HIC 2006 Bridging the Digital Divide: Clinician, consumer and computer
Eds: Johanna Westbrook & Joanne Callen
Publisher: Health Informatics Society of Australia Ltd (HISA)
ISBN 0 9751013 7 4

Archetypes 101

Heather Leslie, Sam Heard

Ocean Informatics Pty Ltd, Sydney, Australia

ABSTRACT

Background: *With increasing interest in openEHR in Australia and overseas, and the recent release of the NEHTA recommendations on standards for Shared EHRs, there is a need for grassroots clinicians to be able understand the role and practical application of archetypes in clinical electronic health records. Creation of rich and meaningful archetypes that underpin archetype-enabled clinical software requires engagement and involvement of the broadest range of clinicians, who will each have varying levels of technical understanding.* ***Objectives:*** *This paper aims to provide a straightforward non-technical overview of archetypes for clinicians and thereby to encourage interested clinicians to participate in archetype development. Specifically this paper describes the openEHR architecture, focusing on the importance of clinician-developed archetypes in enabling truly shareable life-long-health records. This is illustrated through practical examples of the way in which the design of archetypes will influence day-to-day clinical patient care.*

Keywords:

Archetype, *open*EHR, semantic interoperability, Electronic Health Records, shared EHR

INTRODUCTION

In February 2006 the *open*EHR Foundation published release 1.0 of the *open*EHR architecture. This work was the culmination of over 10 years of research and development resulting in a new approach to the development of electronic health records (EHR). The work has been taken up by CEN (European Committee for Standardization) as the basis for the new EHR standard (ENV13606). As this work matures, and as more *open*EHR-enabled systems are built and used, a broader audience needs to be able to understand the concepts and implications that arise from *open*EHR. Until now *open*EHR documentation has focused on design and implementation and is accordingly quite abstract and technical for the average reader. This paper offers a non-technical overview of *open*EHR, particularly focusing on the role of clinicians in building archetypes. The few available practical guides for grass-roots clinicians to create archetypes encapsulate only the most basic principles [1, 2]. This reflects relative infancy of the 'art' of creating archetypes, and emphasises the need to develop non-technical documentation and guidelines to support clinician experts to participate in creating and maintaining archetypes.

*open*EHR ARCHITECTURE

The *open*EHR architecture is described as "a rigorous yet flexible EHR development framework (that) enables reliable sharing of clinical meaning in addition to guaranteed data interoperability" [3]. Importantly, *open*EHR is *not* a commercial software application such as might be used in a consultation to generate a computerised prescription or record a clinical consultation. Rather, *open*EHR provides the specification for an EHR service which supports any or all EHR software applications, so the clinician-user will see and use the software application and can be totally unaware of *open*EHR 'working behind the scenes'. The *open*EHR architecture enables an

ISBN 0 9751013 7 4

*open*EHR-enabled software application to exchange clinical data, and for it to be understood and viewed in another unrelated clinical application. The meaning and context of the health data is preserved and can be interpreted and utilised within the second system. The ultimate goal of *open*EHR is to make shared EHRs achievable.

*open*EHR's new approach to EHR development is known as two-level modelling, and is markedly different to the traditional way of designing and building software. This new approach involves the separation of clinical knowledge (archetypes) from the information or recording model (repository). The latter is referred to as the Reference Model which describes in detail the rules, and structure about how, where and by whom each piece of patient clinical data is stored, where it came from and who has altered it over time.

How is two-level modelling different? Traditional clinical software development is led by professional IT developers who represent the clinical concepts within the database structure itself. This single-level model of software development is relatively quick to get to market, but is vulnerable to the dynamic and ever-changing nature of health knowledge – which every day becomes broader, deeper, and richer. Traditional software applications must be modified and extended to cope with this volatile knowledge burden, and consequently can quickly become outmoded and obsolete. The reality is that clinical systems can never be 'finished', and failure to understand this fundamental concept has previously been a major barrier to the development of long-term health records.

