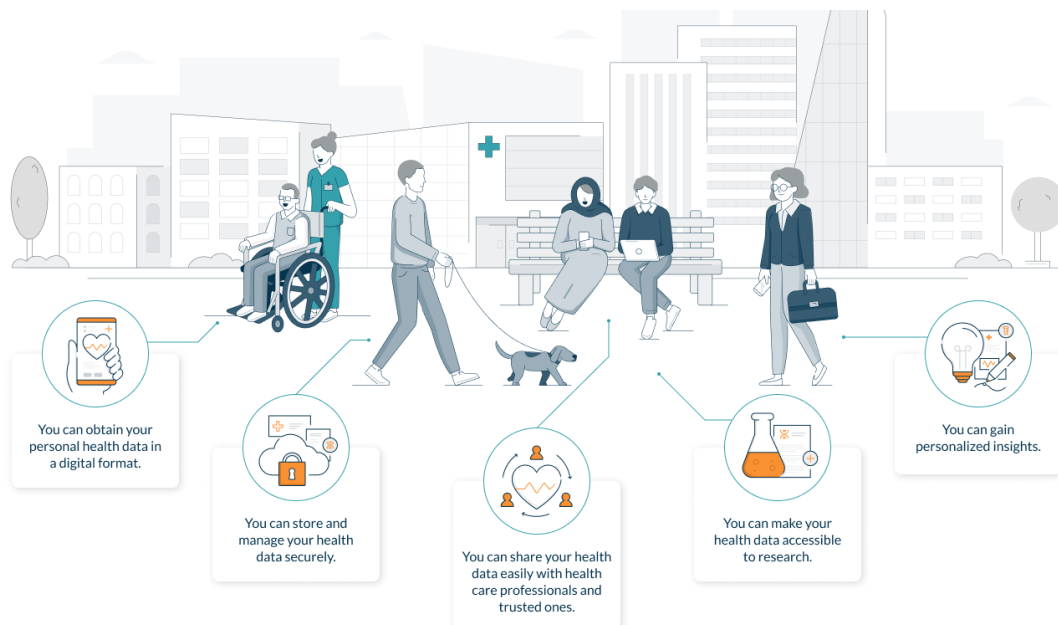


# Citizen-centred EU-EHR exchange for personalised health

# Smart4Health



## Therapists Handbook

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[www.smart4health.eu](http://www.smart4health.eu)

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## Disclaimer

This handbook v1.0 was developed to help therapists in using the MedX machine with HealthMonitor and Health Gateway software. It also explains the connection between the software and the Smart4Health platform. Due to continuous software development, this handbook will be adapted and released in updated versions.

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## 1 Smart4Health MedX Introduction

This handbook is intended to assist therapists in the entire treatment/prevention process on the MedX Lumbar Extension (LE) machine (medical device conformity) in the context of the Smart4Health project. Physiotherapy training will be performed to treat or prevent back pain and promote back-health. The citizens engaged in the program will perform the training to treat back pain and/or to reinforce their upper body range of motion. For 18-weeks, the citizen will execute an isolated training to increase their lower back muscle strength with the goal to decrease or prevent back pain. The value of the training is to treat back pain and to increase the patient wellbeing by reducing the back pain possibility.

The Smart4Health MedX solution is obtained using the following inter-connected modules:

- **Smart4Health platform:** platform where the citizen has access to their MedX data.
- **MedX LE machine:** physiotherapy machine where the exercises are performed.
- **B-Health IoT Box:** Internet of Things (IoT) solution responsible for the acquisition and processing of all sensors data, and implementation of gamification software which helps the citizen during training exercises.
- **HealthMonitor:** browser-based platform to be used by therapists and medical doctors that allows to manage citizens (e.g., registration incl. health-related questionnaires, connection to the Smart4Health platform), analyse their training progress, visualize training and force test conduction and upload their data to the Smart4Health platform.
- **Health Gateway:** computer software that allows a user-friendly interface between the MedX LE machine, the therapist, and the citizen.

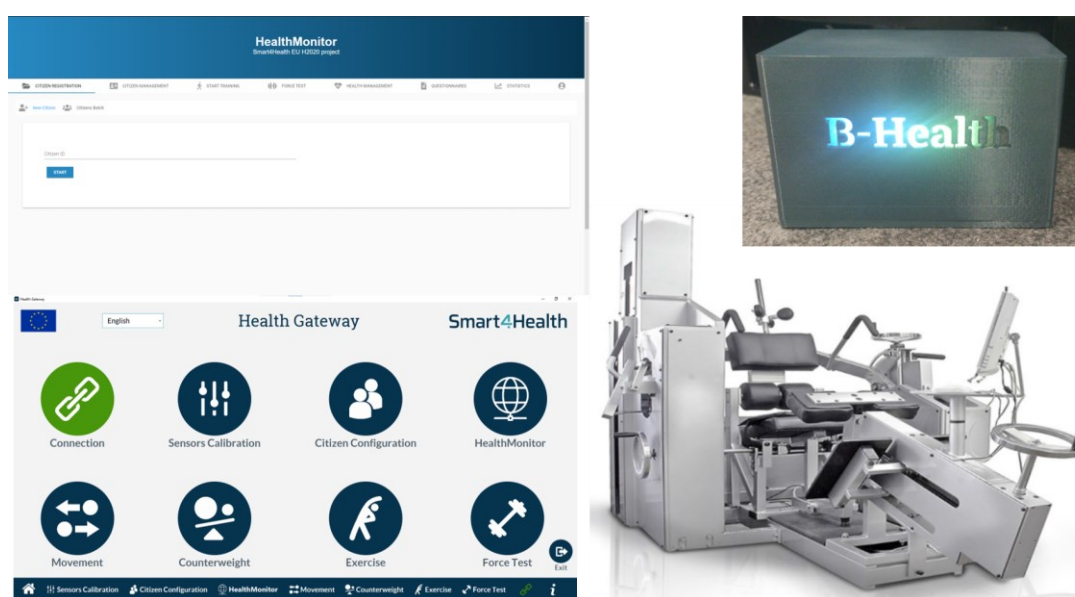


Figure 1 - Setup for training/therapy in MedX machine.

## 1.1 Smart4Health Platform Registration

All citizens who intend to participate in the Smart4Health MedX prevention/treatment program must first register on the Smart4Health platform (Figure 2) available at <https://app.smart4health.eu/>, following these steps:

1. Click *Start Now*.
2. Click *Create Account*.
3. Read and accept the information about password and data key.
4. Provide a valid email and create a password.
5. Read and accept the platform informed consent.
6. Select the place and context.
7. Store the data key safely. Without data key it is not possible to access the Smart4Health account.
8. Verify email address by clicking on the link received by email.

