000000
000000000
000000001
111111111

We are analog human beings trapped in a digital world...
We are compliant, flexible , tolerant.
Yet, we have constructed a world of machines that requires us to be fixed, rigid, intolerant.

Norman Donald

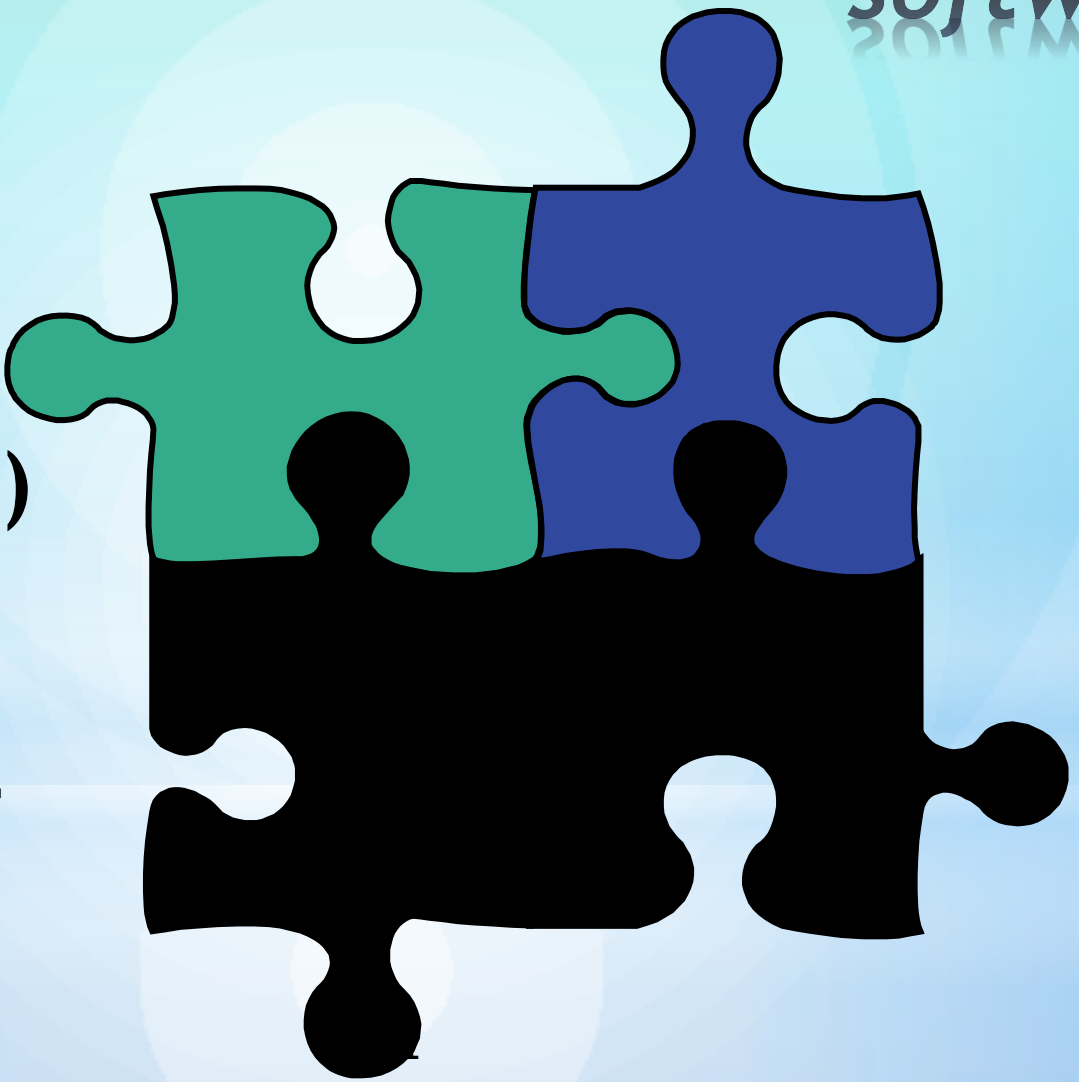


Acknowledgement: Hugh Leslie

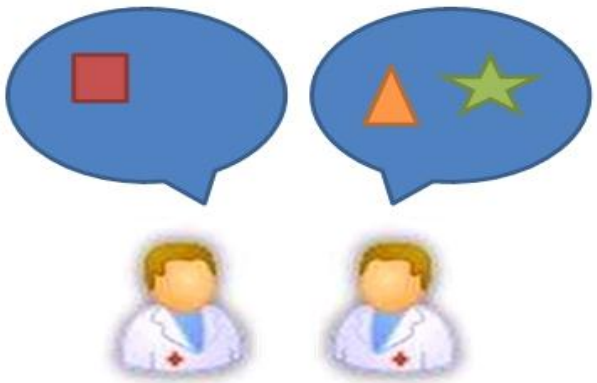
* Dynamic knowledge & traditional software

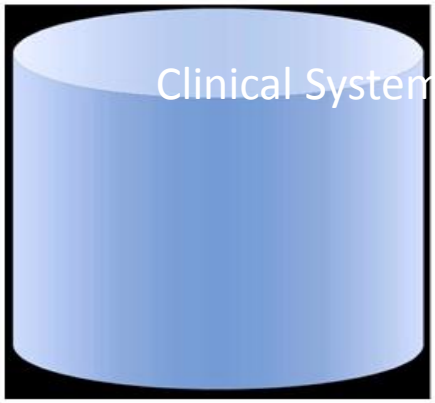
CLINICAL
(dynamic)

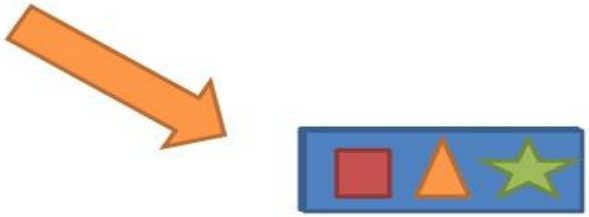
TECHNICAL



A fresh approach…







Acknowledgement: Hugh Leslie

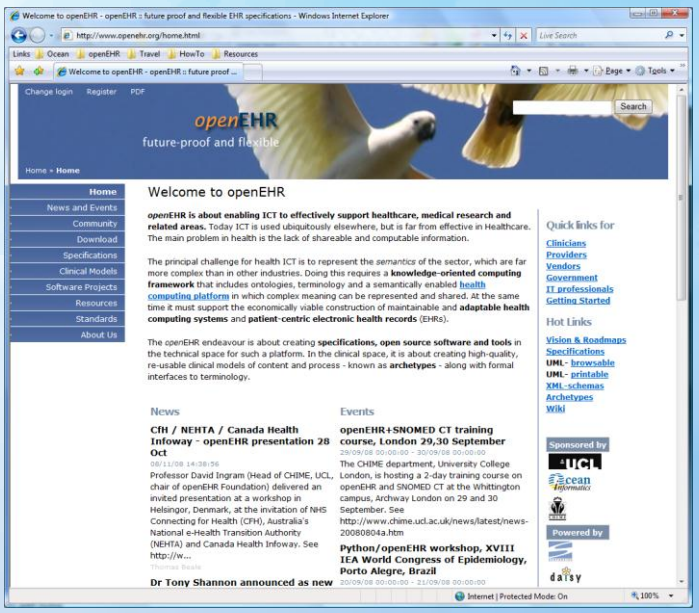
An international, on-line community, pooling efforts so that clinicians, developers and patients, everywhere, can work towards and benefit from compatible and high quality electronic healthcare records, based on an open, freely sharable, tried and tested common approach

www.openEHR.org

*The openEHR Foundation - Working towards EHR standards, experimentally

- The openEHR Foundation is a non-profit established in 2002 – www.openEHR.org
- Open source specifications for a logical EHR architecture
  - Based on 18+ years of international implementation experience including Good European Health Record Project
  - Superset of ISO/CEN 13606 EHR standard
- Engineering paradigm- a knowledge riven plaform
- Separation of clinical and technical concerns
- International Community

What is openEHR?