*open*EHR's two-level modelling enables the repository (based on the Reference Model) to contain only generic knowledge and business rules and is thus smaller, easier, and cheaper for technicians to build and maintain. As clinical knowledge is stored completely separately in archetypes, resulting EHR systems are more flexible as changes in the clinical knowledge can be embraced by modifications in archetypes, without compromising the integrity of information in the repository. For the first time it is possible to keep EHR data for 100 or more years – life-long health records and future-proof EHR systems! It is also important to emphasise at this point that, in an *open*EHR-enabled system, the technicians manage the aspects of an EHR that is within their expertise, leaving the clinicians to drive the clinical aspects through the creation and maintenance of archetypes. As the technical and design aspects of *open*EHR have largely been determined, the next phase is to get clinicians involved in archetype development.

ARCHETYPES

What is an archetype?

The Concise Oxford Dictionary defines an archetype as "an original model, prototype or typical specimen". In *open*EHR, an archetype is the model (or pattern) for the capture of clinical information – a machine readable specification of how to store patient data using the *open*EHR Reference Model.

Archetypes are a keystone of the *open*EHR architecture. Each archetype describes a complete clinical knowledge concept such as 'diagnosis' or 'test result'. By design, they provide structure and specify content which means that archetypes can be both clinically meaningful and interpretable by EHR systems. Archetyped data will have the same meaning no matter what context it is used within the EHR and, similarly, no matter which EHR system it is used or what language is used.

HIC 2006 Bridging the Digital Divide: Clinician, consumer and computer
Eds: Johanna Westbrook & Joanne Callen
Publisher: Health Informatics Society of Australia Ltd (HISA)
ISBN 0 9751013 7 4

Exchange of patient health data requires that the meaning and context of clinical information sent by one system results in accurate interpretation by the receiving EHR. This is known as knowledge-level (or semantic) interoperability. In *open*EHR archetypes perform this important role. In addition, archetypes are the means by which the dynamic nature of clinical knowledge can be captured and utilised in a computer-interpretable format within EHRs. With *open*EHR, clinicians are not just passive users of *open*EHR-enabled software and systems, but actively determine the possible breadth, depth, and richness of patient data kept in EHR systems and directly affect the quality of patient care through their pivotal role in creating, revising, and updating archetypes. Archetypes empower clinicians to influence how their EHRs will function.

Each archetype is inclusive of all the attributes clinicians might want to capture about a specific clinical concept – effectively, creating a maximal data set. It also incorporates additional details such as the context that will be important for interpretation of the data (referred to as the 'State') and about how the information was gathered (referred to as the 'Protocol). These elements of a 'blood pressure' archetype are represented in Figure 1 below.

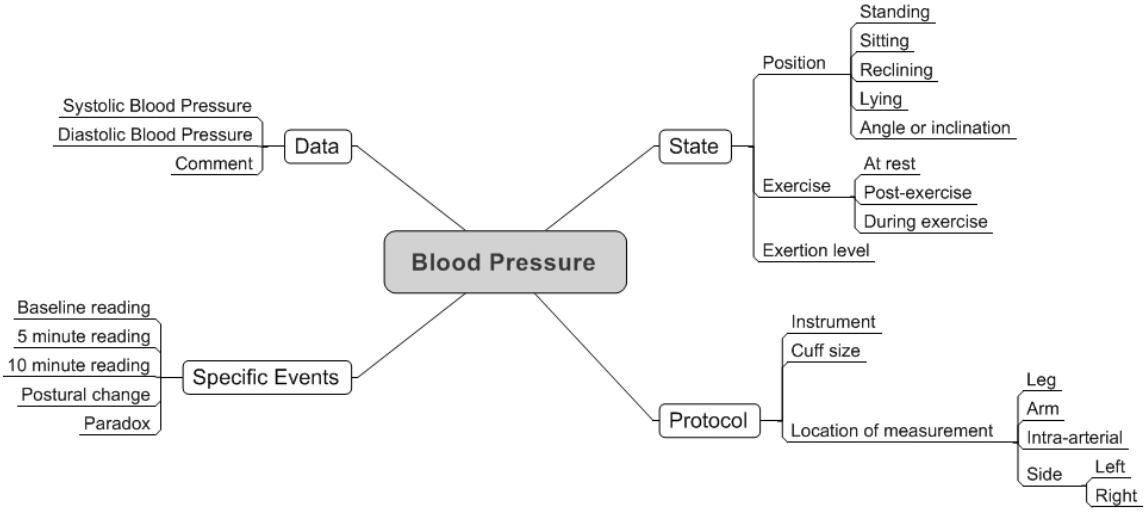

Figure 1: Blood pressure archetype

The range of clinical concepts that are 'archetypable' is open-ended and limited only by the imagination of clinicians and researchers. It is inclusive of all levels of detail required to contribute to a health record – from the smallest and simplest Entries capturing basic concepts such as 'blood pressure' or 'height' through to composite and complex archetypes that define a 'family history', 'clinical consultation record' or 'care plan'.