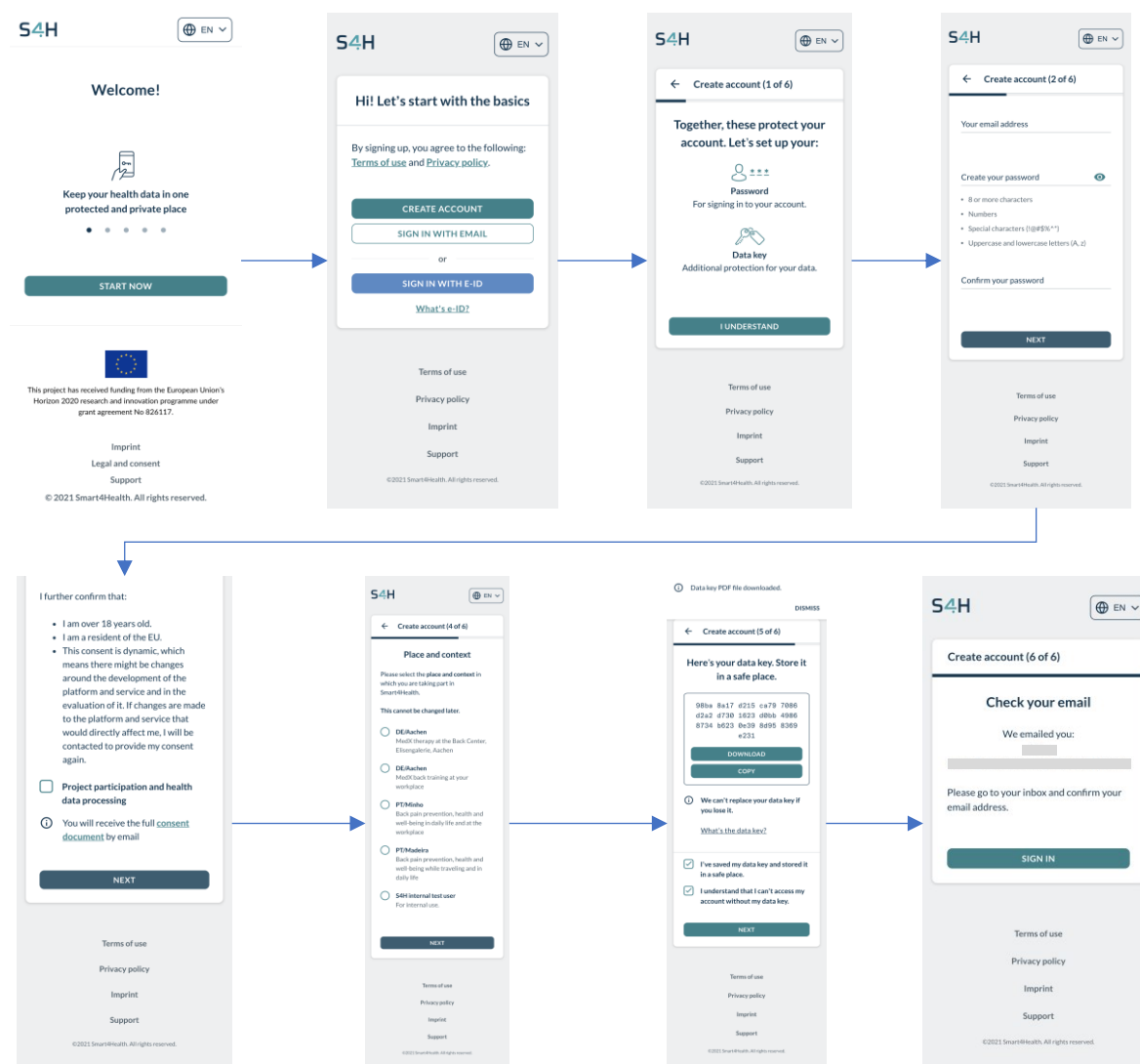


Figure 2 - Smart4Health platform registration.

After registration it is necessary to login for the first time on the platform (Figure 3), following these steps.

9. Click *Sign In With Email*.
10. Provide the email and password chosen at registration.
11. Add your phone number to enable two-factor authentication.
12. Confirm your phone number.
13. Enter the verification code sent by SMS.
14. Enter the data key saved in registration process.
15. Access your health data.

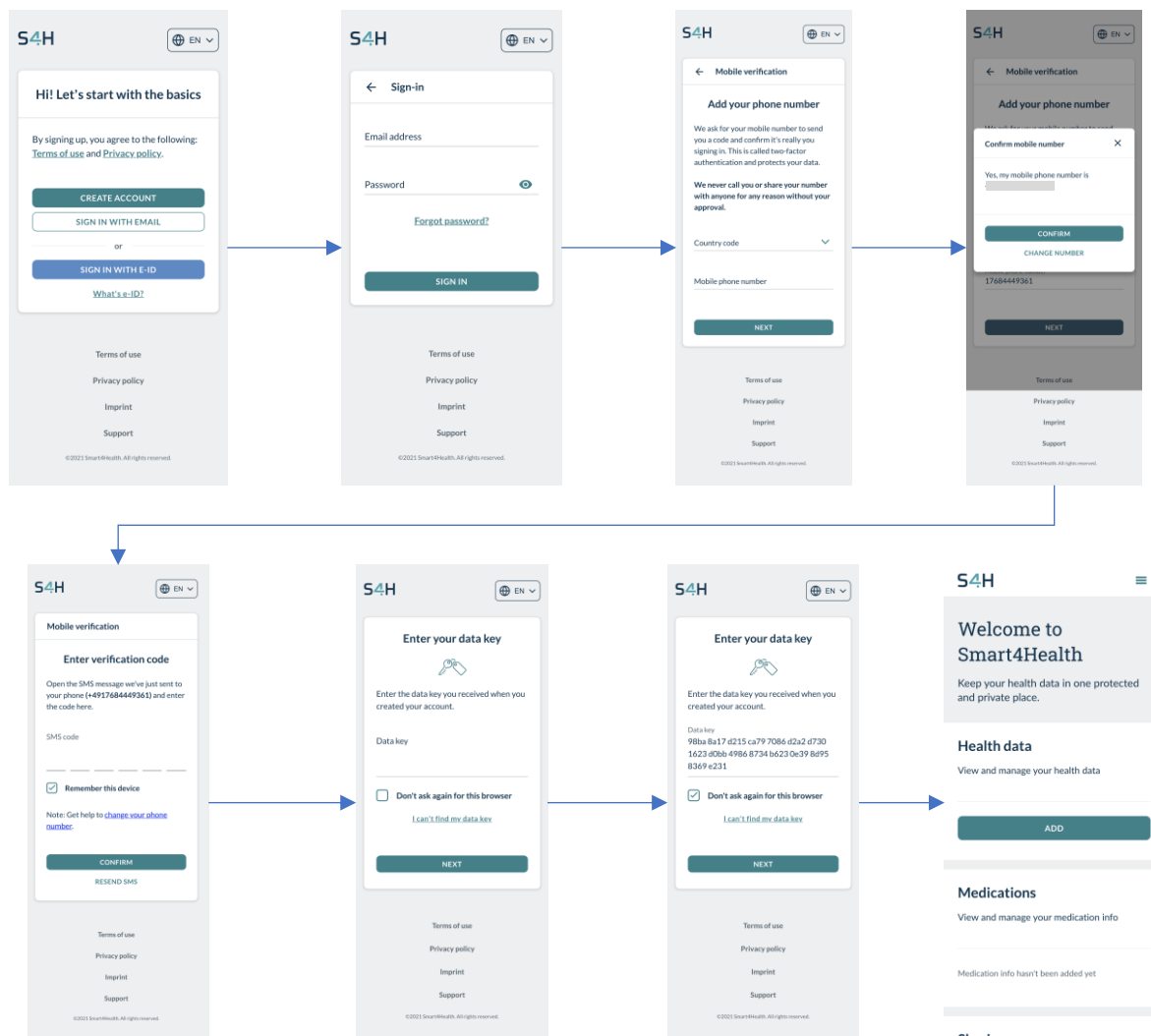


Figure 3 - Smart4Health platform first login.

