Registratie aan de bron

Zorginformatie delen en optimaliseren

Architecture

Volume 1 - Basic document

The basic principles of health and care information models (HCIMs) and how they can be used

February 2017
Version 1.0 EN

Document history

Version	Date	Description
1.0 NL	3 Nov. 2016	NL Version approved by the Architecture Team.
0.1 EN	Nov 25, 2016	Michiel Sprenger after first translation
0.99 EN	Dec 1, 2016	Gé Klein-Wolterink: edited and added figures etc
1.0 EN	Feb 1, 2017	Michiel Sprenger / Albert-Jan Spruyt

The document was drawn up with input from

Name	Organisation / role
Ernst de Bel	Radboudumc
Lindsay Chang	AMC/VUmc
Sjaak Gondelach	UMC Utrecht
Gé Klein Wolterink	Advisor
Ursula Letschert	LUMC
Reino Petrona	AMC/VUmc
Igor Schoonbrood	Maastricht UMC+
Fred Smeele	Nictiz, Clinical documentation at the point of care programme management
Michiel Sprenger	Nictiz
Albert-Jan Spruyt	Nictiz
Ben van der Stigchel	Erasmus MC
Daniël Woning	Isala
Michael van der Zel	UMC Groningen

Contact: info@registratieaandebron.nl, info@nictiz.nl

Contents

1. Introduction

1.1 Background

The Clinical documentation at the point of care (in Dutch[1]) programme is a programme in the Netherlands which aims to structurally improve the documentation and reuse of patient information. In this context, products such as the health and care information models (HCIMs[2]) (in Dutch: Zorg Informatie Bouwstenen - ZIBs) are developed. The objective is for these products to achieve widespread application within healthcare in the Netherlands. This architecture document covers various themes with the main objective of explaining the background and contents of the products developed, the context in which they can be applied within healthcare in the Netherlands and what needs to happen to make implementation possible in practice. The architecture document will consist of multiple volumes, of which the current document is Volume 1.

1.2 The architecture document

The objective of the architecture document is:

- To promote insight into
  - the vision and aims of the programme
  - the concept of the health and care information models (HCIMs)
  - the way in which the results of the programme can be applied in practice.
- Promotion of the implementation and use of the results of the programme and therefore also the HCIMs in practice
- To inform the international community on these activities in the Netherlands, and to promote feedback to the authors.

This document is first of all intended for project leaders, experts in the subject matter, developers, suppliers and others involved in similar programmes. It is also intended for directors, managers and others who are interested in the vision, objectives and practical context of the programme. The architecture document consists of several volumes around specific themes. This basic document is the first volume. For an up-to-date overview of the published documents and topics, please see the Clinical documentation at the point of care website (in Dutch).

Other volumes of the architecture document cover the following topics, for example:

- Implementation of the HCIMs in practice
- Continuity of care
- Reuse for registers and research
- Basic Data Set for Care

The following topics are covered in this document:

- Unambiguous documentation, multiple use (Chapter 2)
- Health and care information models (HCIMs) (Chapter 3)
- Documentation of information and making it available (Chapter 4)
- Sharing and exchanging information (Chapter 5)

[1] Currently most hyperlinks in this document refer to websites in Dutch. This situation will be improved in the future.

[2] Health and care information models are also referred to as Clinical Building Blocks (CBB)

1.3 The programme

For information about the background and contents of the programme, please see the website.
The main objectives that the programme hopes to achieve are:

- Improved patient focus
- Improved coordination and continuity of care
- Improved quality and outcome

The focus is on structural improvement of the documentation and reuse of patient data under the motto 'Unambiguous documentation, multiple use'. To support this, in the context of the programme, HCIMs are viewed as an important tool. That is the subject of this document.

2. Unambiguous documentation, multiple use

2.1 Data and information

Before discussing the meaning of 'Unambiguous documentation, multiple use', it is important to establish the difference between data and information. In practice, this distinction is often not made or not made clearly enough, which can easily result in incorrect conclusions or opinions. It is important to maintain a clear distinction when reading and interpreting this document too.

During the care process, data are recorded. Information is created when the data are interpreted in a certain context. This means that the same data can result in different information, depending on the context and progress in terms of insight, for example. So, during interpretation (at a later date), a different description or interpretation of data may be reached than that recorded during the clinical process, for the benefit of scientific research and quality objectives but also for transfer, epidemiology and billing. This means that, in the first instance, there is multiple use of data. Whether and how the data result in meaningful information depends on the interpretation of these data within the context for which reuse is desired.

In the application of HCIMs in practice, the greatest challenge often seems to be the question of how the data can be placed in the correct context, so that it is (or can be) interpreted in the right way. The complexity this can lead to in practice and the possible solutions that can be found for this will be discussed in a later volume of this architecture document, whilst this volume describes the basic principles.

2.2 The basic principle

The motto of the Clinical documentation at the point of care programme is 'Unambiguous documentation, multiple use'. We consider what that means in more detail through Figure 1.

The figure shows the vision of personal care data for every patient, which is recorded by the patient themselves (and possibly his or her carers) and by various health professionals who have a treatment relationship with the patient. These data are available in full or in part, always under strict conditions, for other health professionals and of course for the patient themselves. The same data are also available in full or in part, also under strict conditions, for secondary purposes, such as provision of data to quality registers, research, financial and administrative purposes and to generate management indicators.

Under strict conditions means (depending on the specific situation):

- that the patient must have given permission for this or not have made any objection (depending on the specific case)
- that there must be a treatment relationship between the patient and the s concerned
- that all (statutory) prerequisites regarding privacy and information security must be met

Statutory frameworks for this are established in the

- Dutch Medical Treatment Contracts Act (WGBO)
- Dutch Data Protection Act (WBP)
- General Data Protection Regulation (GDPR); the European privacy regulation applicable from May 2016

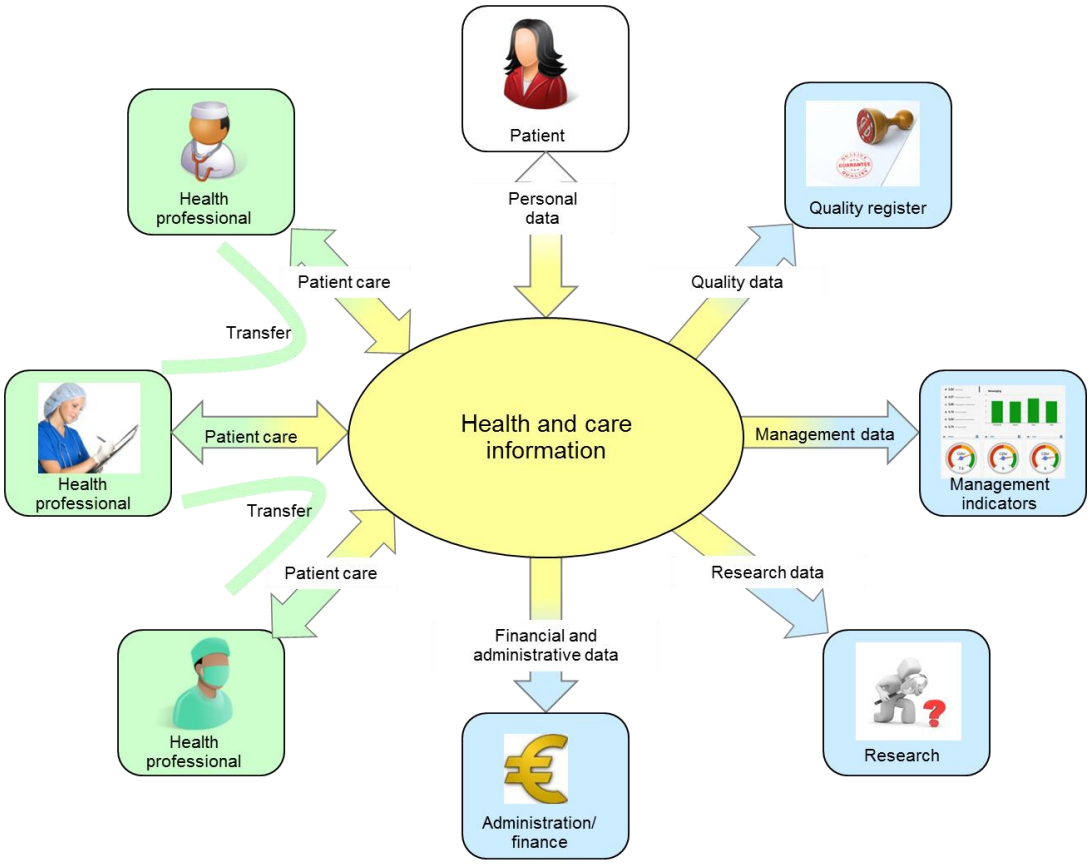

Figure 1 - Unambiguous documentation, multiple use; a vision

2.3 Unambiguous documentation, multiple use

Data is recorded unambiguously at the time it is created. This could be data that is generated by equipment (such as a blood-pressure monitor or an ECG machine) or that is established by a health professional (e.g. during history taking or during surgery), the patient themselves or a carer. A particular piece of data (such as weight or blood pressure) may be recorded more than once over time. All this patient data recorded is, in principle, part of the patient's personal care data and should ideally, under the conditions listed, be available to other health professionals involved in the treatment.