Attributes of Archetypes

By design archetypes incorporate rules on how data can be entered, and so data entered into an archetype-enabled system will only be captured if it fits those rules. This feature improves the data quality of a system considerably, and archetype-powered searches or queries on the EHR are better able to find specific data. Similarly, archetyped data is able to be viewed consistently and reproducibly no matter where they appear within a single EHR or within any number of EHR systems. Some of the rules that clinicians can set within archetypes to make the information captured or viewed fit their requirements include:

HIC 2006 Bridging the Digital Divide: Clinician, consumer and computer
Eds: Johanna Westbrook & Joanne Callen
Publisher: Health Informatics Society of Australia Ltd (HISA)
ISBN 0 9751013 7 4

- The maximum and minimum value of a measurement that could possibly be sensible or meaningful e.g. not allow a pulse rate that is less than zero;
- The allowed units of measurement, with associated numeric ranges e.g. weight in gm or kg;
- The appropriate set of terms from a terminology that could be used e.g. a set of blood groups including the associated Rhesus typing;
- An internal value set that is allowed for an element in the archetype e.g. in a subjective assessment of menstrual loss there may be the options of 'None', 'Light', 'Normal', and 'Heavy'; and
- Establish whether a piece of clinical data is required or optional.

Types of Archetypes

There are three categories of archetypes – each corresponding to classes in the reference model - that are useful to understand when starting out.

1. Thematic archetypes of Compositions – which correspond to commonly used clinical documents, such as 'antenatal visit' or 'care plan'.
2. Organisational archetypes of Sections – these are effectively used to assist with human navigation within EHRs and correspond to document headings, for example 'antenatal examination' or 'summary'.
3. Descriptive archetypes of Entries – these are the most common and are fundamental building blocks of EHRs. There are four types of Entry archetypes:
   - Observations – recording measurable or observable data e.g. blood pressure, symptoms or weight;
   - Evaluations – recording clinically interpreted findings e.g. adverse event or assessment of risk;
   - Instructions – recording the initiation of a workflow process, such as a medication order or referral;
   - Actions – recording clinical activities e.g. procedure or medication administration. Actions complement the instruction and can record the ensuing state of the instruction, such as 'completed' or 'cancelled'.

Using Archetypes

Archetypes are standalone entities and can be:

- Created – build a new archetype to meet clinical needs;
- Shared – existing archetypes are stored in a web-based archetype repository, currently located on the Ocean Informatics web site, and can be browsed;
- Reused – clinicians or software developers are able to re-use existing archetypes from the archetype repository in various EHR systems and for varying needs;
- Specialised – an existing archetype can be refined in order to meet special or specific clinical requirements e.g. the 'weight' archetype has been specialised to create a 'birth weight' archetype;
- Revised – as clinical knowledge changes, the core archetype can be modified and updated without invalidating data stored using archetypes in current use; and
- Versioned – new versions of an archetype can be created if the core archetype is found to be badly flawed e.g. if the knowledge underpinning the archetype is found to be totally incorrect.

HIC 2006 Bridging the Digital Divide: Clinician, consumer and computer
Eds: Johanna Westbrook & Joanne Callen
Publisher: Health Informatics Society of Australia Ltd (HISA)
ISBN 0 9751013 7 4

Language and Terminology

Archetypes are both language and terminology independent. This means that an archetype developed in English can be translated, interpreted and viewed in another language without losing meaning or context, and so EHRs have the potential to be shared across international borders. Currently archetypes have been developed in English, Turkish, Swedish, Dutch, German, and Farsi. Similarly, a range of clinical terminologies can be integrated into archetypes in order to more specifically define each archetype element – for example, SNOMED-CT, LOINC etc.