* Key Innovation

"Multi-level Modelling"

separation of health information representation into layers

1) Reference Model: Technical building blocks (generic)

2) Content Model: Archetypes (domain-specific)

3) Terminology: ICD, CDISC/CDASH, SNOMED etc.

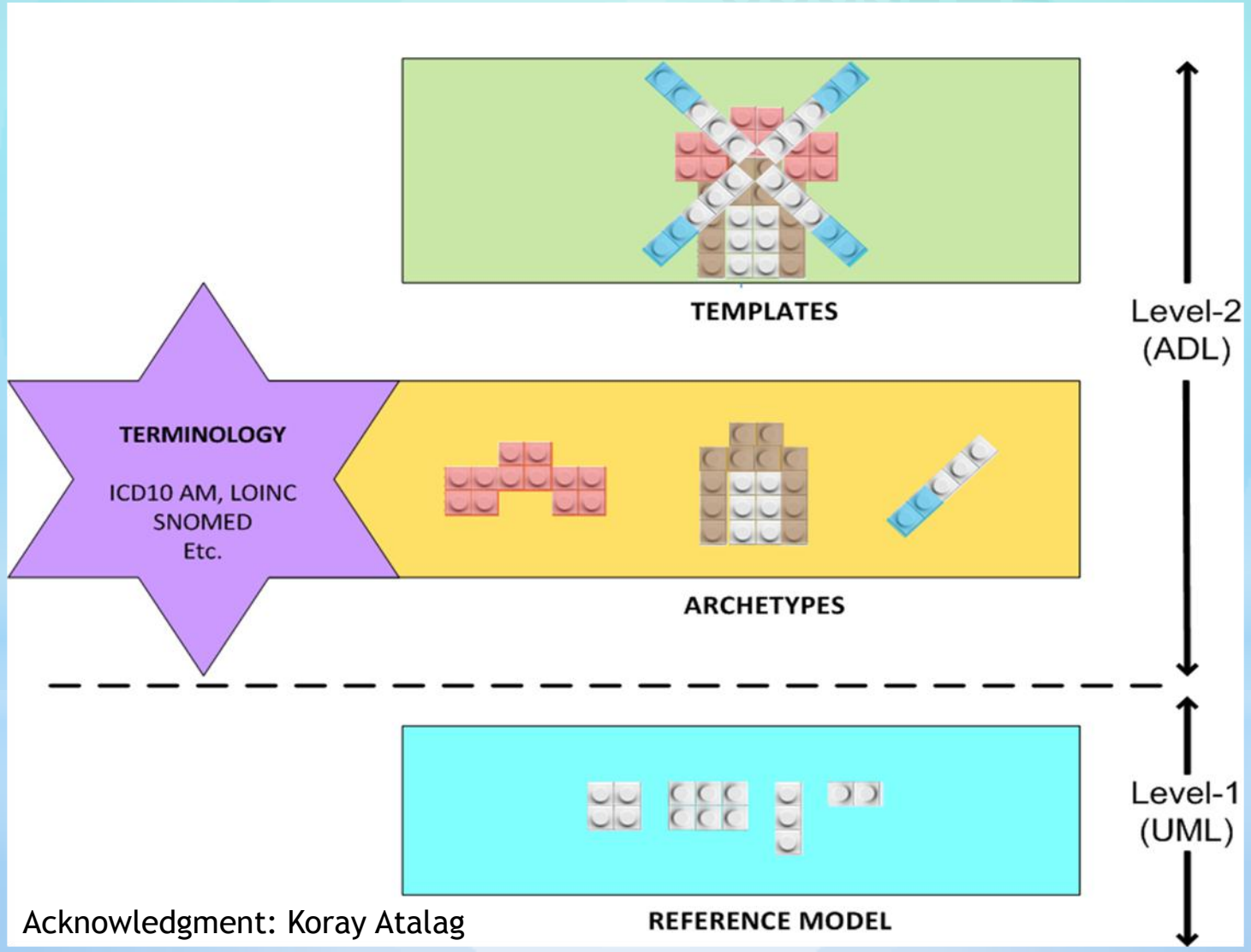
➔ Data exchange and software development based on first layer

➔ Archetypes provide '*semantics*' + behaviour and GUI

➔ Terminology provides linkage to knowledge sources (e.g. Publications, knowledge bases, ontologies)

Acknowledgment: Koray Atalag

Multi-Level Modelling in *open*EHR



Acknowledgment: Koray Atalag

To a technician, an archetype is:

A computable expression of a domain content model in the form of structured constraint statements, based on the openEHR reference model.

A logical information model

Reuseable

Acknowledgment: Hugh Leslie

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A logical information model

Reuseable

Acknowledgment: Hugh Leslie

To a clinician, an archetype is:

A definition of an atomic health concept that as much as possible completely expresses everything that you would ever want to record about that particular thing in any situation.

Acknowledgment: Hugh Leslie

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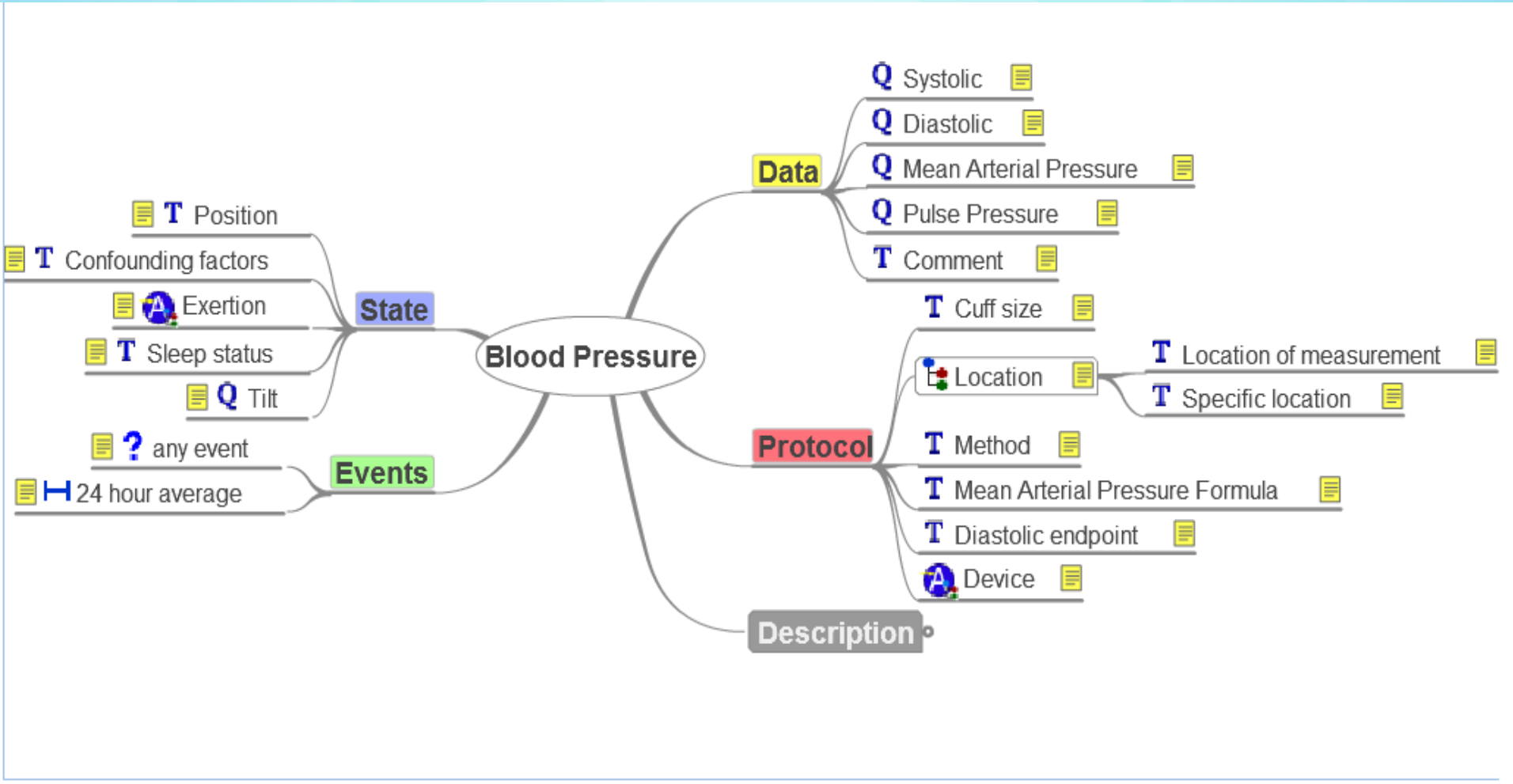
A definition of an atomic health concept that as much as possible completely expresses everything that you would ever want to record about that particular thing in any situation.