Examples:

- The GP records the patient's medication use and allergies or intolerances in the GP's information system. If the patient is brought to the Accident and Emergency Department (A&E) of a hospital in a state of unconsciousness, the emergency doctor can use the data regarding medication use and allergies or intolerances as recorded by the GP as a starting point for the treatment.
- Straight after an operation in which a new hip is implanted, the orthopaedic surgeon registers the type and identification number of the hip implant in the hospital's information system. The data recorded by the orthopaedic surgeon in the hospital's electronic health record (EHR) straight after the operation are used to provide (derived) information to the Dutch National Register of Orthopaedic Implants (LROI).
- In the case of a patient with heart failure, the patient's weight is measured every day by the patient, using an eHealth solution, and (automatically) registered in the information system for the Cardiology Department within the hospital, by the heart-failure nurse. If a patient with heart failure

suffers an exacerbation that results in acute intervention, the anaesthetist will use the latest weight as recorded by the daily measurement using the eHealth solution to determine the correct anaesthesia.

- The diagnosis recorded by the doctor during the care process is also used outside the care process for financial processing (Diagnosis Treatment Combination) and can be used to identify potential research candidates or as an inclusion criterion for a quality register too.

2.4 Practical use and the five-layer architecture model

In practice, care data concerning a particular patient are stored in different environments and various information systems, as shown in Figure 2.

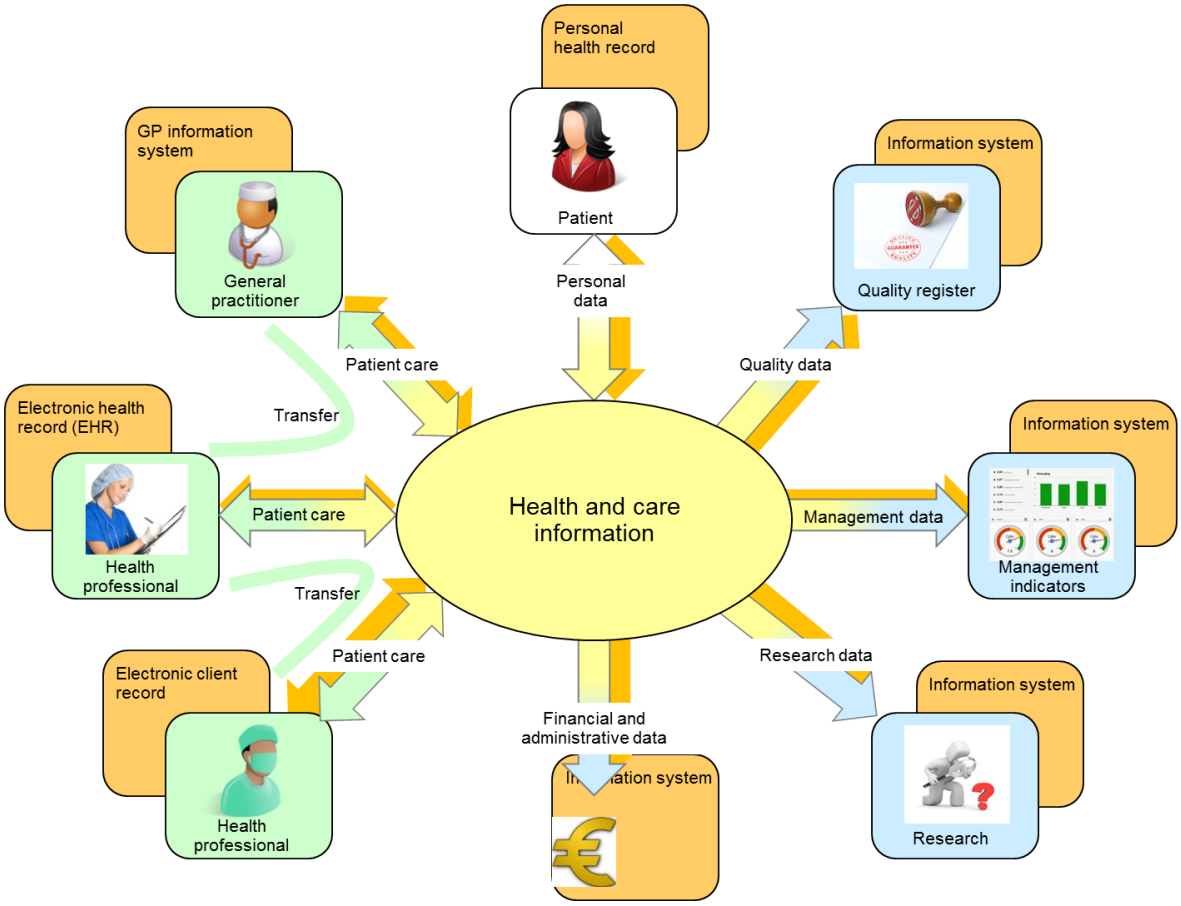

Figure 2 - Practical use; different environments and various information systems

This could include:

- the GP in a GP practice with a GP information system
- the specialist in a hospital with an electronic health record
- a health professional at a nursing, care and/or home-care institution with an electronic client record
- the patient in a home environment with a personal health record
- a laboratory with a laboratory information system
- a quality register with its own information system
- a research institution with its own information system

To allow data to be used in different environments, it is important first of all that the data recorded mean the same thing, or that there is unity of language. This is achieved by making agreements about the semantics, the meaning of the data and data structures as well as establishing these agreements in the form of health and care information models (HCIMs).

The five-layer architecture model shown in Figure 3 helps to explain how HCIMs should be positioned. The model describes the context in which information solutions are achieved in practice within an organisation. The model is important for both a large organisation, such as a general hospital or university medical centre (UMC), and for a health centre or GP practice.

The core of the model is formed by the care process, which is supported by care information (information layer). This information is processed in software systems and applications (application layer) and these applications run on an underlying IT infrastructure. And all this must fit within the policy of the organisation (policy layer).

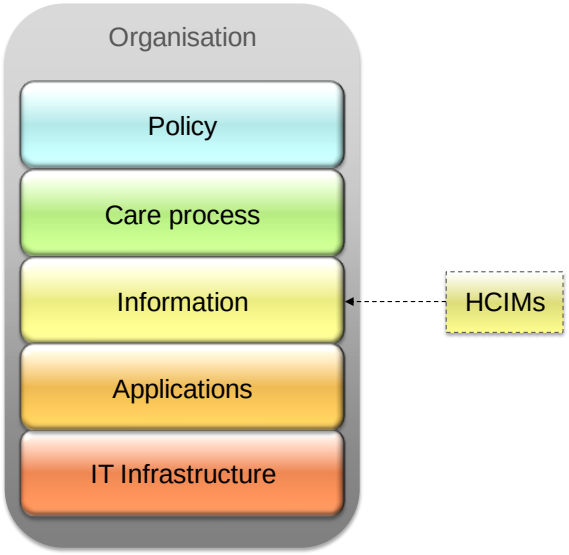

Figure 3 - The five-layer architecture model and the positioning of HCIMs

Care data are generated during the care process and recorded according to the definitions in the information layer. Using the specifications in the HCIMs during recording means that the data are unambiguous and unified language is possible at a semantic level, a necessary condition for multiple use of the data. The HCIMs are neutral with respect to the care process and associated use cases. At the same time, HCIMs are also neutral with respect to software systems, applications and the IT infrastructure.

If data are shared between organisations, healthcare providers or health professionals in the context of cooperation, we refer to interoperability. Further information on interoperability can be found on the Nictiz website.

The focus in this document is on unambiguous registration of data according to the definitions in the information layer, through use of the specifications in the HCIMs, with the most important objective being making multiple use and interoperability possible. To achieve this in practice, all kinds of other matters at the level of the application layer and IT-infrastructure layer, for example, will also need to be worked out and implemented. This will be covered in more detail in another volume of this architecture document.

3 Health and care information models (HCIMs)

3.1 General

An important starting point for the programme is fitting into the environment of the care professional as successfully as possible. This means that agreements at (care-)information level, which support the care process, are guiding and that agreements at application and infrastructure level are derived from these. We use health and care information models to establish agreements on unified language in the field of care information. A health and care information model is an information model in the form of a Detailed Clinical Model (DCM)[3], in which a care-related concept is described in terms of the data elements the concept consists of, the data types for these data elements etc.