## 1.2 HealthMonitor Overview

The HealthMonitor is a browser-based platform (Figure 4) available at <https://healthmonitor.ittm-solutions.com/> developed for the MedX physiotherapy machine, to be used by therapists and Medical Doctors, allowing to register new citizens, visualize training and force test conduction, analyse their training progress and upload their data to the Smart4Health platform.



## General information to use the HealthMonitor:

- Use Chrome (latest version) as browser for the HealthMonitor software.
- Your credentials (username, password and AppID) are provided by ITTM. Please follow the security information for credentials sent by ITTM. As for your credentials, securely store your AppID.
- Change the language on the Login screen in the upper right corner, before login. Note that the same language must be kept for a citizen every time when you use the HealthMonitor.
- When you login for the first time in a browser, an AppID is requested. This AppID is necessary to ensure secure data separation. For the first version, the AppID is provided together with your credentials.
- If you have any questions about the AppID or Credentials, please contact [healthmonitor-s4h@ittm-solutions.com](mailto:healthmonitor-s4h@ittm-solutions.com). Other questions, please contact Smart4Health helpdesk (see 9).

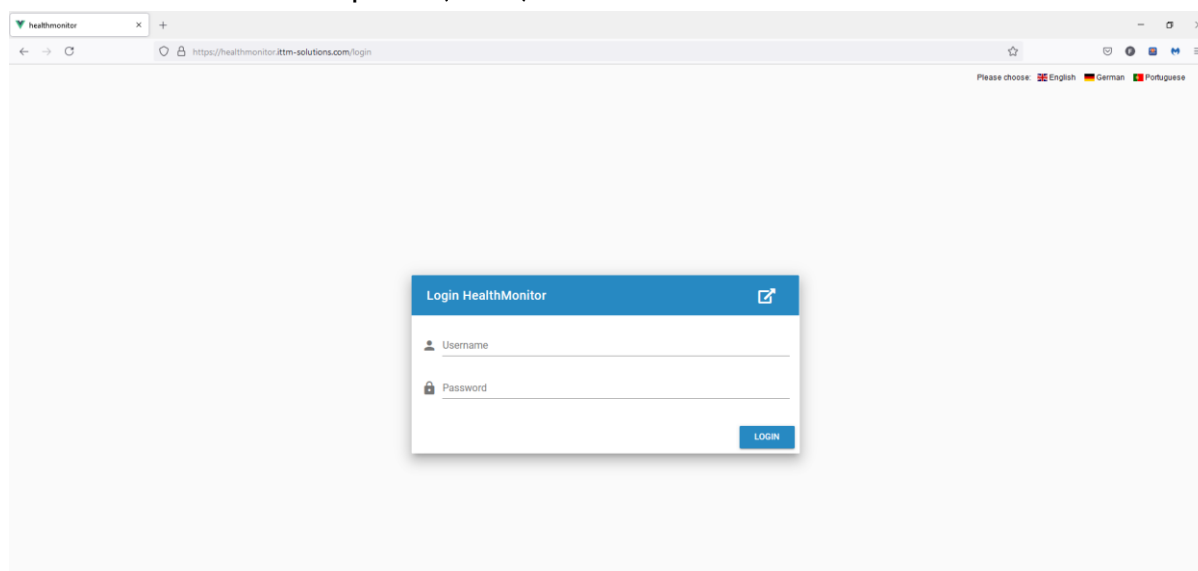


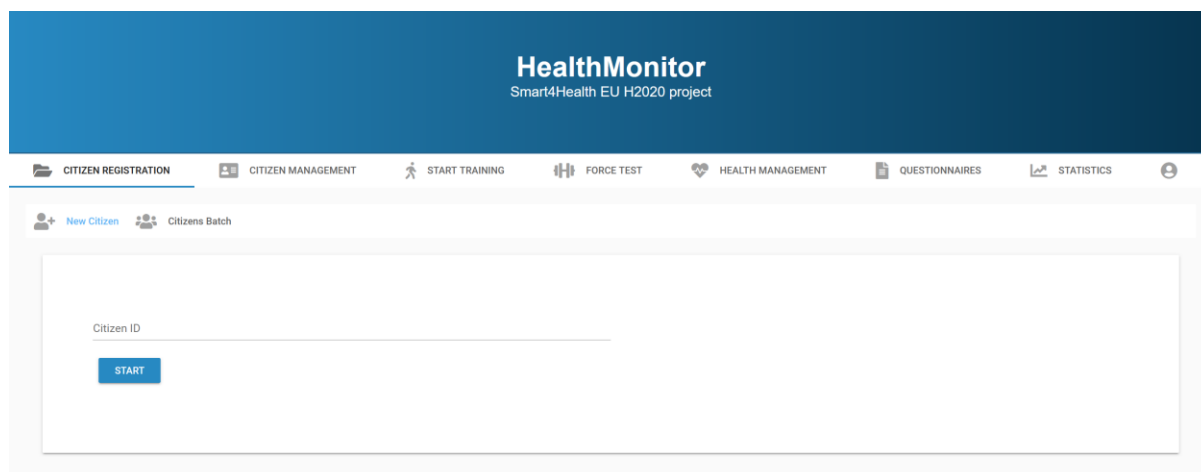
Figure 4 - HealthMonitor: Login page.

### 1.2.1 Landing page

After successfully logging into the HealthMonitor, you will be directed to a landing page. This interface shows the different options that can be carried out in the HealthMonitor. From left to right there are the following tabs:

- Citizen Registration – Create a new citizen account.
- Citizen Management – Select a citizen already registered.
- Start Training – Conduct a MedX training for a citizen after successful citizen registration.
- Force Test – Conduct a force test for a citizen outside the registration process.
- Health Management – Citizen data editing, displaying, evaluating and Smart4Health data upload.
- Questionnaires – Conduct pre-session and post-session questionnaires.
- Statistics – Displaying different statistics of the CUCs in general.





### 1.3 Health Gateway Overview

The Health Gateway is a computer software that can be accessed by icon .

The Health Gateway login is the first window displayed when opening the Health Gateway software. In this window it is possible to start the software with two options:

- Start with HealthMonitor authentication by typing the Username and Password and click the OK button. In this mode the connection with HealthMonitor is established allowing the load of citizen configuration data and the send of force test and training data.
- Enter without HealthMonitor authentication by clicking on the corresponding button. In this mode the use of Health Gateway is allowed without the HealthMonitor features (mainly for testing and demonstration purposes).