How can archetypes contribute to clinical care?

For the first time *open*EHR offers a stable standard format for patient-centred EHRs, as the software does not have to be changed every time clinical knowledge or requirements change - only the archetypes need to be modified. This makes possible life-long health records (from cradle to grave) and future-proof EHR systems. Consider how a pregnancy record of a mother today can 'kick-start' an infants health record and make important pregnancy information, such as exposure to rubella or teratogens, available to that infant in decades ahead. Also, a blood pressure reading that is recorded as part of a clinical consultation today can now be available as part of decision support in 10, 20 or even 50 years time. Rich, broad and deep EHRs can evolve and grow - compared to current isolated pockets of clinical data that are not able to be linked or connected meaningfully.

EHR systems will be able to share patient health information in a consistent and reproducible manner within and between EHRs. The full scope of shared EHRs can now be realised from Personal Health Records and General Practice desktop applications through to Hospital systems and on to Public Health research and planning. Archetype-enabled data entry offers the chance to extend capability without software upgrades and also to improve clinical data collection through constraint to sensible values.

Patient health information based on archetypes can be shared both by multiple EHR systems and by different types of health care professionals. It is even possible to have two different archetype-enabled EHR systems accessing the same patient information. For example, two clinicians within the same General Practice or institution can use the clinical software application of their choice to access exactly the same patient information.

Archetypes also provide the basis for searching or querying EHR repositories. The ability to work from a shared knowledge framework to query information in different systems will transform both clinical care and research. Archetype-enabled research data repositories can be federated, or merged, for more effective research and data-mining.

Intelligent generic decision support programs can rely on archetype-triggered events and for the first time operate in real-time. For example, the loading of a 'medication order' archetype into a clinical EHR application, in response to a clinician writing a computerised prescription, can now trigger generic software to provide appropriate decision support suggestions, warnings or reminders that will improve patient safety. Archetypes can be integrated with clinical terminology systems so that reliable deductions can be incorporated in clinical decision support based on EHR data. Finally, archetypes can facilitate recognition of the current status of a clinical instruction e.g. active, inactive, suspended, completed medication orders or referrals, which is critical for accurate and appropriate decision support systems and reminders/alerts, and in computer-tracking of clinical workflow, such as care plans, and progress through clinical guidelines.

HIC 2006 Bridging the Digital Divide: Clinician, consumer and computer
Eds: Johanna Westbrook & Joanne Callen
Publisher: Health Informatics Society of Australia Ltd (HISA)
ISBN 0 9751013 7 4

CONCLUSION

Archetypes are powerful representations of clinical knowledge which will increasingly be implemented within EHR systems and used everyday by a broad range of clinicians involved in patient care and research. Through the use of archetypes, clinicians contribute directly to the evolution of their EHRs, and to the breadth, depth and richness of patient health data that can be stored within them. At first, designing an archetype can appear daunting and part of an overly complex technical world. However, armed with evolving software tools and simple guidelines, grass roots clinicians can actively participate in an international community who are striving build best-practice and future-proof EHR systems to enhance patient care and safety.

REFERENCES:

[1] Conrick M, Wright G, Bird L. 10 Steps to an Archetype. https://portal.dstc.edu.au/nursing/files/Easy_Steps_Create_Archetype.pdf (Accessed 17/03/2006)

[2] Garde S. An Introduction to Developing and Managing Archetypes. http://healthinformatics.cqu.edu.au/projects/openEHR/openEHRArchetypesTutorial.pdf. (Accessed 17/03/2006)

[3] *open*EHR Foundation. Introducing *open*EHR, 2005 http://svn.openehr.org/specification/TRUNK/publishing/openEHR/introducing_openEHR.pdf (Accessed 17/03/2006).

ACKNOWLEDGMENTS: The authors acknowledge the contributions of Thomas Beale, Peter Schloeffel and Sebastian Garde.

Address for Correspondence:
Dr Heather Leslie
Director and Senior Clinical Consultant
Ocean Informatics Pty Ltd
E heather.leslie@oceaninformatics.biz
W www.oceaninformatics.biz