Over recent years, a number of health and care information models have been developed, in the context of the Clinical documentation at the point of care programme. An overview of the available health and care information models can be found in Appendix 2 - Overview of health and care information models (HCIMs). Detailed and up-to-date information about the available models in our programme can be found at:

- https://www.nictiz.nl/standaardisatie/zorginformatiebouwstenen
- https://zibs.nl/wiki/zorginformatiebouwstenen (Bilingual, in Dutch and in English)

3.2 Positioning of HCIMs

The difference between data and information in the context of health and care processes is explained in Section 2.1. It has also previously been explained in Section 2.4 that HCIMs are positioned in the information layer of the five-layer architecture model (Figure 3) and that they are neutral with regard to the application area, the care process and concrete use cases as well as software systems, applications and IT infrastructure.

Before discussing the definition and details further, the positioning of the HCIMs still needs to be established more accurately, using the following 'pragmatic' definition:
"*A HCIM is a model in the information layer, which defines the way in which (with regard to coding, unit of measurement, attributes etc.) a set of related data elements can be recorded in a system within a process, to allow interoperability at semantic level, if these data elements also need to be available in other processes (and associated systems) (such as allergies, present medication or current pregnancy).*"

So a HCIM is a model that helps to record data unambiguously at information level, with 'unambiguous' referring to the recorded data and not the interpretation of that data in a specific context. For example: A care professional takes a blood-pressure reading and records this unambiguously in accordance with the method indicated in the HCIM (coding, unit of measurement, attributes etc.). This is then a piece of data or an observed fact. How this blood pressure should be interpreted in the context of the treatment or the patient's health status is another question. In other words: the information the data provides depends on the context.

[3] https://nl.wikipedia.org/wiki/Detailed_Clinical_Model

3.3 Definition

A health and care information model is an information model consisting of one or more data elements that, as a whole, describe a relevant care-related concept.

Health and care information models have the following characteristics, among others. A health and care information model:

- is 'large' enough to be clinically significant and relevant
- is 'small' and generic enough to be applicable in a relatively high number of situations; the HCIM is use case neutral
- does not establish technical choices for transfer standards or networks; a HCIM is technically neutral
- is independent of the application in which the building block is used
- is generically defined, so that it is applicable in as many care processes as possible
- can be used in different applications and by different users:

The health and care information models include agreements about:

Definition	• Definition of terms and description of the care-related concept that is being described by the model
The data elements, their cardinality and interrelationships	• The way in which the model is built up of associated (care-related) data elements and their definitions. • The cardinality of each data element (see explanation under this table) • The relationships between the data elements in the model and between the different models
Data type and value range	• The data type for each data element, for example: free text, date/time, numerical or coded, plus the standard associated with this, such as the G-Standard or SNOMED CT. • The value range for each data element, i.e. which values the data element can have and possibly which unit.

The cardinality of a data element indicates whether and how often a data element can or should occur in an instantiation (a concrete manifestation) of an HCIM (Table 1).

Cardinality	Explanation
0..1	The data element may occur 0 to 1 times
0..*	The data element may occur 0, 1 or more times
1..1 or 1	The data element must occur precisely 1 time
1..*	The data element must occur a minimum of 1 time and may occur more times

Table 1 - Cardinality

If a data element must occur (cardinality of 1..1 or 1..*), this means that a value must be given that fits with the data type applicable for the data element. If a data element may occur, the specific situation within the

care process (the use case) determines whether or not the data element should occur. An explanation of cardinality can be found in Section 3.6.

3.4 Drawing up

Important elements of the HCIM specification that always recur are:

Concept	• The definition of the care-related concept
Data Model	• The model in which structure and relationships between the data elements the model consists of are defined, including the data types with which the data elements are recorded and the cardinality, i.e. how often the data element may or must occur.
Value sets	• The value lists in which possible choices for the data elements are defined.

These three elements are explained using the HeartRate HCIM.

Concept

The concept of heart rate is defined as 'the number of beats per minute performed by the heart' with the aim of 'obtaining information about blood circulation and heart function through measurement of the heartbeat'.

Data Model

The data model defines the structure of the health and care information model, i.e. the way in which the building block is constructed from associated data elements. The model for the HeartRate HCIM is shown in the figure below.

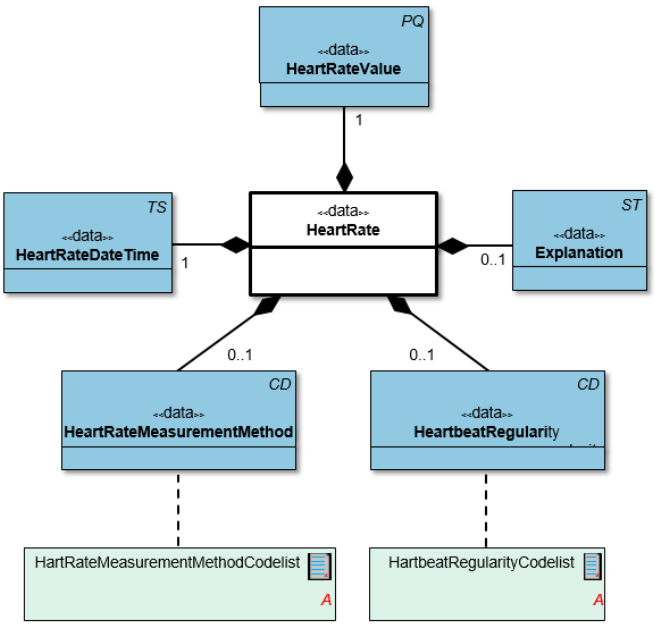

Figure 4 – Data model for HeartRate HCIM

This shows that the 'root concept' for heart rate is built up of the following data elements:

- HeartRateValue
- HeartRateDateTime
- HeartRateMeasurementMethod
- HeartbeatRegularity
- Comment

The cardinality of each of these data elements is also specified. The associated data type is given as well, i.e. how these data elements are recorded in accordance with the definition in the HCIM. An overview of the possible data types is shown in Table 2.

Abbreviation	Data type	Explanation
ANY	Generic Data Type	This abstract data type is the basis for all other data types
BL	Boolean	This data type relates to bivalent logic. Data of this type can only include the values 'true' or 'false', or a nullFlavor.
CD	Concept Descriptions	This data type specifies a concept through a code and the associated code system.
CO	Coded Original	This is a specialisation of the data type CD
II	Instance Identifier	This data type specifies the identification of objects. This includes identifications for organisations or people, for example. Such as a BSN (Dutch citizen service number) or passport number.
PQ	Physical Quantity	Elements of this data type are physical quantities, i.e. an amount that represents a measurable (or countable) value in the physical world, including its unit.
ST	String	This type is intended for free text in its simplest form.
TS	Time Stamp	This data type records the value of a time.
ED	Encoded Data	This is a general type for all kinds of multimedia data. It is used for text, formatted or not, documents or images.
INT	Integer Number	Whole figure

Table 2 - Possible data types[4]

Value sets

For the data types CD and CO, the code lists are defined in the 'Value sets' section. For the HeartRate HCIM, this is the two code lists shown in Table 3 and Table 4. The Value Set OID[5] is a unique identification for the code list and the Code System OID is a unique identification for the code system, in this case SNOMED CT. In the example, all defined values are coded with a SMOMED CT code (concept code).

[4] https://zibs.nl/wiki/Beschrijving_en_gebruik_datatypes
[5] https://www.nictiz.nl/Paginas/OIDs.aspx

HeartbeatMeasurementMethodCodeList			Value Set OID: 2.16.840.1.113883.2.4.3.11.60.40.2.12.3.2	
Concept name	Concept code	Code system name	Code system OID	Description
Palpation	113011001	SNOMED CT	2.16.840.1.113883.6.96	Palpation
Auscultation	37931006	SNOMED CT	2.16.840.1.113883.6.96	Auscultation
Cardiac monitoring	8814007	SNOMED CT	2.16.840.1.113883.6.96	Cardiac monitoring
Electrocardiographic monitoring	46825001	SNOMED CT	2.16.840.1.113883.6.96	Electrocardiography

Table 3 – HeartbeatMeasurementMethodCodeList

HeartbeatRegularityCodeList			Valueset OID: 2.16.840.1.113883.2.4.3.11.60.40.2.12.3.1	
Concept name	Concept code	Code system name	Code system OID	Description
Heart regular	271636001	SNOMED CT	2.16.840.1.113883.6.96	Heartbeat regular
Heart irregular	248650006	SNOMED CT	2.16.840.1.113883.6.96	Heartbeat irregular

Table 4 - HeartbeatRegularityCodeList

An instantiation (an example of a registered heart rate in practice) of the HeartRate HCIM is shown in Table 5.