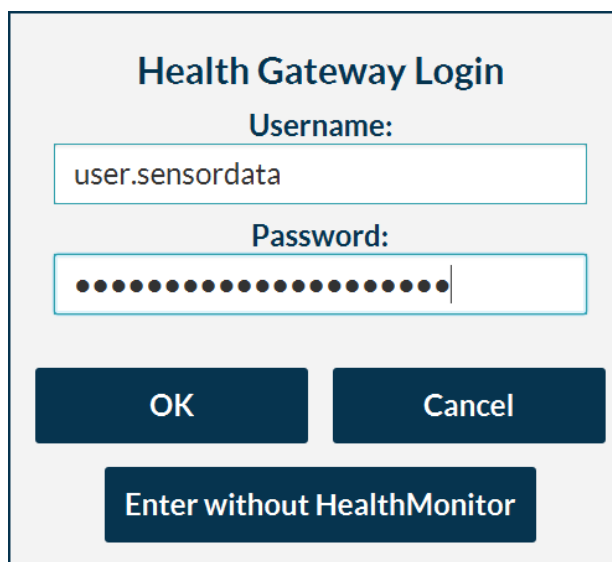


Figure 5 - Health Gateway: Login.

The authentication username and password are provided by ITTM. After the login the home menu is displayed. It is possible to verify the HealthMonitor availability by the colour of “HealthMonitor” tab. If tab appears in white, the HealthMonitor is available, if red, the HealthMonitor connection is not established.



The home menu of the Health Gateway is presented in Figure 6, and it allows to:












- “Language” – Choose the interface language from three available languages, English, German (Deutsch), and Portuguese (Português).
-  “Connection” – Establish the connection with the B-Health IoT Box where the sensors are connected.
-  “Sensors Calibration” – Open sensors calibration menu to calibrate the machine sensors.
-  “Citizen Configuration” – Open citizen configuration menu to view/change citizen configuration. If a connection to the HealthMonitor is present this information is loaded automatically.
-  “HealthMonitor” – Interact with HealthMonitor software. If the connection to HealthMonitor is established the default browser opens on the HealthMonitor website, otherwise, the login menu opens to establish the connection.
-  “Movement” – Open movement menu to define the citizen range of motion.
-  “Counterweight” – Open counterweight menu to define the citizen counterweight.
-  “Exercise” – Perform a training.
-  “Force Test” – Perform a force test.
-  “Exit” – Exit Health Gateway.
-  “Home” – Return to home menu.
-  “Info Page” – View information about the Health Gateway software.



Figure 6 - Health Gateway: Home menu.



### 1.3.1 Connection to the B-Health IoT Box

To perform the connection with the sensors, ensure that the B-Health IoT Box is powered on, and the network is connected. To establish the connection, click in *Connection* icon. While the connection is established, the screen in Figure 7 is shown. After the connection is correctly established the icon turns green as shown in Figure 8.



Figure 7 - Health Gateway: Connecting to B-Health IoT Box.



Figure 8 - Health Gateway: B-Health IoT Box is connected.

The connection status can be checked in the bar at the bottom right icon. If icon appears green the connection is established, otherwise it appears in white.



### 1.3.2 Sensors calibration

The sensors calibration must be carried out at least once a day. A popup window is shown (Figure 9) reminding the user of this need.



Figure 9 - Health Gateway: Popup calibration required.

To carry out the calibration, follow these steps:

1. Unlock the “Sensors Calibration” tab by clicking the lock icon (Figure 10). The password is 1234 (this step is not required if the user clicks on the popup window shown in Figure 9).

Angle calibration:

2. Unlock counterweight.
3. Put the machine in extension angle ( $0^{\circ}$ ) and click *Calibrate* or turn the switch. Wait for the process to finish.
4. Put the machine in intermediate angle ( $36^{\circ}$ ) and click *Calibrate* or turn the switch. Wait for the process to finish.
5. Put the machine in flexion angle ( $72^{\circ}$ ) and click *Calibrate* or turn the switch. Wait for the process to finish.
6. The angle calibration process is complete.

Pressure and force calibration:

7. Unlock counterweight.
8. Put the machine in default angle ( $18^{\circ}$ ).
9. Without citizen on the machine and no pressure on the pressure sensors, click *Calibrate* or turn the switch.
10. The pressure calibration process is complete.

Note: some machines might not have pressure sensors. In that case the pressure calibration only calibrates de force sensor.



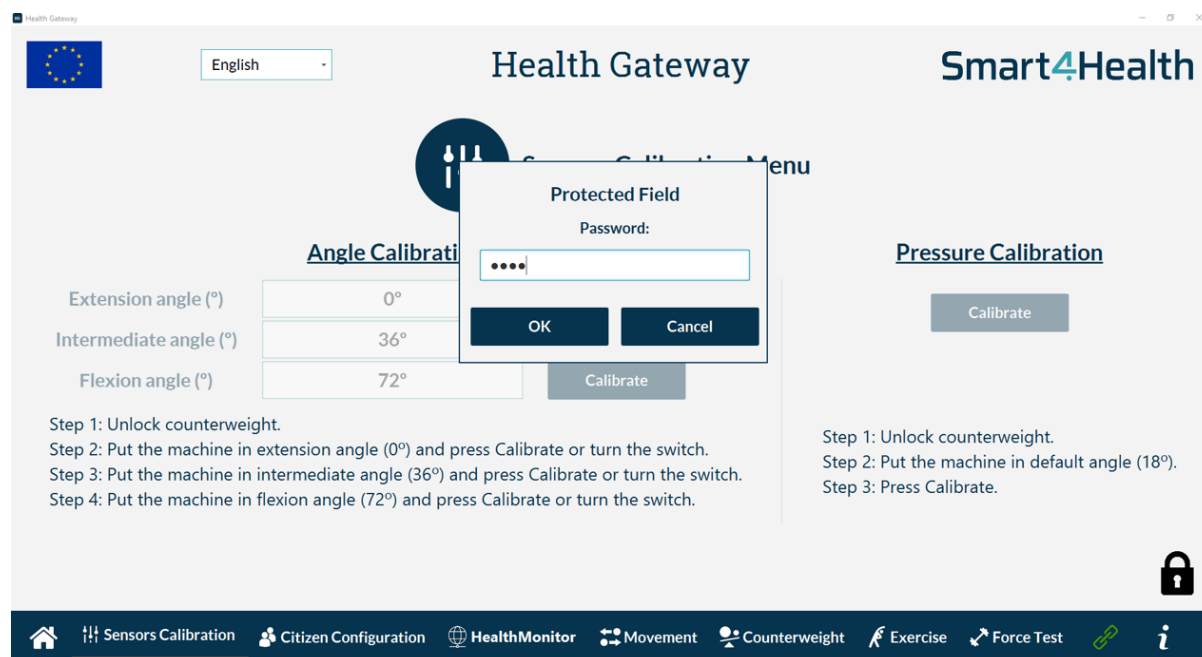


Figure 10 - Health Gateway: Login calibration.

## 1.4 Smart4Health MedX Steps Flow

Depending on the specifications of each CUC and its prevention or therapy context, the flow of appointments can be adapted. For this reason, in this handbook, the entire process of using the MedX machine in Smart4Health project is divided into the following steps:

1. Reception and registration of the citizen.
2. Determination of machine parameters.
3. Citizen evaluation through the initial force test.
4. Carry out trainings on the machine.
5. Citizen reassessment through the force test.
6. Fill in post-session questionnaire.

All these steps will be explained in detail in the next chapters and can be combined into several appointments depending on the specificity of the CUC.