Acknowledgment: Hugh Leslie

*Content Example: Blood Pressure Measurement



* Blood Pressure Measurement
➔Meta-Data

Archetype: Blood Pressure (openEHR-EHR-OBSERVATION.blood_pressure.v1)

Header | Data | State | Protocol | Events | Reference model

Archetype ID	openEHR-EHR-OBSERVATION.blood_pressure.v1
Concept name	Blood Pressure Bound to: [SNOMED-CT(2003)::163020007] (On examination - blood pressure reading (finding))
Concept description	The local measurement of arterial blood pressure which is a surrogate for arterial. pressure in the systemic circulation. Most commonly, use of the term 'blood pressure' refers to measurement of brachial artery pressure in the upper arm.
Keywords	observations, measurement, bp, vital signs, mean arterial pressure, pulse pressure, systolic, diastolic, RR, NIBP
Purpose	To record the systemic arterial blood pressure of an individual.
Copyright	© National E-Health Transition Authority
Use	Use to record all representations of systemic arterial blood pressure measurement, no matter which method or body location is used to record it. The archetype is intended to capture blood pressure measurements in all clinical scenarios - for example, self-measurement with a home blood pressure machine; an emergency assessment of systolic using palpation and a sphygmomanometer; measurements taken in clinical consultations or during exercise stress testing; and a series of measurements made by a machine in Intensive Care. There is a rich state model that supports interpretation of measurements through identifying patient position, exercise, confounding factors and angle of a tilt table in research. Named events have been limited to average over a 24 hour period, however templates can further constrain the default 'any event' to cater for specific requirements for blood pressure measurements such as recording Blood Pressure against specific points in time, or over a range of intervals (+/- mathematical functions).

* Blood Pressure Measurement → Data

Archetype: Blood Pressure (openEHR-EHR-OBSERVATION.blood_pressure.v1)

Header | **Data** | State | Protocol | Events | Reference model

Structure: Tree
Occurrences: 1..1 (mandatory)
Cardinality: 0..* (*optional, repeating, unordered*)

Q	**Systolic** Quantity Occurrences: 0..1 (optional) [**SNOMED-CT(2003)**::163030003] (On examination - Systolic BP reading (finding))	Peak systemic arterial blood pressure - measured in systolic or contraction phase of the heart cycle.	Property: Pressure Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0
Q	**Diastolic** Quantity Occurrences: 0..1 (optional) [**SNOMED-CT(2003)**::163031004] (On examination - Diastolic blood pressure reading (finding))	Minimum systemic arterial blood pressure - measured in the diastolic or relaxation phase of the heart cycle.	Property: Pressure Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0
Q	**Mean Arterial Pressure** Quantity Occurrences: 0..1 (optional)	The average arterial pressure that occurs over the entire course of the heart contraction and relaxation cycle.	Property: Pressure Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0
Q	**Pulse Pressure** Quantity Occurrences: 0..1 (optional)	The difference between the systolic and diastolic pressure.	Property: Pressure Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0
T	**Comment** Text Occurrences: 0..1 (optional)	Comment on blood pressure measurement.	Free or coded text

* Blood Pressure Measurement ➔ Patient State

Archetype: Blood Pressure (openEHR-EHR-OBSERVATION.blood_pressure.v1)

Header | Data | **State** | Protocol | Events | Reference model

Structure: Tree
Occurrences: 1..1 (mandatory)
Cardinality: 0..* (*optional, repeating, unordered*)

Position Coded Text Occurrences: 0..1 (optional)	The position of the subject at the time of measurement.	• Standing [Standing at the time of blood pressure measurement.] • Sitting [Sitting (for example on bed or chair) at the time of blood pressure measurement.] • Reclining [Reclining at the time of blood pressure measurement.] • Lying [Lying flat at the time of blood pressure measurement.] • Lying with tilt to left [Lying flat with some lateral tilt, usually angled towards the left side. Commonly required in the last trimester of pregnancy to relieve aortocaval compression.] *Assumed value:* Sitting
Confounding factors Text Occurrences: 0..1 (optional)	Comment on and record other incidental factors that may be contributing to the blood pressure measurement. For example, level of anxiety or 'white coat syndrome'; pain or fever; changes in atmospheric pressure etc.	Free or coded text
Exertion Slot (Cluster) Occurrences: 0..1 (optional)	Details about physical activity undertaken at the time of blood pressure.measurement.	**Include:** openEHR-EHR-CLUSTER.level_of_exertion.v1 and specialisations
Sleep status Coded Text Occurrences: 0..1 (optional)	Sleep status - supports interpretation of 24 hour ambulatory blood pressure records.	• Alert & awake [Subject is fully conscious.] • Sleeping [Subject is in the natural state of bodily rest.]

* Blood Pressure Measurement ➔ Protocol

Archetype: Blood Pressure (openEHR-EHR-OBSERVATION.blood_pressure.v1)

Header | Data | State | **Protocol** | Events | Reference model

Structure: Tree
Occurrences: 1..1 (mandatory)
Cardinality: 0..* (*optional, repeating, unordered*)

Cuff size
Coded Text
Occurrences: 0..1 (optional)
[SNOMED-CT(2003)::246153002] (Type of cuff (attribute))

The size of the cuff used for blood pressure measurement.
Comment: Perloff D, Grim C, Flack J, Frohlich ED, Hill M, McDonald M, Morgenstern BZ. Human blood pressure determination by sphygmomanometry. Circulation 1993;88;2460-2470.

- Adult Thigh [A cuff used for an adult thigh - bladder approx 20cm x 42cm.]
- Large Adult [A cuff for adults with larger arms - bladder approx 16cm x 38cm.]
- Adult [A cuff that is standard for an adult - bladder approx 13cm x 30cm.]
- Small Adult [A cuff used for a small adult - bladder approx 10cm x 24cm.]
- Paediatric/Child [A cuff that is appropriate for a child or adult with a thin arm - bladder approx 8cm x 21cm.]
- Infant [A cuff used for infants - bladder approx 5cm x 15cm.]
- Neonatal [A cuff used for a neonate, assuming cuff is the appropriate size for maturity and birthweight of the neonate.]