HeartRate DateTime	HeartRate Value	HeartRate MeasurementMethod	Heartbeat Regularity	Comment
08-02-2013,06:43	126/min	Auscultation	Heartbeat irregular	Possible bigeminy?

Table 5 - Representation of an instantiation of the HeartRate HCIM

Alternative writing method

Another way to define the structure of the building block is shown below for the HeartRate HCIM. This method is used in the rest of the document.

HeartRate HCIM

- HeartRateDateTime [TS] 1
- HeartRateValue [PQ] 1
- HeartRateMeasurementMethod [CD] 0..1
- HeartbeatRegularity [CD] 0..1
- Comment [ST] 0..1

Figure 5 - HeartRate HCIM; alternative writing method

3.5 Referencing between HCIMs

Within a building block, reference can be made to other building blocks. This is explained using the ProcedureForTransfer HCIM, which is shown in Figure 6. The following references can be found here:

- The data element Indication, the reason for performing the activity, refers to the concept Problem in the ConcernForTransfer HCIM.
- The data element Product, the product the placement of which in or on the body is the objective of the activity (e.g. the placement of an implant), refers to the Product concept in the MedicalDevice HCIM.
- The data element Location, the healthcare provider where the procedure was or will be carried out, refers to the concept HealthcareProvider in the HealthcareProvider HCIM
- The data element PerformedBy, the health professional who performed the procedure, refers to the concept HealthProfessional in the HealthProfessional HCIM
- The data element RequestedBy, the health professional who requested the procedure, refers to the concept HealthProfessional in the HealthProfessional HCIM

ProcedureForTransfer HCIM

- ProcedureStartDate [TS] 0..1
- ProcedureEndDate [TS] 0..1
- ProcedureAnatomicalLocation [CD] 0..*
- Indication::Problem[ConcernForTransfer] 0..*
- ProcedureType [CD] 1
- Product::Product[MedicalDevice] 0..*
- Location:: HealthcareProvider [HealthcareProvider] 1
- PerformedBy:: HealthProfessional[HealthProfessional] 1...*
- RequestedBy:: HealthProfessional[HealthProfessional] 0...*

Figure 6 – ProcedureForTransfer HCIM with references to other building blocks

The meaning of the reference to the other building blocks is defined clearly at the level of the HCIM, as indicated in the description. With the data element Location, for example, the healthcare provider determines where the procedure was or will be carried out and this is established in accordance with the method defined for the concept HealthcareProvider in the HealthcareProvider HCIM.

This is about the way in which information is established (the how). For a particular process or for a concrete use case, what needs to be recorded must be determined. This also applies in the case of the reference to another building block.

In the case of a reference between building blocks, the cardinality is inherited. For the ProcedureForTransfer HCIM, the data element Location has a cardinality of 1. Location is defined on the basis of the HealthcareProvider HCIM. This is shown in Figure 7.

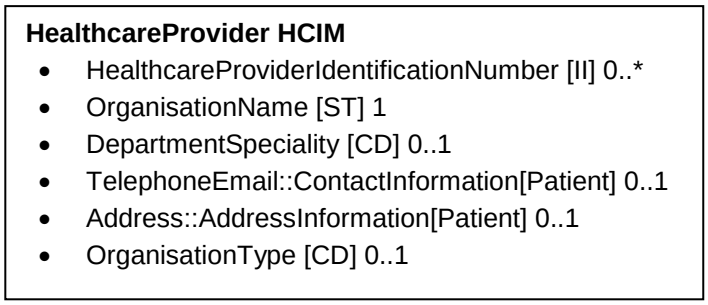

Figure 7 - HealthcareProvider HCIM

This shows that the data element OrganisationName has a cardinality of 1. This cardinality also applies to OrganisationName, as part of the data element Location in the ProcedureForTransfer HCIM. The data element TelephoneEmail within the HealthcareProvider HCIM itself refers to the concept ContactInformation in the Patient HCIM and has a cardinality of 0..1. So this cardinality also applies to the data element TelephoneEmail as part of the data element Location in the ProcedureForTransfer HCIM.

Practical implementation of references

Although the building block leaves the method of creation open, in the event of references between building blocks at the time of the practical creation, a choice will need to be made between the principles of reference and inclusion.

For the implementation, reference means that a pointer in one HCIM refers to the other HCIM. This is shown in Figure 8 for the section Location within the ProcedureForTransfer HCIM.

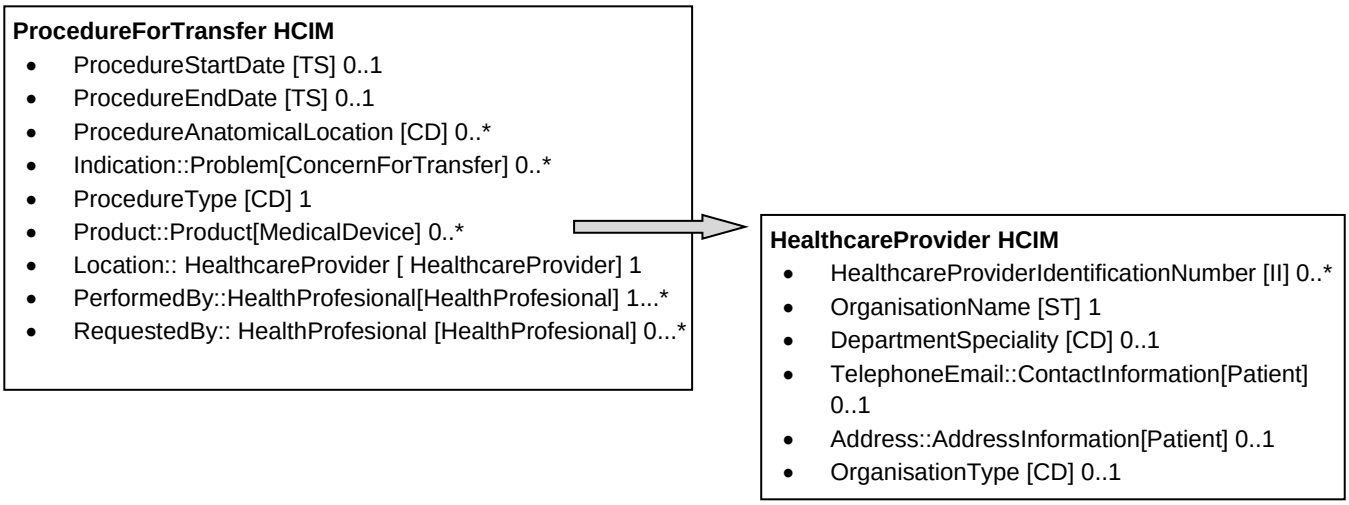

Figure 8 - Referencing between building blocks as form of creation

If inclusion is chosen for the practical creation, (the part of) the building block that is referred to is included in the building block in which it is referred to. The principle of inclusion for the section Location within the ProcedureForTransfer HCIM is shown in Figure 9.

ProcedureForTransfer HCIM

- ProcedureStartDate [TS] 0..1
- ProcedureEndDate [TS] 0..1
- ProcedureAnatomicalLocation [CD] 0..*
- Indication::Problem[ConcernForTransfer] 0..*
- ProcedureType [CD] 1
- Product::Product[MedicalDevice] 0..*
- Location:: HealthcareProvider [HealthcareProvider] 1
    - HealthcareProviderIdentificationNumber [II] 0..*
    - OrganisationName [ST] 1
    - DepartmentSpeciality [CD] 0..1
    - TelephoneEmail::ContactInformation[Patient] 0..1
    - Address::AddressInformation[Patient] 0..1
    - OrganisationType [CD] 0..1
- PerformedBy:: HealthProfessional [HealthProfessional] 1...*
- RequestedBy:: HealthProfessional [HealthProfessional] 0...*

Figure 9 - Inclusion as form of creation

3.6 Explanation of cardinality

It was previously stated in Section 3.3 that, if a data element may occur (cardinality 0..1) or may occur more than once (cardinality of 0..* or 1..*), the specific situation within the process (the use case) determines whether or not the data element should occur and how often. This is explained through an example.

A possible application of HCIMs is that they could be used in the provision of information to quality registers such as the Dutch National Register of Orthopaedic Implants (LROI). This specific case concerns various pieces of data regarding an operation such as the placement of a new prosthesis, among other things. In the case of the placement of a new hip, for example, the data required for the register are:

- the date of the operation
- the anatomical location (left or right hip)
- the indication (reason for the operation)
- the type of operation
- the products (prostheses) placed
- the location where the operation was carried out
- The surgeon and, if present, the assistant surgeon who carried out the operation.