## 2 User Registration

Participants must already be registered in Smart4Health platform and must have signed the corresponding ICs (see below) to participate in the MedX training. Otherwise, see 1.1 and help the citizen to register on the Smart4Health platform.

### 2.1 Welcome

- Welcome the citizen and explain the process.

“Good morning/afternoon and welcome to the Smart4Health project. My name is (name) from (institution). Today I would like to discuss some formal things with you and register you in our software. The first training will then take place at the next step.

The goal of this project is to generate a citizen-centric EU EHR (electronic health record) exchange for personalized health. Now, with the support of the MedX machine, we will analyse your deep back muscles and then train the muscles specifically. The test results will be stored in your Smart4Health platform. Before we start the first training it's important to talk about the participation requirements.”

### 2.2 Medical History/Patient Declaration

- Collect proof of ICp (platform informed consent), for example by forwarding the email received by platform or brings the last page of the ICp.
- Collect ICcuc (CUC informed consent) signed by citizen.
- Clarify any questions.
- Collect all the documentation in a folder.
- The participation must have read the ICcuc and sign that they have no contraindications.

“Did everything work fine when you registered on the Smart4Health platform? Have you read the informed consent and brought it with you/send to us by email? You have also received the informed consent for participation in the project. Have you read those and have any questions about them? Have you signed it?”

### 2.3 System Inputs/Preparation

- Add new citizen in HealthMonitor.
- Add all the requested data.
- Make the Smart4Health Platform Connection.
- Fill out the pre-session questionnaire.

“Next, I would like to register you in our software. For this I need some personal data from you.”



1. To create a new citizen, in landing page, go to the *citizen registration* tab and click on the *Start* button (Figure 11). A new Citizen ID is created.

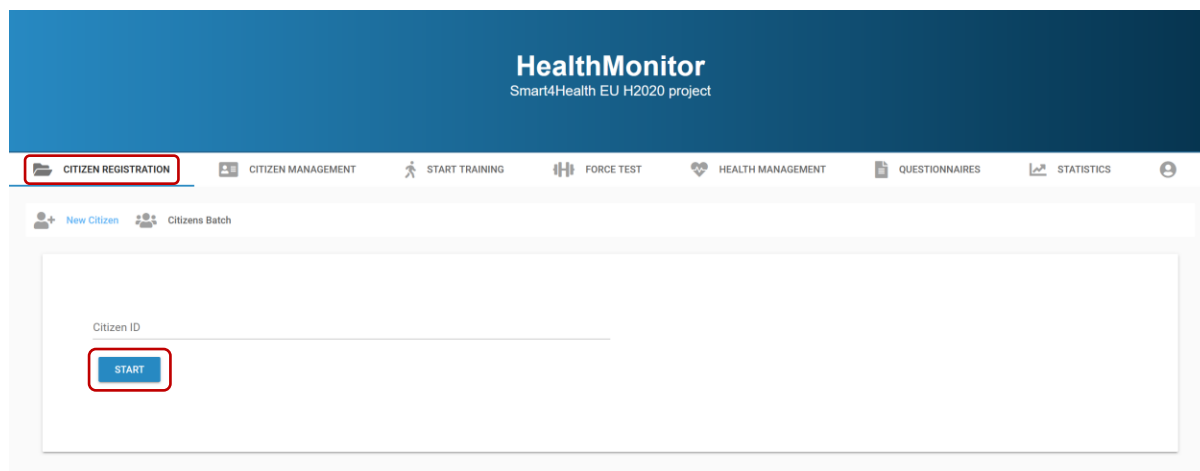


Figure 11 – HealthMonitor: Add new citizen.

2. Select the Use case type (prevention/treatment) in which the citizen is enrolled (Figure 12).

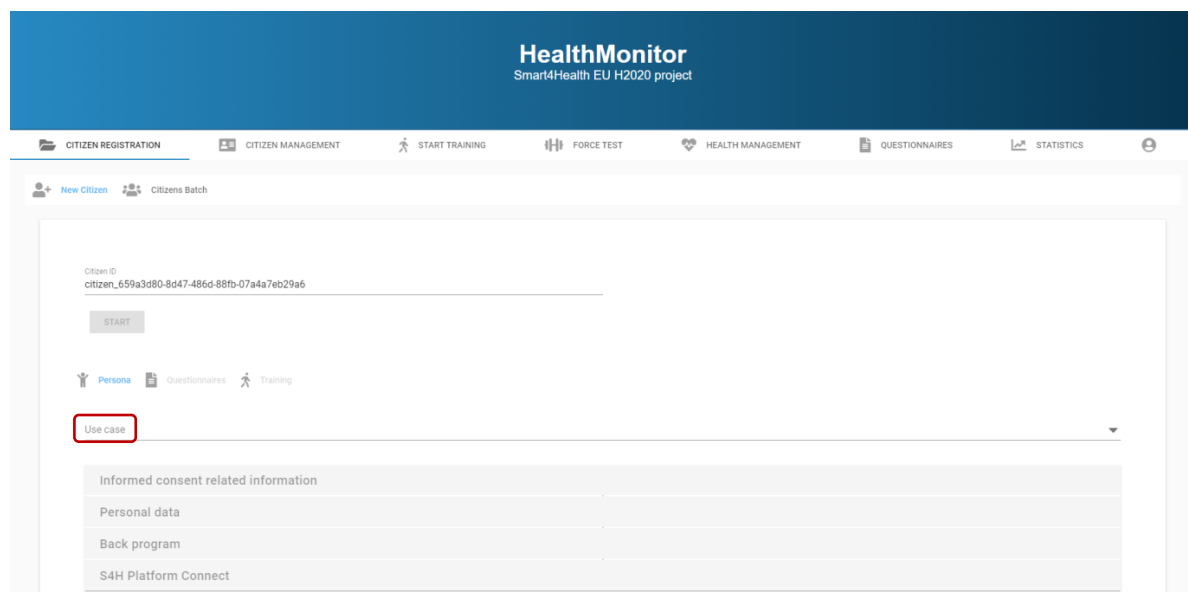


Figure 12 - HealthMonitor: Select use case.

In the *citizen registration* page, all personal data is collected in three different tabs (Persona, Questionnaires and Training) that will open automatically.



### 2.3.1 Persona

#### 2.3.1.1 Informed consent related information

The Informed Consent Form is required to record what the participant/patient is willing to store. In this step, it is verified that the participant signed the ICs (Figure 13).

3. Select the correct CUC so that participant can be correctly assigned. Prevention (CUC4 ,5, 8) or Treatment (CUC3).
4. Platform consent signed -> yes.
5. CUC consent signed -> yes.
6. Click *Store* button.

The screenshot shows a web browser window with the URL 'healthmonitor-test.litn-solutions.com/healthmonitor'. The navigation menu includes 'CITIZEN REGISTRATION', 'CITIZEN MANAGEMENT', 'START TRAINING', 'FORCE TEST', 'HEALTH MANAGEMENT', 'QUESTIONNAIRES', and 'STATISTICS'. The main content area shows a 'New Citizen' form with the following details:

- Citizen ID: citizen\_bbc79e67-5359-450e-aed2-eb72c834a637
- START button
- Persona, Questionnaires, Training tabs
- Use case: Treatment
- Informed consent related information** section:
  - CUC: CUC3
  - Platform consent signed: Yes
  - CUC consent signed: Yes
- STORE (highlighted with a red box) and RESET FORM buttons
- Personal data section (partially visible)

Figure 13 - HealthMonitor: Informed consent related information.

