re.flex machine-readable data export

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Introduction

re.flex is a system that enables patients in need of physical therapy to do their exercises at home without the need to go to a physiotherapy clinic. Using two motion sensors and a mobile application, it provides a proven exercise program, detects and counts exercises performed by the user, offers feedback on the quality of the execution and receives pain and intensity data reported during the training.

Objective

This document describes the interoperable data format in which the personal and health related data for musculoskeletal patients can be transferred from one system to another. It should enable other manufacturers or developers of digital health applications to process and interchange this kind of data.

The document aims to provide interoperability as required by Sections 5 and 6 from DiGAV.

This document is based on the HL7® FHIR® Standard Version 4.0.1.

The following HL7® FHIR® standard structures were used:

Patient : https://www.hl7.org/fhir/patient.html

Observation: https://www.hl7.org/fhir/observation.html

Data concepts

The data export is in the open standard JSON format, widely used to exchange data. This export can be done by the patient using the re.flex application.

The following data is relevant when working with musculoskeletal patients

- patient related data - data identifying the patient
- adherence data - how well has the patient followed the training program in terms of repetitions
- exercise execution data - how well has the patient executed the exercises and what is the feedback (in terms of pain and exertion), has the patient reported
- general execution data - what pain and exertion levels has the patient reported before and after the training

Patient data

The full description of the Patient structure used fields and extensions to the FHIR® standard are below.

Field	Format	Description
name - given	String	The patient's first name
id	Integer	The patients' unique id
telecom - email	String	The email of the patient
extension - SubscriptionStart	YYYY-MM-DD format	The first day of training
extension - SubcriptionEnd	YYYY-MM-DD format	The last day of training

Observation - Adherence data

The full description of the Observation structure for adherence data and the extensions to the FHIR® standard are shown below.

Field	Format	Description

effectiveDateTime	YYYY-MM-DD format	The date when the exercise was scheduled
id	String	The unique id of the observation with the following format: YYYY-MM-DD-RD-patient id-exercise id, e.g. “2020-10-01-RD-1234-321”
value	integer	The number of repetitions done
extension - exercise_name	String	The name of the exercise
extension - exercise_id	integer	The unique id of the exercise
extension - sets	integer	How many sets had the patient scheduled for this exercise on this day
extension - reps_per_set	integer	How many repetitions per each set of the exercise had the patient scheduled on this day

Observation - Exercise execution data

The full description of the Observation structure for exercise execution data and the extensions to the FHIR® standard are shown below. The actual values are stored in the FHIR component structure of the Observation.

Field	**Format**	**Description**

effectiveDateTime	YYYY-MM-DD format	The date when the exercise was scheduled
id	String	The unique id of the observation with the following format: YYYY-MM-DD-EE-patient id-exercise id-set number, e.g. “2020-10-01-EE-1234-321-1”
extension - exercise_name	String	The name of the exercise
extension - exercise_id	integer	The unique id of the exercise
extension - set_number	integer	On which set of the exercise were the execution values reported
component - pain	integer	What pain level (on a 0 to 10 scale) did the patient report for this exercise
component - exertion	integer	What exertion level (on a 0 to 10 scale) did the patient report for this exercise
component - accuracy	float	With what average accuracy did the patient perform the exercise

General execution

The full description of the Observation structure for general execution data based on the FHIR® standard are shown below. The actual values are stored in the FHIR® component structure of the Observation.

Field	Format	Description
effectiveDateTime	YYYY-MM-DD format	The date of the trainin
id	String	The unique id of the observation with the following format: YYYY-MM-DD-GE-patient id, e.g. “2020-10-01-GE-1234”
component - pain_before_training	integer	What pain level (on a 0 to 10 scale) did the patient report before starting the training on this day
component - pain_after_training	integer	What pain level (on a 0 to 10 scale) did the patient report after finishing the training on this day
component - exertion_after_training	integer	What exertion level (on a 0 to 10 scale) did the patient report after finishing the training on this day

The whole data export

The data export is defined as a Bundle and has the following

Field	Format	Description
id	string	The bundle id is always “reflex-data-export”
Patient	object	The patient data object
Observation - adherence_data	object	The adherence data objects
Observation - exercise_execution	object	The exercise execution data objects
Obvservation - general_execution	object	The general execution data objects