The ProcedureForTransfer HCIM could be used for the provision of these data, as shown in Table 6. In the second column of this table, the data type for the data element is shown (where ::HCIM means that reference is made to another building block), in the third column, the cardinality of the data elements in the building block is shown and the fourth column shows the cardinality for the specific application of the building block in the use case for provision of data to the LROI. The cardinality of the data elements for the use case is a ‘tightening’ of the cardinality in the building block. So in this use case, 0..1 in the building block becomes 0..0 or 1..1. Cardinality of 0..* in the building block becomes 0..0, 1..1 or 1..* in the use case and 1..* becomes 1..2. Cardinality of 1..1 remains 1..1. The cardinality in the use case cannot be less strict than in the building block.

A similar mechanism applies for the cardinality of the data elements in the building blocks referred to, but that has not been elaborated on further in this example.

ProcedureForTransfer HCIM	Data type	Card. HCIM	Provision to LROI use case	
			#	Contents
ProcedureStartDate	TS	0..1	1..1	Date of operation
ProcedureEndDate	TS	0..1	0..0	--
ProcedureAnatomicalLocation	CD	0..*	1..1	Anatomical location
Indication::Problem[ConcernForTransfer]	::HCIM	0..*	1..1	The reason for carrying out the procedure
ProcedureType	CD	1..1	1..1	Type of operation
Product::Product[MedicalDevice]	::HCIM	0..*	1..*	The products (prostheses) placed during the procedure
Location::HealthcarePovider[HealthcarePovider]	::HCIM	1..1	1..1	The location where the operation was carried out
PerformedBy:: HealthProfesional [HealthProfesional]	::HCIM	1..*	1..2	The surgeon and the assistant surgeon (if present)
RequestedBy:: HealthProfesional [HealthProfesional]	::HCIM	0..*	0..0	--

Table 6 - ProcedureForTransfer HCIM for provision to LROI

3.7 Data elements implicitly present in each building block

A number of data elements are implicitly present in each building block and are therefore not explicitly specified in the information model for the building block.

- Date/time of registration
- Source of data (usually the author)
- A technical identification of an instantiation of the building block
- The subject or the patient/person in question

In a later volume of this architecture document (Implementation of HCIMs in Practice), how this can be achieved in the technical implementation of a building block will be described in further detail.

3.8 Management of the HCIMs

Nictiz manages the HCIMs and makes these available for use in care throughout the Netherlands. Further information about the management of HCIMs and the handling of adjustment or change proposals can be found on the Nictiz website.

4. Recording data and making this available

4.1 Introduction

'Unambiguous documentation, multiple use' begins with the unambiguous documentation (registration) of data in an information system. Only once this has happened can the data also be shared and used multiple times. In practice, it is apparent that there are different ideas and interpretations about what it means to record and store data unambiguously and in accordance with the specifications of the HCIMs. This chapter describes how this can be interpreted.

4.2 A generic model of a care-information system

To explain all this, a generic model of a care-information system is used, as shown in Figure 10. The following considerations also apply to comparable information systems and applications such as electronic health records (EHRs), electronic client records (ECDs), personal health records (PGDs) etc. N.B. This is a generic model that is only relevant in the context of this discussion. The model does not aim to be an accurate modelling of an EHR or a comparable system.

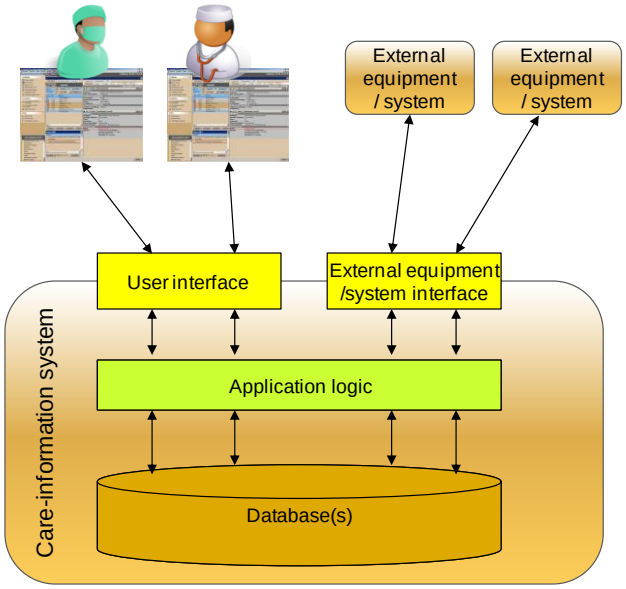

Figure 10 - Generic model of a care-information system

The care-information system as shown in the generic model consists of:

- One or more databases in which the data are stored
- Application logic that ensures the correct interaction between the database(s) and the outside world.
- User interface(s) that allow health professionals to record and consult data in the database via screens and/or mobile devices
- External interfaces to external equipment and systems.

Database(s)

Without taking technical details into account, it can be stated that every information system in which care data are stored and processed has one or more underlying databases in which data elements are stored and read back. How such a database is set up and the internal data model used will differ from system to system and from supplier to supplier.

Application logic
The application logic ensures, for example, a translation between the database world, the associated data models and the way in which data are recorded, processed and made available again there on the one hand and the way in which interaction with the outside world via user interfaces and the interfaces with external equipment and systems takes place on the other.

User interface(s)
The user interface generally takes the form of a screen or a mobile device, such as a tablet. Through this user interface, a user can record and view data. The set-up of the screens, the way in which data are made accessible for the user and the functionality with which the system supports the user in this differ from system to system and from supplier to supplier and form important competitive features of various suppliers' system solutions.

External interface(s)
External interfaces make it possible to connect to external equipment (such as blood-pressure monitors, imaging devices like X-ray machines, ECG machines etc.) and other (care-)information systems. Through these external interfaces, data can be entered and recorded in the database(s) and read back and made available again from the database(s).

4.3 Recording data and making this available

What does the fact that it is possible to record data and make this available in accordance with the specifications of the HCIMs mean? To explain this, a distinction is made between the user interface and the external interface.

External interface
For the interface to an external piece of equipment or system, this means that an external piece of equipment or system can

- offer care data to the interface, in accordance with the specification in HCIMs. This interface passes the data to the application logic, which stores it in the underlying database(s).
- make requests through the interface, which results in the data being retrieved from the underlying database(s) by the application logic and made available in accordance with the specification in the HCIM.

So the information system must be capable of converting the internal data model in the database to the data model in accordance with the specification in HCIMs and vice versa. This makes (semantic) interoperability with the outside world possible. So the data model in the care-information system's database does not have to be the same as the HCIM's, but it must be possible to convert it to that data model (it needs to be compatible). Of course, it is also possible for the internal data model to indeed be the same as the HCIM's; in this case no conversion is required. At the end of this section, the conversion of data models and the risks this poses are covered in more detail.

The fact that data are in accordance with the specification in HCIMs means that use is made of the same definitions of the concepts and their interdependencies, of the same data elements from which the concepts are composed and of the same associated value lists and data types.

User interface
For the user interface, this means that, via the user interface and in accordance with the specification in the HCIMs, a user can

- record data, with the data being stored in the underlying database(s) by the application logic
- view this data, which results in the data being made available from the underlying database(s) by the application logic.

In a specific environment, it is always a care process that determines which data elements should be registered or displayed. As the user interface needs to fit closely with the care process, it is possible that, in different environments with different systems:

- different terms will be used for a specific concept or data element in a HCIM, as this suits the users better. If these terms are synonymous, i.e. they refer to the same concept and piece of data (e.g.: gender/sex); this is not a problem. If not, a risk arises.
- different subsets of the concepts and data elements in a HCIM will be used, since specific concepts and/or data elements can be not relevant within a specific environment. If interoperability between two environments is desired, it is important for agreements to be made about the subsets to be used.
- different subsets of the value lists associated with the data elements in a HCIM will be used, since specific values can be not relevant within a specific environment.

Furthermore, it is of course the case that the design of the screens, the degree to which and the way in which the user is supported are completely separate from the fact that the data are displayed in accordance with the specification in the HCIMs.

Not a blueprint for a database!
The distinction made between the underlying database(s) and the application logic in the model highlights the fact that the specification in an HCIM should not be seen as the specification or blueprint for a database or parts of this. How the data are stored in a database is not relevant, as long as the system is capable of providing information to the outside world in accordance with the specification in HCIMs as well as being able to accept this from the outside world. The more the set-up and data models of the underlying database(s) match the specification in the HCIMs, the easier the recording and provision of the data in accordance with the specification in the HCIMs will be and the less this will be associated with necessary translation or ‘mapping’ from one model to the other. Of course the various suppliers are completely free in the way in which choices are made about this.

External interfaces and user interfaces are not necessarily aligned
It may also be the case that a system is capable of processing certain data via the external interfaces in accordance with the specification in the HCIMs, while the user interfaces are not yet implemented in this way and vice versa.