#### 2.3.1.2 Personal data

7. Fill in the requested *personal data* (Figure 14):
  - Gender.
  - First name.
  - Last name.
  - Location.
  - Profession.
  - Work shift.
  - Date of birth.
8. Fill in *contact information*: The contact details are necessary so that a connection to the Smart4Health platform can take place afterwards. This information must be the same used in Smart4Health platform registration
  - Email.
  - Mobile phone including the country code (e.g., +49).
9. Fill in *address information* (only requested in treatment CUCs).
10. Fill in *attending physician* (only requested in treatment CUCs).
11. Click *Store* button.





The screenshot shows a web browser window with the URL `healthmonitor-test.ittm-solutions.com/healthmonitor`. The page has a navigation bar with 'START', 'Persons', 'Questionnaires', and 'Training'. Below this, there's a 'Use case' dropdown set to 'Treatment'. The main content area is titled 'Personal data' and contains several input fields: 'Gender', 'First name', 'Last name', 'Location', 'Profession', 'Work system', 'Date of birth', 'Contact', 'E-Mail', 'Mobile phone (e.g. +49160123456789)', 'Address' (with sub-fields for Street, Number, ZIP, City, and Country), and 'Attending physician'. At the bottom, there are two buttons: 'STORE' (highlighted with a red box) and 'RESET FORM'.

Figure 14 - HealthMonitor: Personal data.

### 2.3.1.3 Back program

12. Fill in *back program* information (Figure 15):

- Contraindications -> yes/no.
- Primary diagnosis (does not have to be filled in).
- Secondary diagnosis (does not have to be filled in).
- Patient history (does not have to be filled in).
- Session start (Start date/First trainings date).

13. Click *Store* button.

The screenshot shows a web browser window with the URL 'healthmonitor-test.ittm-solutions.com/healthmonitor'. The page title is 'Back program'. At the top, there are two buttons: 'STORE' (blue) and 'RESET FORM' (yellow). Below this is a section titled 'Medical Information' with a sub-section 'Contraindications' set to 'No'. There are dropdown menus for 'Primary diagnosis' and 'Secondary diagnosis'. A large text area for 'Patient history' is present, with a character count '0 / 500'. Below this is a 'Session start' section with a date picker and a 'TODAY' button. At the bottom, there are two buttons: 'STORE' (blue) and 'RESET FORM' (yellow), with the 'STORE' button highlighted by a red box.

Figure 15 - HealthMonitor: Back program.

### 2.3.1.4 Smart4Health Platform Connection

The connection between Smart4Health platform and HealthMonitor must be made at this stage, during the registration process (Figure 17). This "pairing" can also be repeated in the *Health Management* at any time, see Figure 18.

14. Click *S4H Connect* button to start the process.

Please inform the citizen that she/he will receive an email requesting the connection between the HealthMonitor and Smart4Health. The citizen must follow the instructions in the email and authorize the connection (Figure 16):

- a. Click *Connect* option (1).
- b. In webpage click *Let's get started* (2).
- c. Confirm the phone number and click *Continue* (3).
- d. Insert the pin received by SMS and click *Confirm* (4).
- e. Click *Log In* to access your Smart4Health account (5).
- f. Insert your credentials of Smart4Health platform, email, and password, and click *Login* (6).
- g. Click *Allow access* to authorize HealthMonitor connection (7).
- h. See confirmation message of successful connection (8).

Note that only if the connection is established, data can be uploaded to the Smart4Health platform.



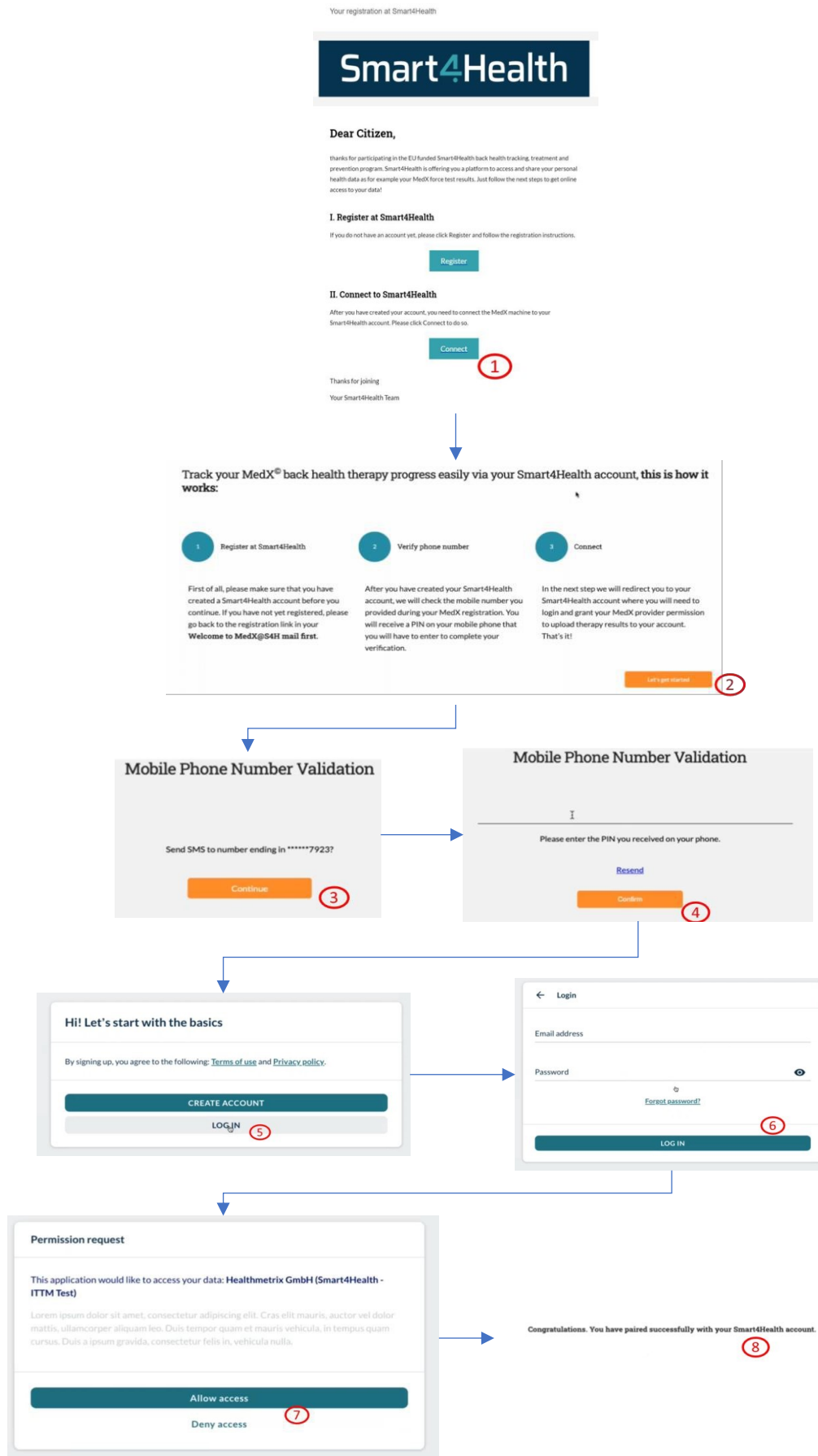


Figure 16 - Smart4Health platform: HealthMonitor connection.