Location
Cluster
Occurrences: 0..1 (optional)
Cardinality: 1..* (*mandatory, repeating, unordered*)

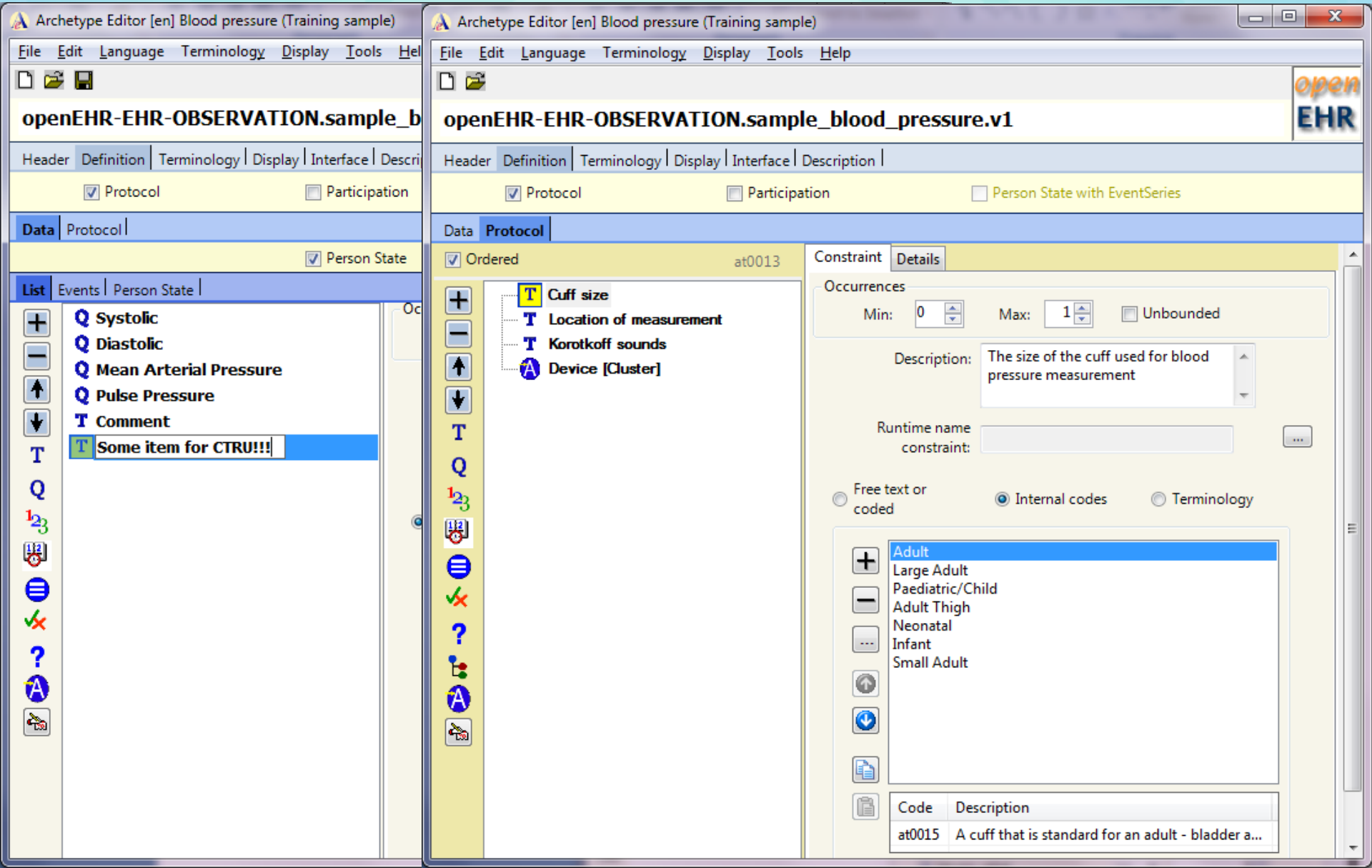
Body location where blood pressure is measured. Use 'Location of measurement' to select from common sites. Use 'Specific location' to record more specific details or a site that is not in the common set or to refer to an external terminology.

Location of measurement
Coded Text

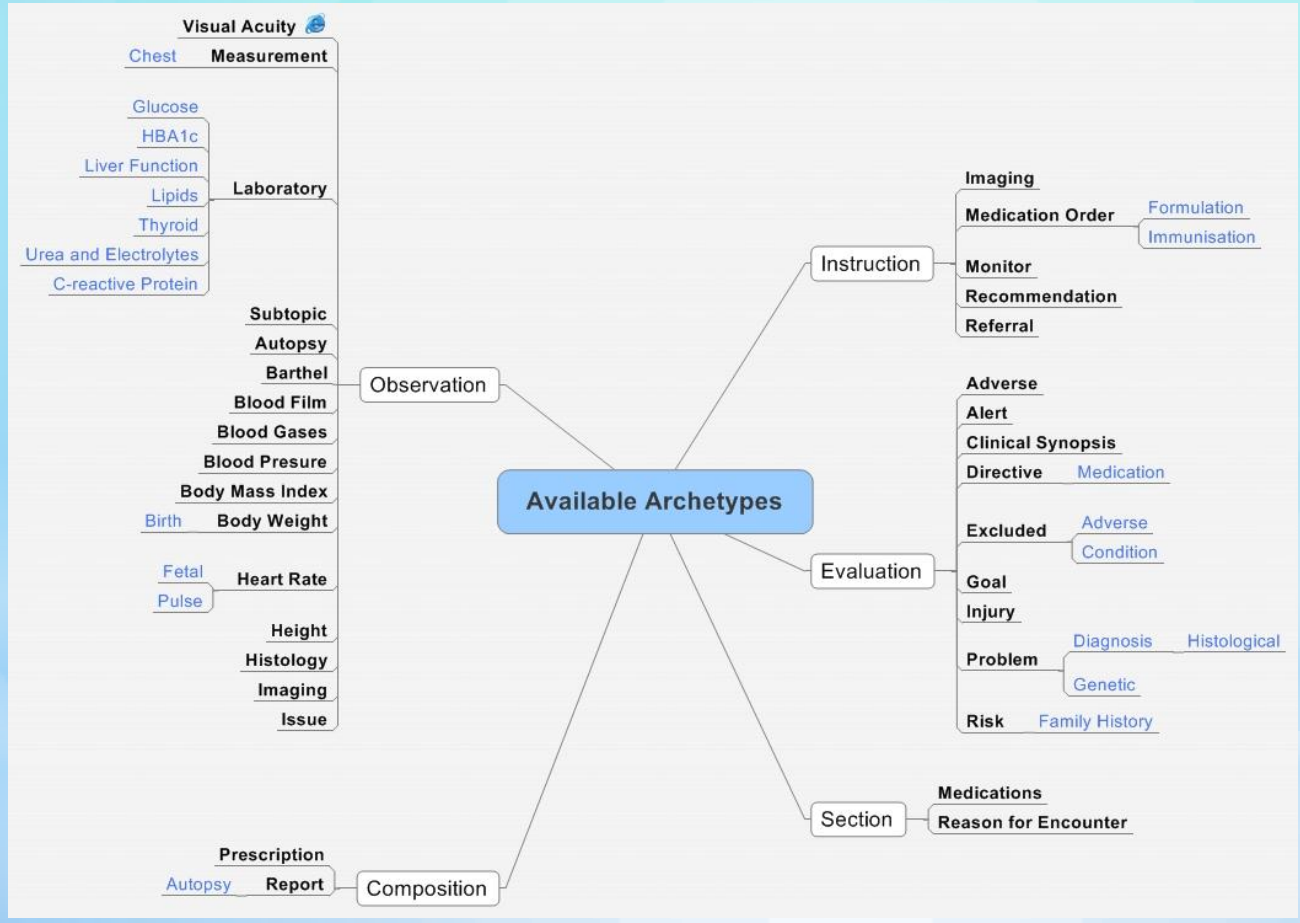
Common body sites where blood pressure is recorded.

