

Appendix 2, Project description:

Karolinska University hospital maintains and supports the regional main EHR (Electronic Health Record) system, named TakeCare, on behalf of Region Stockholm and it's over 2 million inhabitants. TakeCare has been used many years and contains over 5 million patient records. We want to convert the content to openEHR format, including partly using "integration archetypes".

Background

TakeCare will no longer be used after 2029 and a procurement of a new main EHR system will likely be finalized during 2024, that new main EHR procurement is NOT part of this framework agreement. However, when decommissioning TakeCare, then openEHR based systems and services are the most interesting candidates for storing and making available the data from the decommissioned TakeCare system.

This document describes a call-off in tender Area 3 "Consulting services" of the openEHR-focused "Digital Health Platform" framework agreement. We are requesting integration expert consultancy regarding openEHR/FHIR-models, mapping and conversion algorithms from our legacy EHR (TakeCare) to openEHR (clinical data) and partly to FHIR (mostly administrative data). Initially this will be in the form of a PoC (Proof of Concept). The PoC will give important input regarding the feasibility and potential cost for storing data from decommissioned systems like TakeCare.

We already believe that different such conversions, described below, are possible, but in the PoC we want to figure out scalable ways of doing them and get a better understanding of how much work is needed. If the PoC results are satisfactory there will likely be follow-up call-offs for conversion of most of the approximately 25 different major information types in TakeCare.

Staff resources and call-off structure

We are splitting the PoC call-off in two parts (A & B) requesting partly different expertise so that the two parts can be assigned to different framework agreement partners that may have different experience/expertise. We also hope this increases availability of expertise since global experts in the field are likely already booked and a single provider might not be able to provide 2 FTEs (Full Time Equivalents) on short notice. (However, the same provider might still win both of the separately and independently evaluated call-offs.) The winners of each part will be expected to work in close collaboration with each other and with Karolinska's staff. An FTE may in practice be filled by several persons from the winning framework partner provided that they keep each other well informed so that we do not need to repeat ourselves during meetings etc. Details about required availability of consultants with different competence levels are stated in the procurement portal (Tendsign).

The two call-offs request up to 1 FTE each, most likely for three months, ideally starting mid-August 2024. The two expertise areas are

- A. Informatics focus
- B. Integration & visualisation focus

Qualification requirements for each are explained further down in this document and in the procurement portal (Tendsign).

Several documents about the source formats and APIs used by TakeCare are in Swedish, and the Supplier needs to have some Swedish speaking staff, partner or subcontractor or other ways to understand/translate those documents when such needs arise. Several such documents are detailed in Appendix 3 and 3.1.

The called-of consultants will be experts and work as resources as parts of a hybrid (partly remote) team, led by Karolinska. All resulting work will become intellectual property of Karolinska. Karolinska

however aims to publish most things from the PoC that can be of public interest as open source using permissive licences.