Example: the TobaccoUse HCIM includes a code list for the status of TobaccoUse with seven different possible values (smokes daily, smokes sometimes, smokes passively, ex-smoker, non-smoker but past smoking habits unknown, never smoked, other). It is possible for the system to be set up so that these seven values can be stored and provided again and can also be shared via the external interfaces but for the screens still to display ‘old’ forms with, for example, five possible values (smokes, smokes passively, ex-smoker, never smoked, other). In this case, a mapping (translation) needs to be carried out between the value lists.

The conversion of data models and the risks
It will (still) not always be possible to avoid the conversion of data models through mapping, translation or derivation, but this does lead to risks and ambiguity. This is explained through two examples.
First of all, the example provided above regarding tobacco use. Here, two value lists are given, which are placed next to each other in the table below.

TobaccoUseStatus value list from the TobaccoUse HCIM		Other value list for tobacco-use status	
1	smokes daily	smokes	A
2	smokes sometimes		
3	smokes passively	smokes passively	B
4	ex-smoker	ex-smoker	C
5	never smoked	never smoked	D
6	non-smoker but past smoking habits unknown	other	E
7	other		

Table 7 - Comparison of two value lists

The mapping of the value list in the TobaccoUse HCIM to the list with five values is possible, but mapping the other way around is not easy and certainly not without loss of information. Value A 'smokes' in the second list can only be converted to value 1 'smokes daily' or value 2 'smokes sometimes' in the first list, but it is difficult to make a choice. The mapping of value E 'other' in the second list to value 7 'other' or value 6 'non-smoker but past smoking habits unknown' in the first list is difficult too.
This also means that uncertainty arises about the actual meaning of the values received, if it cannot be said with certainty that the data were originally recorded on the basis of the same value list.

A second example concerns the data element AddressData (part of the Patient HCIM) which includes the element AddressType as an attribute. AddressType has an associated code list, which includes home address/residential address, temporary address and work address, among others. In a specific implementation in an electronic health record (EHR), it may be the case that there is no separate field for 'address type' but that there are different fields for the different distinct types of address. If these types match the address types in the code list completely, an unambiguous derivation can be made from one model to the other, in which no information needs to be lost. If these types do not match completely, it may still be possible to make derivations but information could be lost and uncertainty about the interpretation of the data may be created.

These examples show that, in principle, it is possible in certain cases to carry out a conversion (through mapping, derivation) from one data model to another, but that this can quickly result in loss of information and uncertainty about the interpretation of the resulting data.
To prevent this, it is preferable to match the data models specified in the HCIMs wherever possible and indicate clearly when and to what extent these are deviated from. Several practical examples are elaborated on in a later volume of this architecture document.

4.4 Set-up of a care-information system

It is important to make a distinction between set-up and contents of a care-information system:

- Set-up is about whether a care-information system is capable of recording and providing data in accordance with the HCIM definition.
- Contents is about whether a particular piece of data for a particular patient is actually recorded in the system by a user.

An information system is set up for a particular HCIM if data elements that form part of the HCIM can be requested according to the HCIM specification with regard to

- The definition of the data element (do they have the same meaning)
- The structure of the data elements and their interdependencies

- The specification of the way in which the content is recorded on the basis of particular data types and associated value lists (see paragraph 0)

The example of the Patient HCIM (Figure 11) explains what this means. An information system is completely set up for the Patient HCIM if all data elements that form part of the HCIM can be recorded and requested according to the specification in the Patient HCIM with regard to

- specification of the concept (same meaning)
- specification of the structure (with all data elements and the correct relationships)
- specification of the way in which the contents is established (data types, value lists, code tables)

An information system is partially set up for the Patient HCIM if the above is applicable for part of the data elements in the HCIM. If certain data elements cannot yet be recorded in the information system, it may be that:

- they are not implemented as they are not relevant for a particular system and its users
- they are not yet implemented as the set-up of the system is phased and will therefore take place at a later time for this data element.

Relationships between the data elements

A major part of the set-up of an information system on the basis of HCIMs is the importance of the relationships between the data elements bound together in an HCIM. In the example of the Patient HCIM (Figure 11) it is clear that this relates to the patient's address information and contact information. These relationships will be found in all information systems. But in other building blocks, such as the ProcedureForTransfer HCIM (Figure 6) the relationships are more complicated. This building block includes the data elements:

- Indication (reason for procedure)
- Product (the product that is placed in or on the body)
- Location (the healthcare provider where the procedure was or will be carried out)
- PerformedBy (the health professional who performed the procedure)
- RequestedBy (the health professional who requested the procedure)

This means that, for these data, it is not just about the specified data type with associated value lists, but the interrelationship must also be explicitly indicated. For example, the fact that a particular diagnosis (indication) is actually the reason for the procedure.

Patient HCIM

- NameInformation [C] 1
  - GivenNames [ST] 0..1
  - Initials [ST] 0..1
  - Nickname [ST] 0..1
  - Familyname [C] 1
    - Prefix [ST] 0..1
    - Surname [ST] 1
  - PartnerFamilyName [C] 1
    - PartnerPrefix [ST] 0..1
    - PartnerSurname [ST] 1
  - NameUse [CD] 0..1
- AddressInformation [C] 1
  - Street [ST] 0..1
  - HouseNumber [ST] 0..1
  - HouseNumberLetter [ST] 0..1
  - HouseNumberExtension [ST] 0..1
  - HouseNumberDesignation [CD] 0..1
  - Postcode [ST] 0..1
  - CityOrTown [ST] 0..1
  - Municipality [ST] 0..1
  - Country [CD] 0..1
  - AdditionalInformation [ST] 0..1
  - AddressType [CD] 1
- ContactInformation [C] 1
  - TelephoneNumbers [C]0..*
    - TelephoneNumber [ST] 1
    - NumberType [CD] 1
  - EmailAddresses [C] 0..*
    - EmailAddress[ST] 1
    - EmailType [CD] 1
- PatientIdentificationNumber [II] 0..1
- DateOfBirth [TS] 1
- Gender [CD] 1
- MultipleBirthIndicator [BL] 0..1
- DeathIndicator [BL] 0..1
- DateOfDeath [TS] 0..1

Figure 11 - Patient HCIM

4.5 Contents of a care-information system

Contents is about whether a piece of standardised data is recorded in a care-information system such as the electronic health record (HER). A precondition for this is of course that an information system must be set up in such a way that the data can actually be recorded. If data about a particular patient are actually stored in accordance with the specification in a HCIM, we also call this an instantiation of the HCIM with specific data about a specific patient.

Patient HCIM Example

For an instantiation of the Patient HCIM (Figure 11), for a particular patient, the data element could be:

- *NameInformation* completed in full in accordance with the specification
- *AddressInformation* completed with various addresses, such as official address, work address and holiday address (defined with the AddressTypeCodeList)
- *TelephoneNumbers* completed with various telephone numbers, such as home, mobile and business (defined with the NumberTypeCodeList)
- *EmailAddresses* are empty
- *PatientIdentificationNumber*, *DateOfBirth* and *Gender* entered in accordance with specification
- *MultipleBirthIndicator, DeathIndicator* and *DateOfDeath* are empty.

ConcernForTransfer HCIM Example

The ConcernForTransfer HCIM (Figure 12) may include multiple instantiations for a particular patient.

ConcernForTransfer HCIM

- ConcernLabel [ST] 0..1
- Problem [C] 1..*
  - ProblemType [CD] 0..1
  - ProblemName [CD] 1
  - ProblemStartDate [TS] 0..1
  - ProblemStatus [CD] 1
  - ProblemStatusDate [TS] 1
  - Comment [ST] 0..1

Figure 12 - ConcernForTransfer HCIM

For example, instantiations with different

- *ProblemType*, defined according to the ProblemTypeCodeList
  (such as problem, diagnosis, finding, complaint or functional limitation)
- *ProblemName* defined according to the ProblemNameCodeList
  (e.g. on the basis of ICPC-1, SNOMED CT, ICD-10)
- *ProblemStatus* defined according to the ProblemStatusCodeList
  (such as up-to-date, being checked)

LaboratoryResultForTransfer HCIM Example

The LaboratoryResultForTransfer HCIM (Figure 13) will also generally include multiple instantiations for LaboratoryTest for one patient.

LaboratoryResultForTransfer HCIM

- PanelOrBattery [CD] 0..1
- ResultStatus [CD] 0..1
- ResultType [CD] 1
- LaboratoryTest [C] 0..*
  - TestName [CD] 1
  - TestMethod [CD] 0..1
  - TestDateTime [TS] 0..1
  - Result [ANY] 1
  - ReferenceRangeUpperLimit [ANY] 0..1
  - ReferenceRangeLowerLimit [ANY] 0..1
  - ResultFlags [CD] 0..*
- Specimen [C] 1
  - SpecimenId [II] 0..*
  - SpecimenMaterial [CD] 1
  - CollectionDateTime [TS] 1
  - CollectionMethod [CD] 0..1
- Comment [ST] 0..1

Figure 13 – LaboratoryResultForTransfer HCIM

4.6 Multiple use places demand on set-up and contents

Multiple use and set-up

In the set-up of a care-information system on the basis of HCIMs, the demands made of (multiple) use of the patient information that is stored must be taken into account. Building blocks and elements of these that are not included during the set-up cannot be registered and thus cannot be used multiple times.