- Right arm [The right arm of the

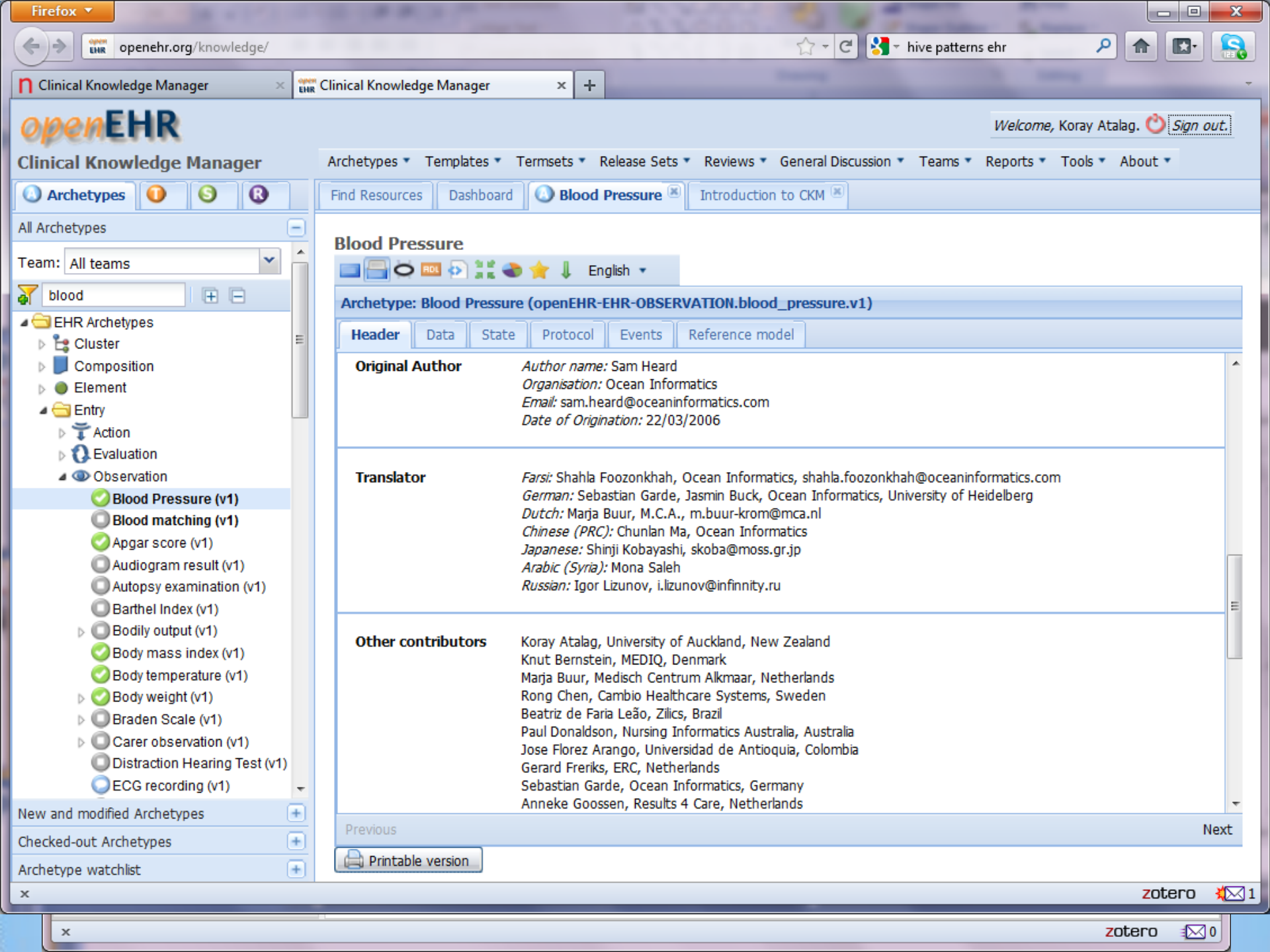
*Open Source Archetype Editor



Banks of curated, clinician-defined archetypes



openEHR


Firefox
openehr.org/knowledge/
hive patterns ehr
Clinical Knowledge Manager
Clinical Knowledge Manager
openEHR
Clinical Knowledge Manager
Welcome, Koray Atalag. Sign out.
Archetypes Templates Termsets Release Sets Reviews General Discussion Teams Reports Tools About
Archetypes
All Archetypes
Team: All teams
blood
EHR Archetypes
Cluster
Composition
Element
Entry
Action
Evaluation
Observation
Blood Pressure (v1)
Blood matching (v1)
Apgar score (v1)
Audiogram result (v1)
Autopsy examination (v1)
Barthel Index (v1)
Bodily output (v1)
Body mass index (v1)
Body temperature (v1)
Body weight (v1)
Braden Scale (v1)
Carer observation (v1)
Distraction Hearing Test (v1)
ECG recording (v1)
New and modified Archetypes
Checked-out Archetypes
Archetype watchlist
Find Resources
Dashboard
Blood Pressure
Introduction to CKM
Blood Pressure
English
Archetype: Blood Pressure (openEHR-EHR-OBSERVATION.blood_pressure.v1)
Header
Data
State
Protocol
Events
Reference model
Original Author
Author name: Sam Heard
Organisation: Ocean Informatics
Email: sam.heard@oceaninformatics.com
Date of Origination: 22/03/2006
Translator
Farsi: Shahla Foozonkhah, Ocean Informatics, shahla.foozonkhah@oceaninformatics.com
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Jose Florez Arango, Universidad de Antioquia, Colombia
Gerard Freriks, ERC, Netherlands
Sebastian Garde, Ocean Informatics, Germany
Anneke Goossen, Results 4 Care, Netherlands
Previous
Next
Printable version
zotero
1
zotero
0

* Blood pressure: CKM review

Review of archetype: Blood pressure (Revision: 6) (by ian.mcnicoll, 08-Feb-2009 14:39:53)

Header | **Data** | State | Protocol | Events | Special Questions | Overall Comments

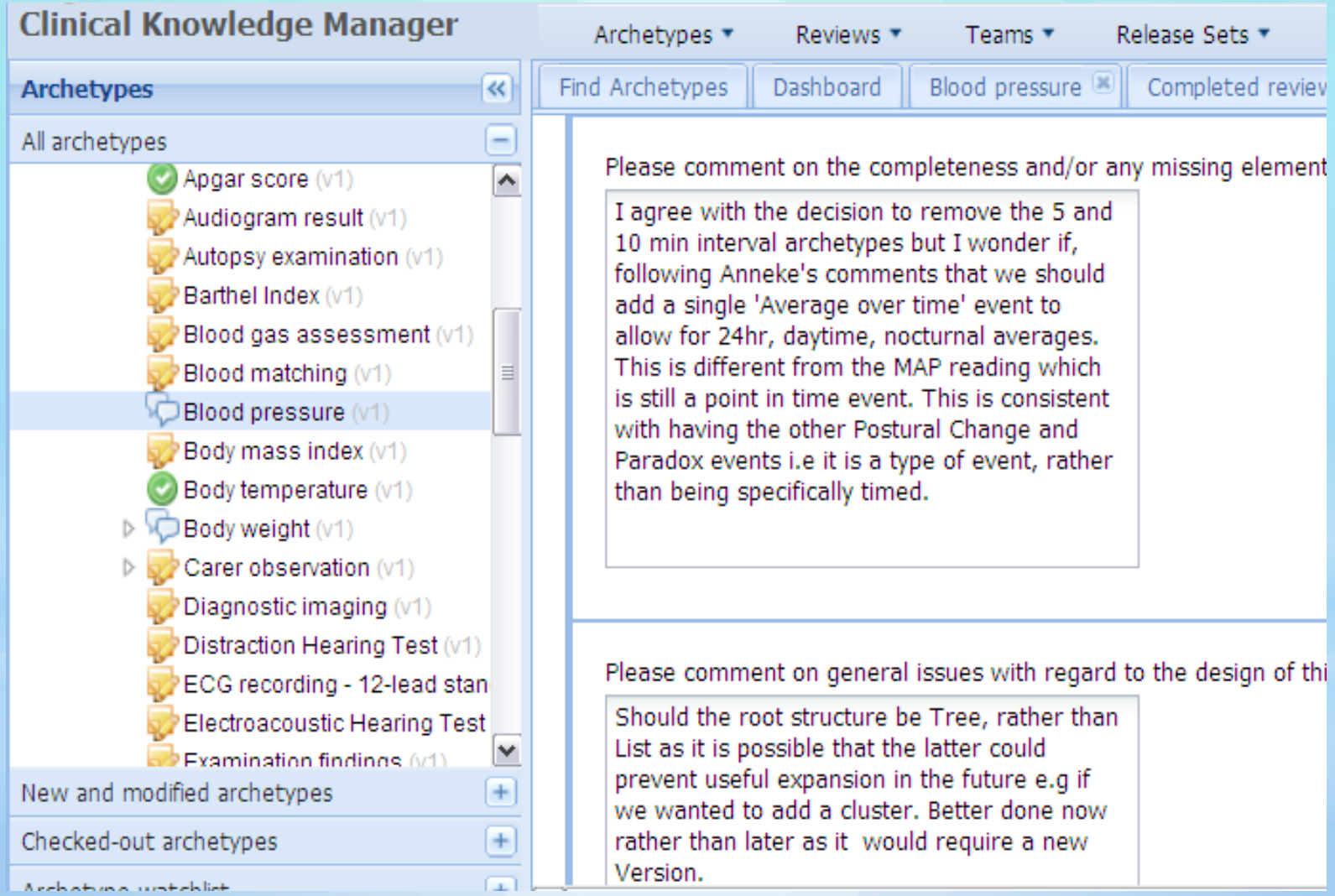
Structure: List
Occurrences: 1..1 (mandatory)
Cardinality: 0..* (*optional, repeating, ordered*)