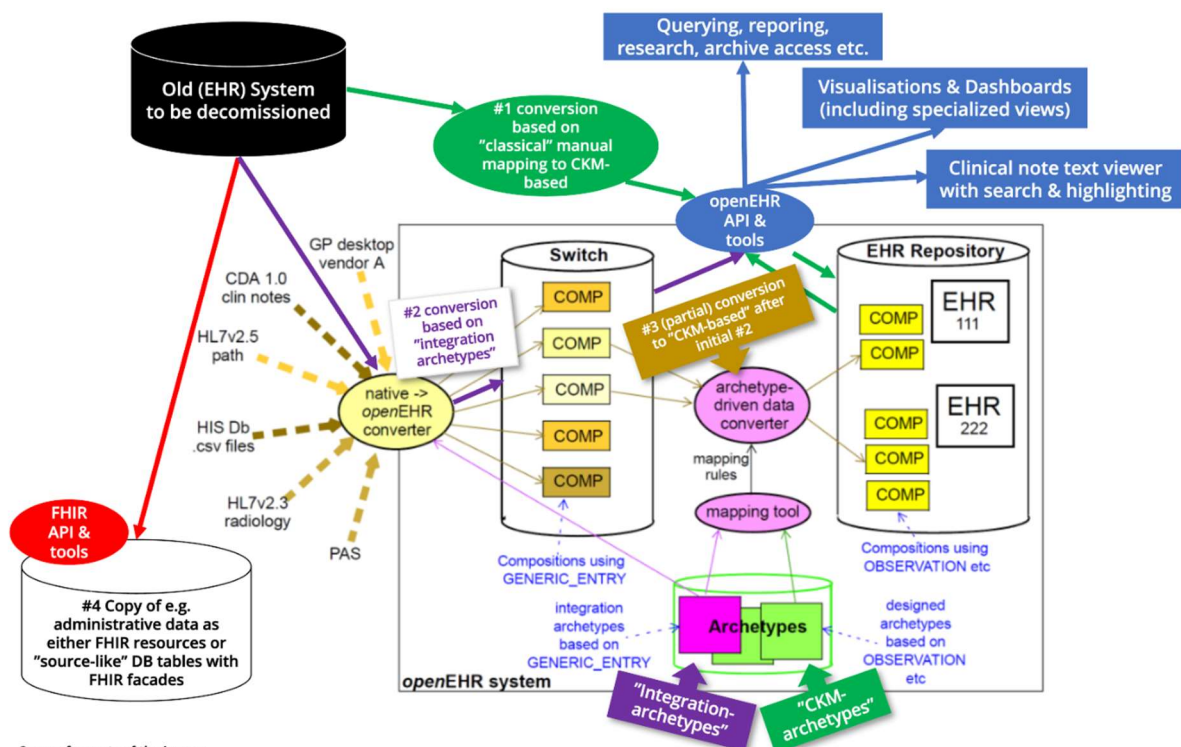
Karolinska will supply the following resources (they are thus not requested in this call-off). They will be available for collaborative work in the team:

- TakeCare-experts (from TakeCare’s Supplier) via normal support channels
- Coordination + architecture 0.5 - 1 FTE (including from Karolinska’s TakeCare/EHR expertise)
- Informaticians and information architects (from Karolinska) 1–1.5 FTE including expertise regarding our TakeCare usage/config and regarding medication management and also staff familiar with openEHR.
- If needed: UI developer from Karolinska, up to 0.5 FTE during relevant periods, assisting the called-off consultants in call-off B (Integration & visualisation focus) in creating PoC overviews/dashboards based on test data mapped to openEHR

Target and method categories

Different information types in TakeCare will need to be converted to different categories of target formats using different methods labelled #1 to #4 and described in a table on the next page.

For more context we have created and included an image below where the categories (#1-#4) and the PoC context has been added to an image originally from [the openEHR “Integration Information Model”](#) specification:



Source for parts of the image:
<https://specifications.openehr.org/releases/RM/latest/integration.html>

Technical implementation details: the parts labelled "Switch" and "EHR Repository" can be contained in the same CDR, but tagged/ marked in a way that makes it easy to choose if API calls (e.g. AQL-queries) should return responses from only one specific part or both.

The prime target category & method candidates are:

#1	<p>openEHR COMPOSITIONS based on templates mainly based on internationally designed archetypes available in CKM (https://ckm.openehr.org/)</p> <ul style="list-style-type: none"> This kind of conversion is realistic for source information types that have well defined APIs and data structures with limited variability of content. This kind of conversion consists mainly of manual template modeling (and possibly some archetype creation if anything is missing in the CKM) followed by manual modeling of mappings from attributes in source format to attributes in the manually designed templates. Conversion of the actual health record data (instances of EHR content), according to this modeled mapping, shall then be automated using some appropriate tool/service.
#2	<p>openEHR COMPOSITIONS based on templates based on generated integration archetypes using e.g. openEHR's GENERIC_ENTRY. (See https://specifications.openehr.org/releases/RM/latest/integration.html)</p> <ul style="list-style-type: none"> This kind of conversion is realistic for sources that follow a generic model (somewhat analogous to openEHR's RM) and that also has a catalogue listing the forms/templates and terminology subsets defined in the source system. Manually mapping thousands of these would not be realistic from a resource- and cost/benefit-perspective. <ul style="list-style-type: none"> In TakeCare that catalogue is thousands of "mallar" (forms/templates) each based in a number of "sökord" (keywords/headings). There are thousands of "sökord" and they are partly reused between "mallar". This kind of conversion is based on understanding the generic source formats/patterns and creating two categories of algorithms/programs <ul style="list-style-type: none"> An algorithm on a "schema" level that takes the catalogue of source system forms/templates and automatically converts them to integration archetypes and templates. Another algorithm on an "instance" level that iterates over the EHR content in the source system for a patient and translates it to openEHR COMPOSITIONS based on the previously generated integration archetypes and templates.
#3	<p>openEHR COMPOSITIONS based on #2 (algorithmically designed) templates but in some cases also converted to COMPOSITONS based on #1 (manually designed) templates.</p> <ul style="list-style-type: none"> This kind of conversion is realistic for source categories where there is too much variation in the source to have time to manually model and map everything (so mainly #2 – the algorithmic way will be used), but where we know that it would be of high value to have some selected subcategory of the data or parts of it (also) manually mapped and converted to templates mainly based on internationally designed archetypes available in CKM. In TakeCare this can for example be the thousands of different "mätvärden" (measurement observations) where we want to select some subcategories of great value (e.g. Pulse, Blood pressure etc.) and have those also mapped also to COMPOSTITIONS based on templates based on proper CKM archetypes. This kind of conversion likely will consist of a first automated step of type #2 (algorithmically designed) and stored in the CDR. For some subcategories this will then be followed by a step based on further conversions of type #1 (manually designed) and stored again in the CDR in the new CKM-based format but also including a link to the corresponding COMPOSITION based on "integration archetypes" that was originally stored. This way also context not possible to convert to "proper" CKM-based format can be read by staff accessing the information at a later point in time.
#4	<p>FHIR resources based on national or regional/local FHIR profiles.</p> <ul style="list-style-type: none"> This kind of conversion is realistic for source categories that we have deemed valuable to have accessible primarily in FHIR format, for example some administrative information. This kind of conversion can be done in at least two ways <ul style="list-style-type: none"> either by converting source data to FHIR format and store the converted data in a FHIR server. (Via our contract with Tietoevry we have the FHIR services included in Better Platform available, we also have experience running the opensource HAPI FHIR Server.) or extracting and storing database posts from the source system in a format close to the source system's format and creating a FHIR facade that can be accessed. The storage should then be done in a database we can keep running after TakeCare has been decommissioned. (We have e.g. PostgreSQL and Couchbase available in our internal cloud at Karolinska)

Shared work to be done

Work with the following source categories is requested, in currently prioritized order. We understand that it will be hard to estimate the time needed for different parts and have thus chosen to list more parts than we believe will be doable in 2-3 months however we hope to get a lot of useful results for at least the first three (or ideally four).

Swedish name & Category # above	English name + comments	Main API in TakeCare
Läkemedel (cat. #1)	Medications. The source API is fairly well documented and has limited variability.	Xchange (XML) API: Medications. MedicationHistoryGet
Journaltext (cat. #2)	Clinical notes (forms). Huge variability in size, structure, and content.	Xchange (XML) API: CaseNote. CareDocumentationGet
Kemlabb (cat. #1)	Clinical Chemistry (a lot of analysis and mapping is already done). The mapping/conversion should be general and cover any value from the source, but for the visualization at least the following are of special demo-interest (Swedish terms) <ul style="list-style-type: none"> - P-glukos CGM - P-Kreatinin - P-Alaninaminotransferas (ALAT) 	Juno (JSON) API: <ul style="list-style-type: none"> • .../lab/replies/chemistry • .../lab/replies/chemistry/{documentId} • etc.
Mätvärden (cat. #3)	Measurements. Uses a kind of forms/templates (there are more than 1000). Map at least these also to CKM-based form: <ul style="list-style-type: none"> - NEWS2 Score and several vital parameters it is depending on - Blood Pressure (there might be more than one "mätvärde" as source) - Height, Weight, BMI - If time allows, also some other values we have shortlisted as useful for a patient overview/dashboard 	Juno (JSON) API: <ul style="list-style-type: none"> • .../measurements • .../measurements-index • .../measurements/{measurementDocumentId} • etc.
Aktiviteter (cat. #1)	Activities. Variation is mainly in the terminology used, not in structure	Juno (JSON) API <ul style="list-style-type: none"> • .../activities • etc.
Bokningar (cat. #4)	Appointment bookings.	Juno? (JSON) might be in a data dump rather than via API