In the set-up of a care-information system, the cardinality of the various data elements in a building block must also be taken into account. The data elements with cardinality of 1 or 1..* must be taken into account in the set-up as they form a compulsory element of the building block, in the sense that it must be possible to record them. The data elements in the building block with cardinality of 0..1 and 0..* are not compulsory on the basis of the building block itself but optional. In that case, the demands made of (multiple) use of these data elements on the basis of the care processes and associated use cases determine whether these must be included in the set-up.

Multiple use and contents

The care process determines which data set is necessary for a concrete use case. Which use cases the data in the information system will be used for determines which data must be registered and therefore what the contents of the information system must be.

Examples of use cases:

- A nurse records a patient's sensitivity to certain antibiotics. Following a test, the probability of this allergy changes from probable to certain.
- A nurse measures a patient's heartbeat (pulse) every hour; the value but not the measurement method is recorded in this case.
- A patient is transferred from a specialist at an academic hospital to a specialist at a general hospital.
- A patient uses the 'Blue Button' functionality to download a summary of his or her record from the electronic health record (EHR) at a hospital, in the form of a personal health record (PGD).

- Data are provided by the hospital to a quality register such as the Dutch National Register of Orthopaedic Implants (LROI) or Dutch National Intensive Care Evaluation (NICE)
- Data are provided by a hospital for a research project.

For every use case, parties concerned must make agreements about the contents of the data to be used in the form of the specification of a data set on the basis of a selection of data elements (data selection) in HCIMs.

The specification of this data set determines the demands that are made of the

- set-up: can the information system record and provide the data elements in accordance with the specification in the HCIMs
- contents: are the relevant data actually recorded

A data element that is part of the data that can be used (multiple times)

- can be compulsory or optional
  - compulsory means that a value must always be given; if the value is not available, this is indicated
  - optional means that a value may be given
- can be entered under certain conditions
  - e.g. only the current problems for the ConcernForTransfer HCIM
  - e.g. only the latest result for each measurement or all results from the last six months for the LaboratoryResultForTransfer HCIM

4.7 Compliance

The question can be asked to what extent a practical implementation (of a care-information system, for example) is in line with the specification and characteristics of the HCIMs; in technical terms this is about compliance. Further information about the definition of compliance can be found through The Open Group[6]. The previous sections show that the following aspects can be considered here, among others:

- The extent to which a care-information system is capable of storing patient information and providing this again in accordance with the definition in the HCIMs via external interfaces
- The extent to which a care-information system is capable of displaying and storing patient information in accordance with the definition in the HCIMs via the user interface on the screens
- Which HCIMs and which version of the HCIMs does this apply to?
- To what degree are HCIMs implemented in full i.e. with all concepts and their interrelations, all data elements and all value lists that make up the definition and to what degree are they implemented in part?
- And if not in full: what happens with the data elements that occur and cannot be mapped?

This topic will be covered in more detail in a separate document.

[6] http://www.opengroup.org/public/arch/p4/comp/comp.htm#Terminology

5. Sharing and exchanging data

5.1 Introduction

Unambiguous documentation begins with recording data in an information system with an electronic health record (EHR) or electronic client record (ECD) as application, for example. The data can then be used multiple times, by sharing or exchanging this. We make a distinction between the following applications here:

- Sharing or exchanging care data to support the care process
  - between patient and health professional or between health professionals
- Sharing or exchanging care data for secondary purposes
  - for quality registers, research etc.

5.2 Sharing and exchanging data to support the care process

The first and primary application is sharing or exchanging data to support the care process. A number of concrete examples:

- Within a hospital, care professionals (doctors, nurses and others) have access to the same 'underlying' data through screens.
  What data the health professionals see, how the screens look and what functionality for support is available depends on the health professional's role, and the process he/she is currently involved in.
- A doctor will receive access to data concerning his/her patient in a hospital information system through a portal.
- A patient will receive access to his/her data in a hospital information system through a portal.
- Various care professionals who work together in the context of care for chronic conditions (diabetes, COPD etc.) share data in a collaborative care information system, in which they work together
- If a patient is transferred from an academic hospital to a general hospital, data are exchanged between the relevant care professionals from one hospital information system to the other.
- If a patient is transferred from a hospital to a nursing home, data are exchanged between the relevant care professionals from the hospital information system to the nursing home's information system.

These examples all form different use cases or applications. For each of these use cases, the data that must be shared or exchanged in that specific case needs to be discussed. This places demands on the set-up and contents of the systems concerned.

Sharing the data

We refer to sharing of data if the relevant health professionals and/or patient actually use the same information system. This is visualised in Figure 14. Depending on the role of the user and the associated authorisations, he/she will receive access to certain 'underlying' data. When setting up the system, who will need to receive access to the data and what demands this places on the set-up of the system is taken into account. By choosing a uniform and standardised set-up, based on HCIMs (Section 4.4) the foundation is laid for unambiguous sharing of data and multiple use.

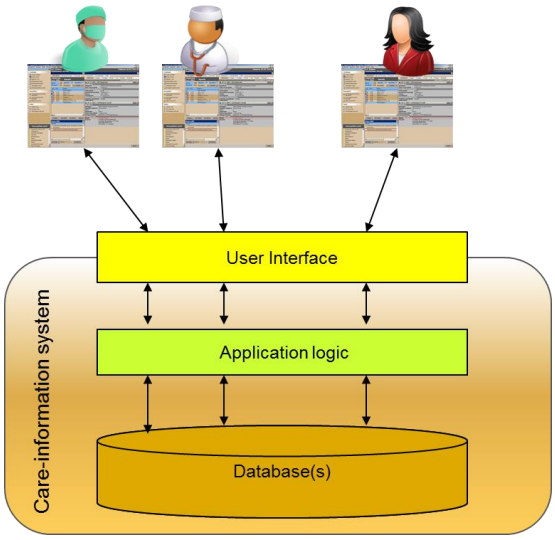

Figure 14 - Sharing of data

An example of a concrete application for sharing data in this way is the set-up of the basic record within the electronic health record (EHR) implementation at a hospital where, in this case, the basic record refers to the part of the patient record that is the same for all health professionals.

Exchange of data for care

We refer to exchange of data when the relevant health professionals and/or the patient use different information systems, with data being transferred from one system to the other. This principle is shown in Figure 15, where data are exchanged between two care-information systems.

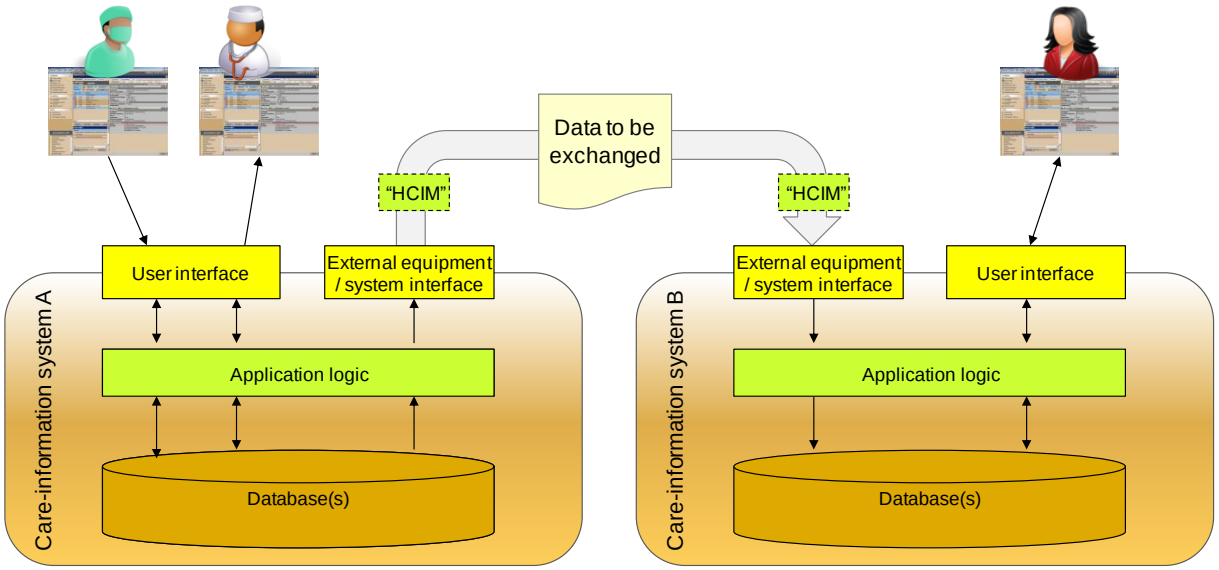

Figure 15 - Exchange of data

For the exchange of data, it must be agreed which data should be exchanged at which time for the concrete use case. This places demands on the set-up of the information systems concerned. If the data are exchanged in accordance with the HCIM specification, which is a precondition for interoperability, both systems must be capable of sending and receiving data in this way. Of course, this places demands on the way in which this data are registered by users. If, for example, (part of) the patient history is recorded in the electronic health record (EHR) as free text, it is not possible to exchange specific data from this with other systems as an HCIM. Furthermore, for a specific use case, entry of certain data elements will be compulsory (as described in Section 4.6). This therefore places demands on the content of the information system and that means that this data needs to be recorded during the (care) process. So each use case for exchange of data places demands on the minimal set-up (which items in which form) and contents of the relevant information systems (which data must be registered). In this case, minimal means the data elements that form a compulsory part of the set-up and contents are defined.