JSON example

Below there is an example of the JSON data export format.


```
{
    "resourceType": "Bundle",
    "id": "reflex-data-export",
    "type": "collection",
    "timestamp": "2020-10-01T10:12:21Z",
    "entry":  [
        {
            "fullUrl":
"http://hl7.org/fhir/StructureDefinition/Patient/1234",
```

```
            "resource": {
                "resourceType": "Patient",
                "id": "1234",
                "meta": {
                    "profile":  [
                        "http://hl7.org/fhir/StructureDefinition/Patient"
                    ]
                },
                "name":  [
                    {
                        "use": "official",
                        "given":  [
                            "John"
                        ]
                    }
                ],
                 "telecom":  [
                    {
                        "system": "email",
                        "value": "john@doe.net"
                    },
                ],
                "extension":  [
                    {
                        "url": "SubscriptionStart",
                        "valueDateTime": "2021-01-04"
                    },
                    {
                        "url": "SubscriptionEnd",
                        "valueDateTime": "2021-03-04"
                    },
                ],
            }
        },
        {
            "resource": {

                "resourceType": "Observation",
                "id": "2020-01-20-RD-1234-321",
                "meta": {
                    "profile":  [

"http://hl7.org/fhir/StructureDefinition/Observation"
                    ]
                },
                "code": {"text": "repetitions_done"},
                "status": "final",
                "category":  [
                    {
                        "coding":  [
                            {
                                "system":
"http://terminology.hl7.org/CodeSystem/observation-category",
                                "code": "therapy"
                            }
                        ]
                    }
                ],
                "extension": [
                    {
```

```
                        "url" : "exercise_name",
                        "valueString": "Squat",
                    },
                    {
                        "url": "exercise_id",
                        "valueInteger": 321,
                    },
                    {
                        "url": "sets",
                        "valueInteger": 2,
                    },
                    {
                        "url": "reps_per_set",
                        "valueInteger": 10,
                    },
                ],
                "valueInteger": 20,
                "effectiveDateTime": "2020-01-20",
            }
        },
        {
            "resource": {
                "resourceType": "Observation",
                "id": "2020-01-20-EE-1234-321-1",
                "meta": {
                    "profile":  [
"http://hl7.org/fhir/StructureDefinition/Observation"
                    ]
                },
                "code": {"text": "exercise_execution"},
                "status": "final",
                "category":  [
                    {
                        "coding":  [
                            {
                                "system":
"http://terminology.hl7.org/CodeSystem/observation-category",
                                "code": "therapy"
                            }
                        ]
                    }
                ],
                "extension": [
                    {
                        "url" : "exercise_name",
                        "valueString": "Squat",
                    },
                    {
                        "url": "exercise_id",
                        "valueInteger": 321,
                    },
                    {
                        "url": "set_number",
                        "valueInteger": 1,
                    },
                ],
                "component": [

                    {
```

```
                        "code": {"text": "pain"},
                        "valueInteger": 2,
                    },
                    {
                        "code": {"text": "exertion"},
                        "valueInteger": 6,
                    },
                    {
                        "code": {"text": "accuracy"},
                        "valueString": "9.7",
                    },
                ],
                "effectiveDateTime": "2020-01-20",
            }
        },
        {
            "resource": {

                "resourceType": "Observation",
                "id": "2020-01-20-GE-1234",
                "meta": {
                    "profile":  [
"http://hl7.org/fhir/StructureDefinition/Observation"
                    ]
                },
                "code": {"text": "general_execution"},
                "status": "final",
                "category":  [
                    {
                        "coding":  [
                            {
                                "system":
"http://terminology.hl7.org/CodeSystem/observation-category",
                                "code": "therapy"
                            }
                        ]
                    }
                ],
                "component": [
                    {
                        "code": {"text": "pain_before_training"},
                        "valueInteger": 1,
                    },
                    {
                        "code": {"text": "pain_after_training"},
                        "valueInteger": 2,
                    },
                    {
                        "code": {"text": "exertion_after_training"},
                        "valueInteger": 4,
                    }
                ],
                "effectiveDateTime": "2020-01-20",
            }
        }
    ]
}
```