15. Click *Continue* button to continue the registration process.



Figure 17 - HealthMonitor: Smart4Health Platform Connect.

The Smart4Health connection and its status can be consulted in *Health Management* page (Figure 18). You will find one of three states:

- Pending [1/3] – Connection process has not yet been initialized.
- Initialized [2/3] – Connection process has already been started but the citizen has not authorized it yet.
- Connected [3/3] – Connection process completed successfully.

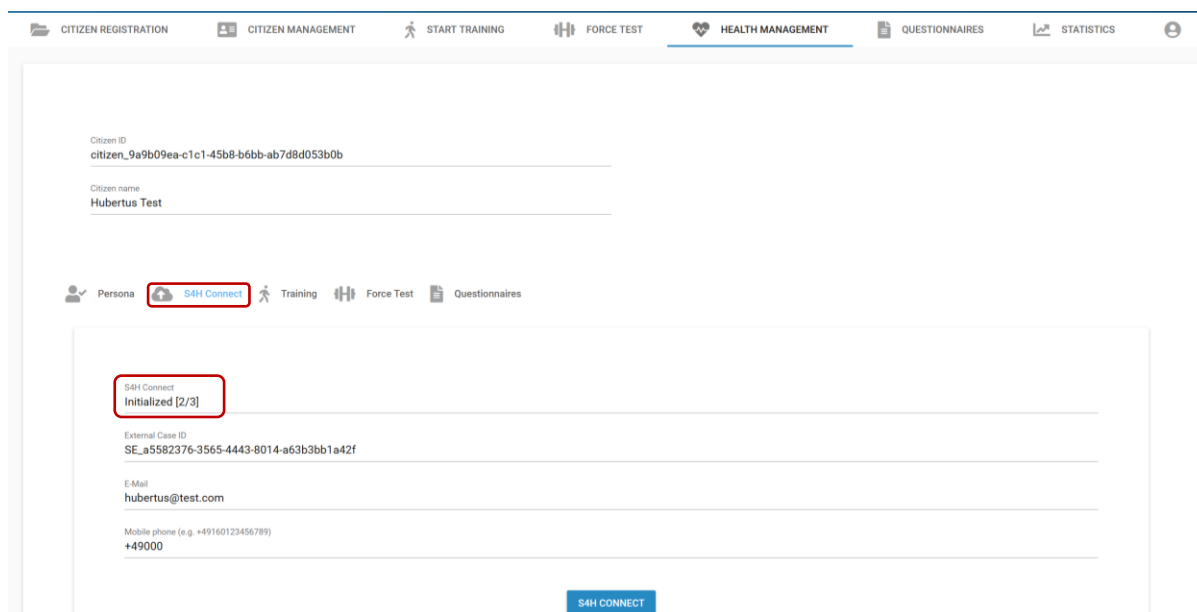


Figure 18 - HealthMonitor: Smart4Health connect status.



### 2.3.2 Questionnaires

Questionnaires depend on the use case of the CUC (Prevention or Treatment). After selection, the questionnaire can be filled in together with the citizen. It is possible to skip this during registration (*Skip Questionnaires* button), but it will be asked again before the start of training (if not already done). Questionnaires are mainly used to assess the health status of a citizen. By asking this prior to and again after the 18 trainings, the success (e.g., less back pain) can be measured and compared.

Prevention CUC questionnaire (Figure 19):

16. Fill in all the questions in *general health status and back health, physical activity, and company health* tabs.
17. Press *Continue* button to continue to the next tab.
18. Press *Store* button to save the answers.

Figure 19 - HealthMonitor: Prevention questionnaires.

Treatment CUC questionnaire (Figure 20):

16. Fill in all the questions in *back pain* tab that contains questionnaires that ask about pain, well-being, and current pain medication use.
17. Press *Store* button to save the answers.
18. Press *Continue* button to continue the registration process.

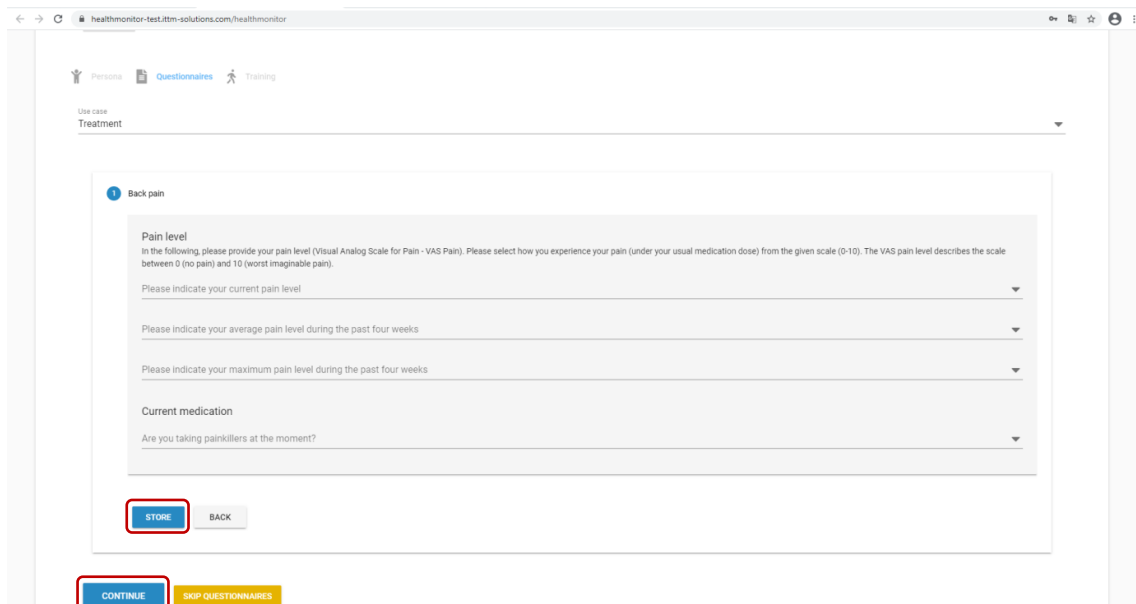


Figure 20 - HealthMonitor: Treatment questionnaires.

### 2.3.3 Training

#### 2.3.3.1 Body composition

19. Fill in *body composition* information and click *Store* button (Figure 21):

- Body height.
- Body weight.

The *BMI* and *BMI category* are calculated automatically. The information is, for instance, needed to visualize the force test.