In order to actually be able to exchange the data, agreements will need to be made for the implementation, about the way in which this happens, e.g. in the form of a message or document, on the basis of HL7 CDA or HL7 FHIR etc. Further detail on this falls outside the scope of this document and is covered in another volume (in development) of the architecture document. Information about this can be found on the Clinical documentation at the point of care website.

5.3 Sharing and exchange of data for secondary purposes

Care data is also used for secondary purposes such as management indicators, quality indicators, administration and finance and research. In line with the principle of ‘Unambiguous documentation, multiple use’, here too, the aim is to make as much use as possible of data that have already been recorded during the care process.

In practice, there are major differences in the degree to which this is possible. During the care process, data is primarily recorded with the objective of supporting the care process. For secondary purposes, data is often required that is not of primary importance for support of the care process and is therefore not recorded in this context. For this reason, separate registers are kept for provision of data to quality registers, for example.

In the context of the Clinical documentation at the point of care programme, a number of pilot projects are being used to work out the practical implementation of provision of the data to a number of quality registers on the basis of health and care information models (HCIMs).

The basic principle of the provision of data to a quality register on the basis of health and care information models is shown in Figure 16. In practice, provision in this way is not possible at present. For further information about provision to quality registers, please see the relevant volume (in development) of the architecture document. Information about this can be found on the Clinical documentation at the point of care website.

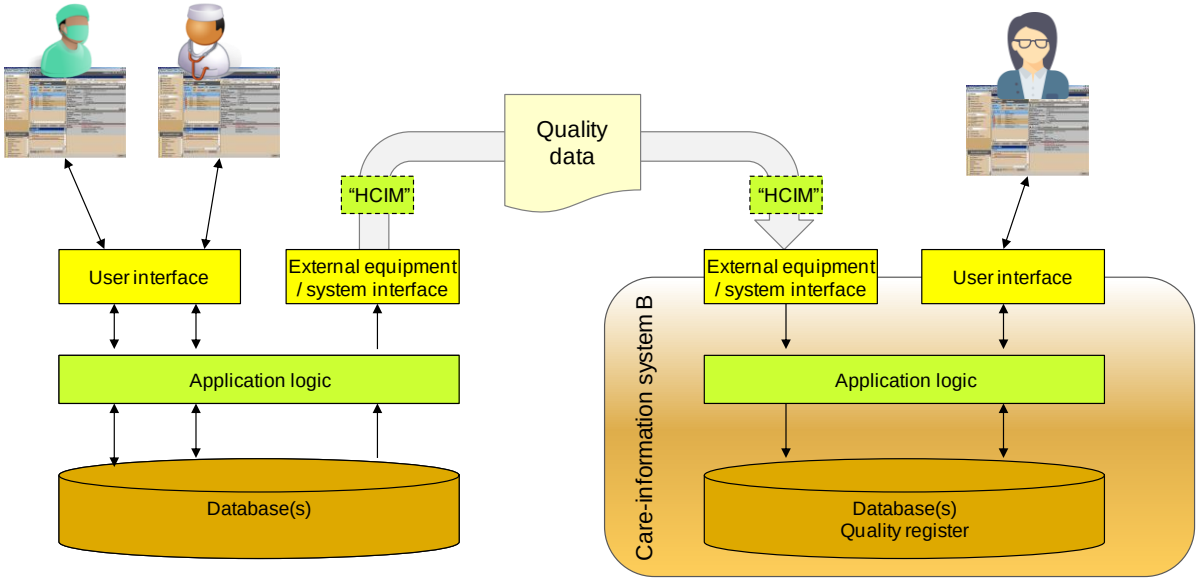

Figure 16 - Provision to a quality register (basic principle)

Appendix 1 - List of abbreviations and terms

Abbreviation	Meaning	Explanation
ANY	Generiek Datatype (Generic Data Type)	Datatypes
BgZ	Basisgegevensset Zorg (Basic Data Set for Care)	BgZ
BL	Boolean	Datatypes
CD	Concept Descriptor	Datatypes
CDA	Clinical Document Architecture	HL7 CDA standard
DBC	Diagnose Behandel Combinatie (Diagnosis Treatment Combination)	
DCM	Detailed Clinical Model	Wikipedia
ECD	Elektronisch Cliënten Dossier (Electronic Client Record)	
ECG	Electrocardiogram	
ED	Encapsulated Data	Datatypes
EHR	Elektronisch Patiënten Dossier (Electronic health record)	
FHIR	Fast Healthcare Interoperability Resources	HL7 FHIR standard
HIS	Huisartseninformatiesysteem (GP Information System)	
HL7	Health Level Seven	HL7 Nederland
II	Instance Identifier	Datatypes
INT	Integer Number	Datatypes
LIS	Laboratorium informatiesysteem (Laboratory Information System)	
LROI	Landelijke Registratie Orthopedische Implantaten (Dutch National Register of Orthopaedic Implants)	LROI
NICE	Nationale Intensive Care Evaluatie (National Intensive Care Evaluation)	NICE
PGD	Persoonlijk Gezondheidsdossier (Personal Health Record)	
PGO	Persoonlijke Gezondheidsomgeving (Personal Health Environment)	
PQ	Physical Quantity	Datatypes
ST	String	Datatypes
TS	Timestamp	Datatypes

UMC	Universitair Medisch Centrum (University Medical Centre)	
VVT	Verpleeg-, Verzorgingshuizen en Thuiszorg (Nursing Homes, Care Homes and Home Care)	
XML	EXtensible Markup Language	Wikipedia
HCIM	Zorginformatiebouwsteen (Health and care information model)	
ZIS	Ziekenhuisinformatiesysteem (Hospital Information System)	

Appendix 2 - Overview of health and care information models (HCIMs)

Medically originated health and care information models (HCIMs)

- Respiration
- AlcoholUse
- Alert
- AllergyIntolerance
- BarthelADLIndex
- TreatmentDirective
- Payer
- BloodPressure
- MaritalStatus
- Contact
- ContactPerson
- DrugUse
- FamilyHistory
- FunctionalOrMentalStatus
- GlasgowComaScale
- HeartRate
- LifeStance
- BodyWeight
- BodyHeight
- BodyTemperature
- MedicationUse
- MedicationAdministration
- MedicationDispense
- MedicationPrescription
- MedicalDevice
- Nationality
- O2Saturation
- Education
- Patient
- PainScore
- PulseRate
- TobaccoUse
- ConcernForTransfer
- PlannedCareActivityForTransfer
- LaboratoryTestResultForTransfer
- TextResultForTransfer
- ProcedureForTransfer
- Vaccination
- AdvanceDirective
- LivingSituation
- HealthcareProvider
- HealthProfessional

Nursing originated health and care information models (HCIMs)

- GeneralMentalFunctions
- GeneralMeasurement
- TreatmentObjective
- BladderFunction
- BurnWound
- CommunicationSkills
- BowelFunction
- PressureUlcer
- HearingFunction
- VisualFunction
- SensoryObservationFunction
- FamilySituation
- SkinDisorder
- HelpWithMedication
- HelpFromOthers
- Infusion
- MenstrualCycle
- Mobility
- MUSTScore
- Malnutrition
- FallRiskForTransfer
- ParticipationInSociety
- PainPerception
- SleepFunction
- SNAQScore
- FeedingTubeSystem
- SpecificMentalFunctions
- Stoma
- LanguageProficiency
- OutcomeOfCare
- AbilityToDrink
- AbilityToEat
- AbilityToPerformHaircareActivities
- AbilityToPerformMouthcareActivities
- ToiletUseAbility
- AbilityToDressOneself
- AbilityToWashOneself
- NursingIntervention
- NutritionAdvice
- FreedomRestrictingMeasures
- FreedomRestrictingMeasuresMentalHealthcare
- Wound
- IllnessPerception

See also: https://zibs.nl/wiki/zorginformatiebouwstenen