Your Comment:

Q	**Systolic** Quantity Occurrences: 0..1 (optional) [SNOMED-CT(2003)::163030003]	Peak systemic arterial blood pressure over one cycle - measured in systolic or contraction phase of the heart cycle	Property: Pressure Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0	Your Comment:
Q	**Diastolic** Quantity Occurrences: 0..1 (optional) [SNOMED-CT(2003)::163031004]	Minimum systemic arterial blood pressure over one cycle - measured in the diastolic or relaxation phase	Property: Pressure Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0	Your Comment:
Q	**Mean Arterial Pressure** Quantity Occurrences: 0..1 (optional)	The average arterial pressure that occurs over the entire course of the heart contraction and relaxation cycle. In non-invasive blood pressure measurements the MAP is calculated using (2 x Systolic Blood Pressure + Diastolic Blood Pressure) divided by 3.	Property: Pressure Units: • 0.0..750.0 mm[Hg] Limit decimal places: 1	Your Comment:
Q	**Pulse Pressure** Quantity Occurrences: 0..1 (optional)	The difference between the systolic and diastolic pressure over one contraction cycle.	Property: Pressure Units: • 0.0..750.0 mm[Hg] Limit decimal places: 0	Your Comment:
T	**Comment** Text Occurrences: 0..1 (optional)	Comment on blood pressure reading	Free or coded text	Your Comment:

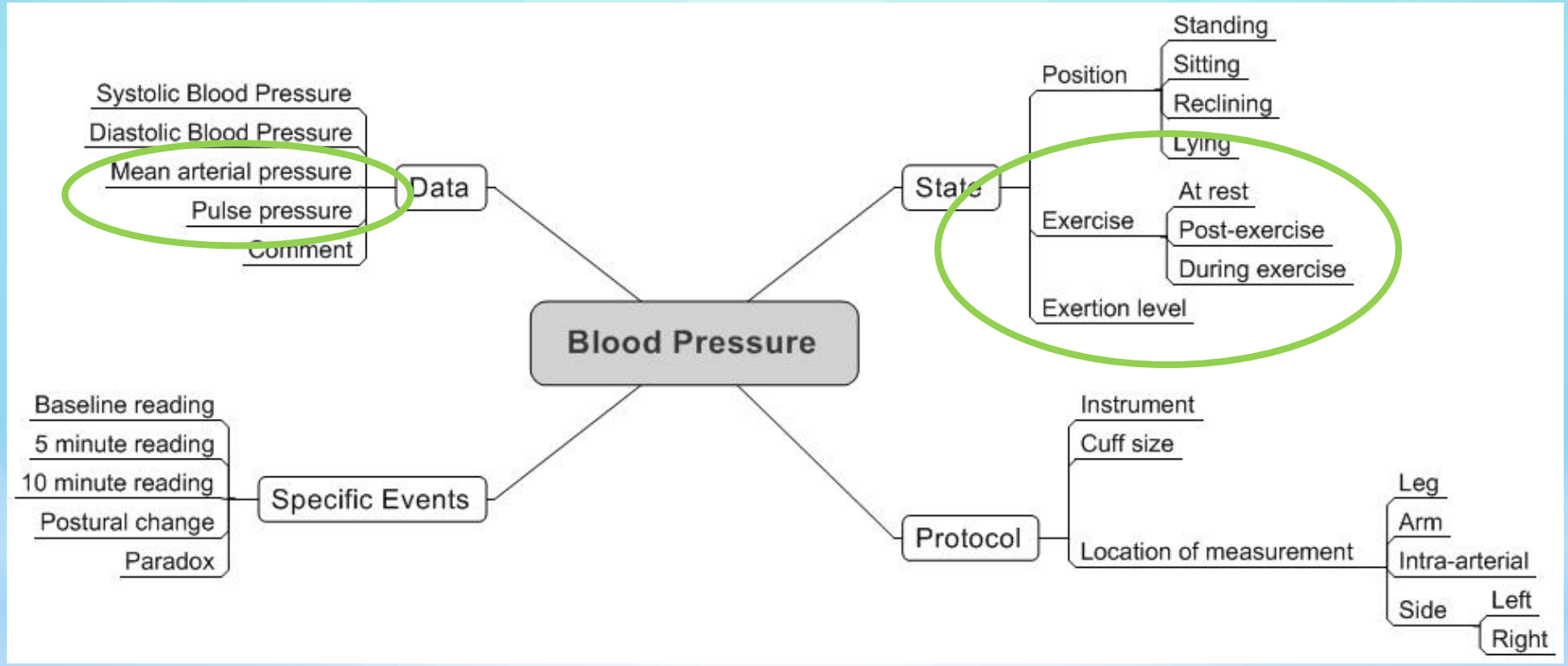
Acknowledgement: Heather Leslie & Ian

Blood pressure: CKM review



Acknowledgement: Heather Leslie & Ian

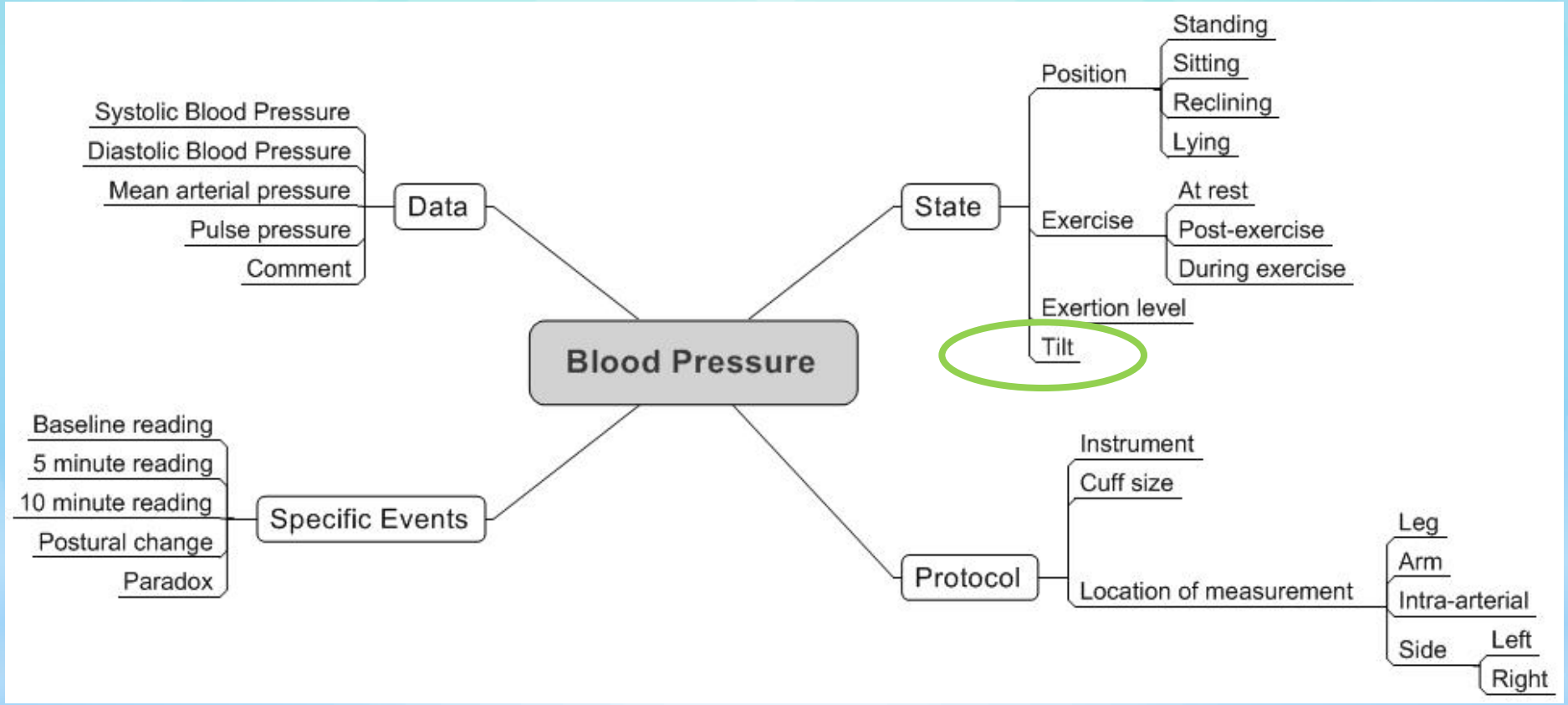
*Blood Pressure v2



…additional input from other clinical settings

Acknowledgement: Heather Leslie & Ian

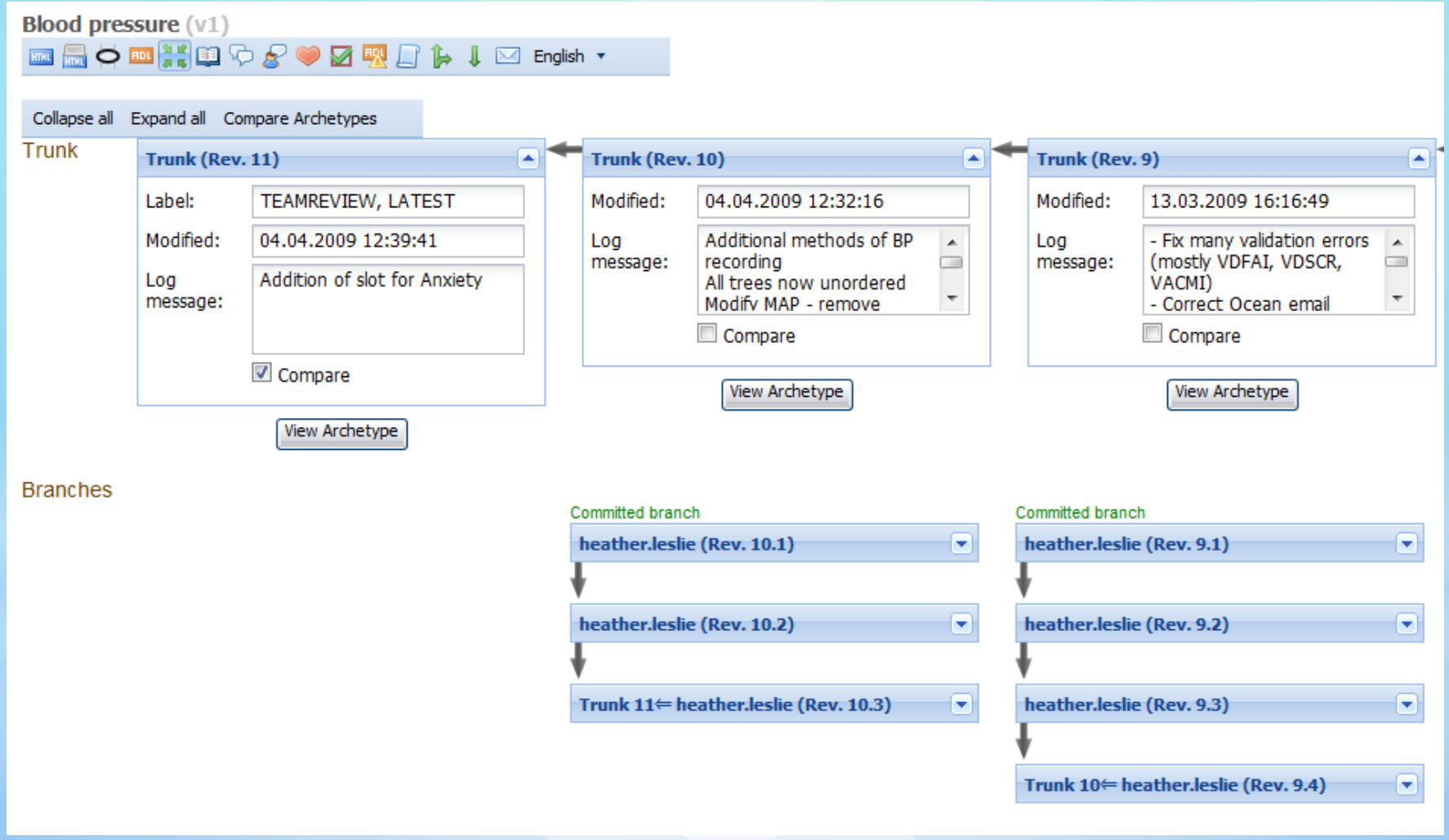
*Blood Pressure v3



…and researchers

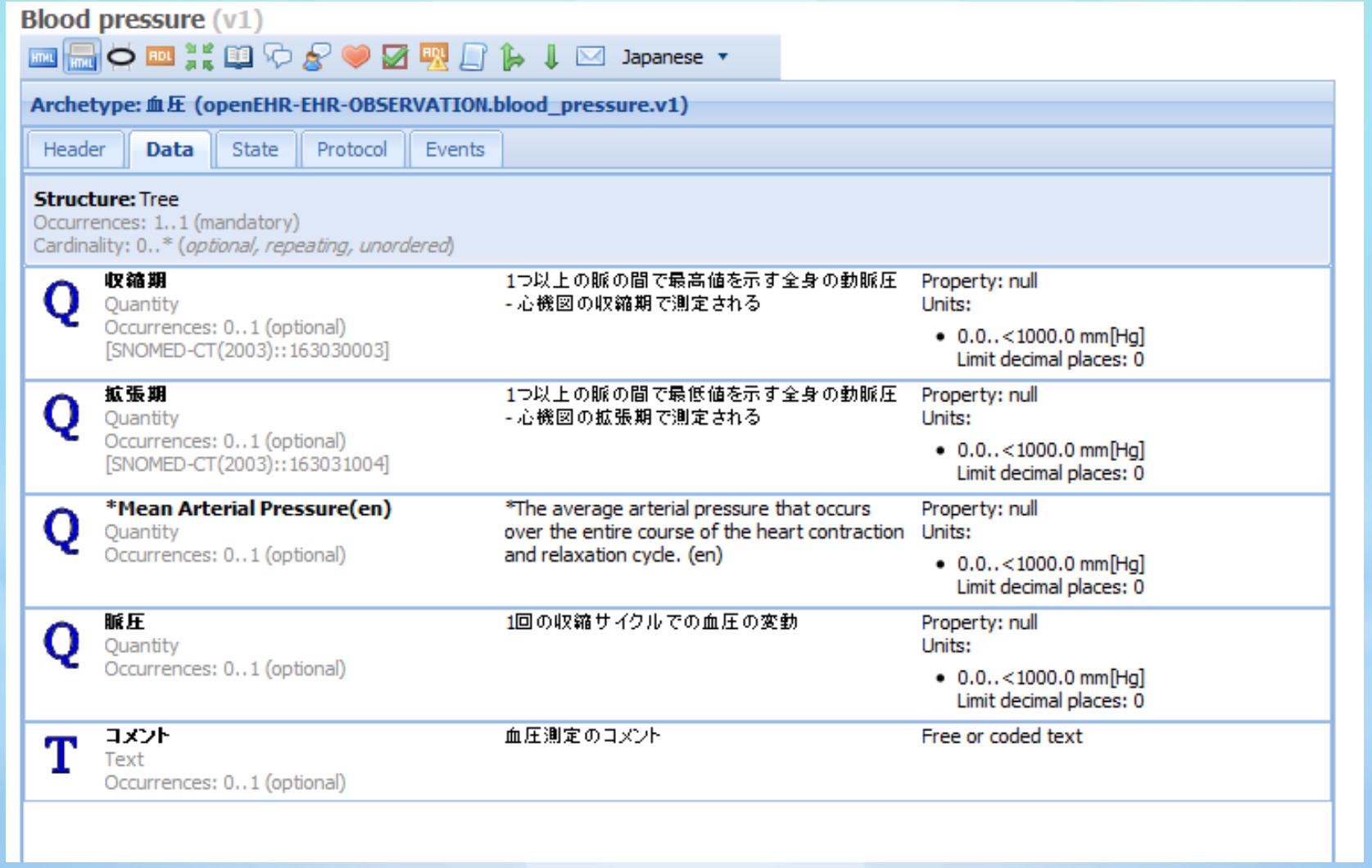
Acknowledgement: Heather Leslie & Ian

* CKM: Versioning



Acknowledgement: Heather Leslie & Ian

Blood Pressure: Translation



Blood pressure (v1)

Japanese

Archetype: 血圧 (openEHR-EHR-OBSERVATION.blood_pressure.v1)

Header | **Data** | State | Protocol | Events

Structure: Tree
Occurrences: 1..1 (mandatory)
Cardinality: 0..* (*optional, repeating, unordered*)

Q	**収縮期** Quantity Occurrences: 0..1 (optional) [SNOMED-CT(2003)::163030003]	1つ以上の脈の間で最高値を示す全身の動脈圧 - 心機図の収縮期で測定される	Property: null Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0
Q	**拡張期** Quantity Occurrences: 0..1 (optional) [SNOMED-CT(2003)::163031004]	1つ以上の脈の間で最低値を示す全身の動脈圧 - 心機図の拡張期で測定される	Property: null Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0
Q	***Mean Arterial Pressure(en)** Quantity Occurrences: 0..1 (optional)	*The average arterial pressure that occurs over the entire course of the heart contraction and relaxation cycle. (en)	Property: null Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0
Q	**脈圧** Quantity Occurrences: 0..1 (optional)	1回の収縮サイクルでの血圧の変動	Property: null Units: • 0.0..<1000.0 mm[Hg] Limit decimal places: 0
T	**コメント** Text Occurrences: 0..1 (optional)	血圧測定のコメント	Free or coded text

Acknowledgement: Heather Leslie & Ian

* CKM: Discussions

ian.mcnicoll (08.01.2009 00:54)

Do we need something on anxiety level?

4 replies

In GP patient anxiety/ agitation is a common confounding patient state for a number of observations e.g BP, Respirations, heart rate.

Should we include a cluster Slot for a CLUSTER archetype Anxiety level

Overall Comments

Koray Atalag on the completeness and missing elements (16-Jul-2009)

Consider its use in conditions where atmospheric pressure and/or ambient pressure is not normal (i.e. underwater, hyperbaric chambers, high-altitude and so on.). [Probably "confounding factors" node will do it]. For example diving increases blood pressure, even in divers with normal pressure. This occurs due to the immersion-caused shift of the blood into the thorax and the constriction of peripheral blood vessels.

However I think we need to add a value item to the position node for conditions where gravity is zero. The reason is that all those positions actually alter the blood pressure because they change the direction of the gravitational force exerted on the cardiovascular system. We are actually interested with the vectoral direction of the gravitational force and what I suggest is we may also want to record its total "absence" which will definitely alter blood pressure.

Andrew James on the completeness and missing elements (16-Jul-2009)

Complete

Editor Feedback:

Enhanced the Confounding factors description to include changes in atmospheric pressure.
Any more required detail can be added as an archetype revision when we clarify the additional requirements for space/hyperbaric chambers etc.

*openEHR community

- is open to individuals or organizations that support its goals and methods, with free individual membership and subscriptions from formal Associates
- supports international community and consensus on the principles of a good electronic healthcare record (GEHR), and embodies these within the *open*EHR specifications and architecture
- researches and develops best practice in the formal specification and validation of clinical requirements, design and implementation of EHR systems
- works for their international clinical harmonization and standardisation

Clinical challenges for adopting archetypes

* Grow communities to author, review and adopt archetypes for different domains