Most of the relevant Juno (JSON) listed above with leading "... " are GET calls that should be prefixed by /patients/{patientId}, see Appendix 3 for details. In appendix 3 (PDF) "Documentation and Example files" you will find technical details about:

- TakeCare API Documentation form both Juno and Xchange APIs
- Example data from legacy EHR, some with corresponding screenshots of end user UI

In appendix 3.1 (excel file) you will find configuration data, a list of Keywords/"sökord".

In addition to the work with mappings and data instance conversion the converted data needs to be **presented and visualized** in a way that a non-technical audience can appreciate. The audience needs to see that the subset of data that has been converted from TakeCare can now be presented in a way equivalent to or superior to the way it was presented in TakeCare. To do this, among other things, the tools and platforms included in Tietoevry's Lifecare Open Platform and the included Better Platform should be used since we have them available as a result of a previous call-off (experience with such tools is thus requested). Primarily a dashboard/summary/overview for single-patient views should be created. If time allows, then multi-patient ward overviews of e.g. NEWS 2 and other values can be created. Regarding the highly variable textual data from "Journaltext" (Category #2) a general

composition (text) viewer capable of handling GENERIC_ENTRY/"integration archetypes" must be made available for single-patient-views, ideally if time permits also with good search and search result highlight capabilities.

The patient data and TakeCare configuration data used in the PoC will be from fictitious test patients in test environments, thus no sensitive information is expected to be shared. The solutions used during the PoC do not need to be fully integrated in our environments, they can for example be file batch loads that we then commit to a CDR using scripts & tools. The approaches should however be designed in a way such that as much as possible can be re-used and with limited effort also later be run in our environments and normal integration flows, e.g. as microservices in our OpenShift platform using e.g. event streaming platforms like Kafka to allow for asynchronous flows.

Any artefacts (including openEHR archetypes and templates) developed or generated during the POC, as well as any data conversion scripts etc, shall be properly stored and version controlled in systems approved by Karolinska and well documented to allow for re-use.

Required consultancy experience **Call-off A: Informatics focus**

Extensive openEHR modelling and mapping experience at Level 5 (as defined in framework agreement) must be available from the Supplier. Documented experience of working with openEHR for modelling of the following will be evaluated:

- Medication related archetypes and templates
- Clinical measurements (e.g. vital parameters) and related archetypes and templates
- Laboratory medicine, especially clinical chemistry, related archetypes and templates

Required consultancy experience **Call-off B: Integration & visualisation focus**

Extensive experience, at least Level 4 (as defined in framework agreement), of creating scripts/programs/algorithms that convert legacy EHR data to openEHR format must be available from the Supplier. Documented experience of working with the following will be evaluated:

- Automated conversion of data from legacy systems to openEHR format. Preferably including:
 - Creation (preferably automated) of "integration archetypes" (and associated templates) based on "schema", form-definitions etc from legacy EHR systems
 - Use of data conversion approaches described in [the openEHR "Integration Information Model"](#) specification.
- Creating openEHR-based visualisations like dashboards or patient overviews using our available platforms (Tietoevry's Lifecare Open Platform or the included Better Platform).

Shared requirements and information

In the procurement portal you are requested to submit

- Documentation of the requested experience for the call-off you are responding to.
- CV for (all) the offered consultant(s) you intend to engage to fill the total requested FTE during the contract period

Start will occur as soon as possible after 15:th of August. **Final phase** with presentations, demo and conclusions will be towards the end of the PoC, 1:st of November to 15:th of November (in parallel with finalisation of documentation etc).

The work will likely be performed during eight (8) to twelve (12) active work weeks. The contract is thus formally expressed as 2 months with options to extend for 1+1 months.