* Enrich the tooling to support clinicians
* Improve the binding to SNOMED-CT
* Define good practice for authorship
* Establish quality, governance and certification processes

Features and benefits

- Enables clinical control of semantic interoperability through archetypes
- Allows evolution of representation of clinical concepts over time
- Dissociates electronic health care records from dependency on particular clinical software applications or particular health care information infrastructures
- 'Future-proofs' health records for lifelong care
- Has been shown to provide a more sustainable code base for clinical systems, up to 8x more time-efficient to maintain than traditional database methods

State of play, today

- Comprehensive EHR specification
  - Information model, Archetype model, Communication specification, Service specification
- Growing
  - base of implementation experience and learning, in real-life settings
  - set of tools - .NET, JAVA, Ruby, Python
  - community of developers and users, organised within national/regional associations
- Linkage with clinical research, clinical trials standards and education

Outcomes

*open*EHR is now found…

- in CEN/ISO EN13606-1 and -2
- in around 15 commercial products
- in the CIMI content standardization initiative
- in the e-health programmes of the UK, Denmark, Sweden, Australia and Brazil, with another 10 or so countries moving towards it
- In national chapters in Japan, New Zealand and Brazil
- in dozens of universities
- in a growing number of enterprise clinical and secondary applications

openEHR basis of CIMI

- HL7 Fresh Look task force to focus on clinical content modelling, now independent
- Gathered together leading international experts on clinical content modeling – diverse experiences to create an open and shared repository of computable clinical models
- Founding organizations include: UK NHS, Canada Health Infoway, NEHTA, Ministry of Health Singapore,GE Healthcare, Intermountain Health, Kaiser Permanente, Mayo Clinic,openEHR, CDISC, HL7, IHTSDO and US Dept of Defence/VA/NIH
- Based on a single initial formalism and on a common set of base data types
- With formal terminology bindings
- CIMI specifications will be freely available to all.

CIMI (2)

- GOAL: to enable the storage of lifelong health information; simplify data exchange, aggregation, querying and analysis; and support knowledge-based activities such as decision support.
  - This will be achieved through the development of non-proprietary, common and fully defined information models of clinical content and known transformations
- **ADL 1.5** will be the initial formalism for representing clinical models in the repository.
- SNOMED CT and LOINC the reference terminologies
- CIMI will use the openEHR constraint model (Archetype Object Model: AOM).
- A significantly pared down version of the openEHR RM approved as the starting point for a CIMI Reference Model
- AML : Archetype Modeling Language – UML profile for modeling archetypes - OMG RFP (http://www.omg.org/cgibin/doc?health/2012-06-06)

openEHR in Brazil

- Reference Model to the National EHR
- Modeling of clinical content has already begun using the 13.606 archetypes of Minas Gerais States for primary care
- An assessment of the differences in modeling between these 13606 archetypes and openEHR was done to identify equivalent existing openEHR archetypes, where was found that some of the 13606 models might represent complex concepts and should be template
- A lot of commonality was found, which is going to facilitate the mapping
- There´s an undergoing process to have a national CKM instance , initially hosted by SES Minas Gerais which is celebrating a partnership with Brazilian Medical Informatics Association and Federal University of Minas Gerais in order to set up a governance process of clinical content artefacts in Brazil

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