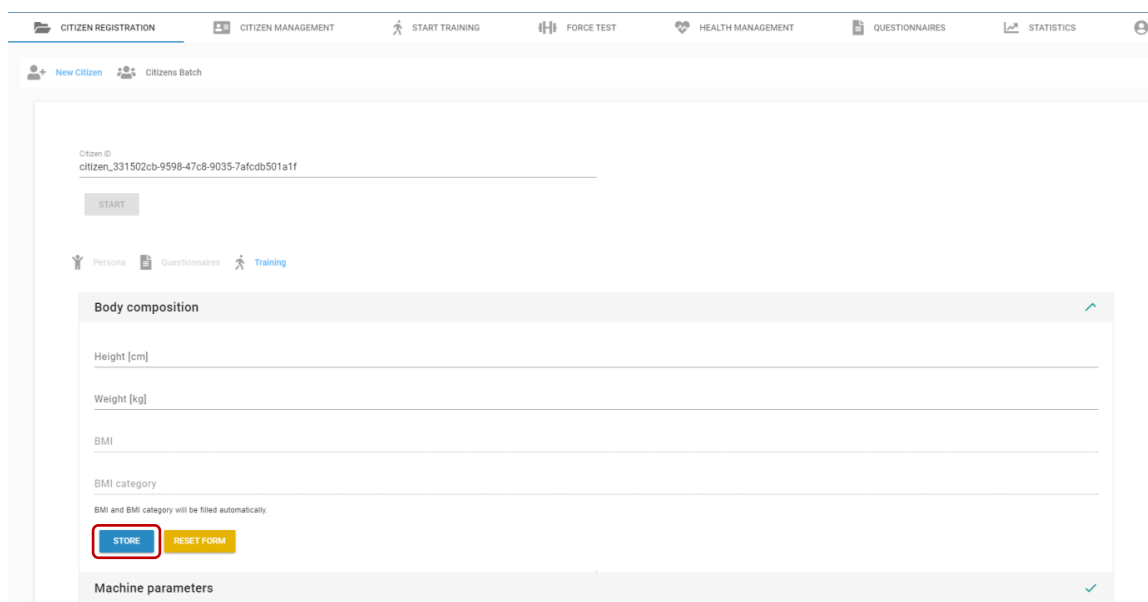


Figure 21 - HealthMonitor: Body composition.



### 2.3.3.2 Machine parameters

Process presented in chapter 3.

20. Select machine ID. The machine ID is written on the machine itself (can be found on the weight block on top of the machine, silver plate). If in doubt, please contact Smart4Health helpdesk (see 9).
21. Execute movement test.
22. Calculate counterweight value.
23. Perform a Warm Up.



### 3 Machine Parameters

Machine parameters calculation is part of the citizen registration process. In this step you must (Figure 22):

1. Introduce the MedX-LE machine.
2. Ask the citizen to sit in the machine and set it correctly.
3. Select the *machine ID* (can be found on the weight block on top of the machine, silver plate).
4. Select the position of the thigh pads (*tight position*).
5. Select the use of a seat cushion (*seat cushion*). This is recommended if the citizen is shorter than 1.60m.
6. Enter the range of motion of citizen (*extension, flexion, and zero-position* angles). Calculated by movement test (see 3.1).
7. Enter the *counterweight* value of citizen. Calculated by counterweight test (see 3.2).
8. Perform a Warm Up (see 3.3).

Figure 22 - HealthMonitor: Training - Machine parameters.

#### 3.1 Movement Test

To perform the movement test, you need to switch to Health Gateway software. Make sure that the connection to the B-Health IoT Box is established and the calibration performed. Go to the movement tab and follow these steps:

1. Click *Start* button or use the machine switch to start the process.
2. Follow the instructions provided on the screen (Figure 23).
3. Proceed to the next step by clicking the *Next* button or use the machine switch.
4. Verify the acquired values. If necessary, you can adjust the values in this step.
5. Fill this information in the HealthMonitor.



*Note:* At any time, it is possible to return to the previous step by clicking *Back* button or cancel the process by clicking *Cancel* button.

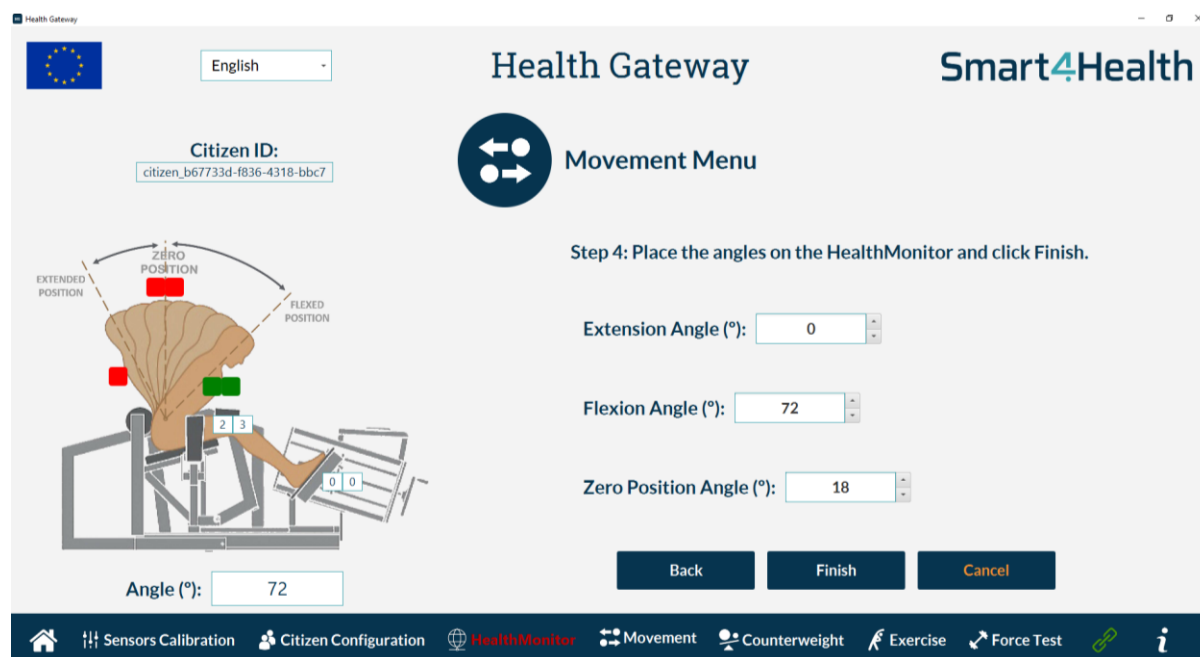


Figure 23 - Health Gateway: Movement Menu.

This tab also shows the status of the other sensors on the machine that allows the citizen to be positioned correctly. This information is shown by red symbols when the citizen is wrongly positioned and green symbols when it is correctly positioned. For legs and feet, the real force value is shown. On machines that do not have extra sensors, this information is not displayed.

### 3.2 Counterweight Test

To perform the counterweight test, you need to switch to Health Gateway software. Make sure that the connection to the B-Health IoT Box is established and the calibration performed. Go to the counterweight tab and follow these steps:

1. Click *Start* button or use the machine switch to start the process.
2. Follow the instructions provided on the screen (Figure 24).
3. Proceed to the next step by clicking the *Next* button or use the machine switch.
4. Verify the counterweight units in the end.
5. Fill this information in the HealthMonitor.

*Note:* At any time, it is possible to return to the previous step by clicking *Back* button or cancel the process by clicking *Cancel* button.

It may happen that due to movements of the person in the machine or other factors, the sensors of the MedX LE do not display a stable "Counterweight" indication. This may cause problems to "zero" them. In this case estimated values must be used. The counterweight is about the triple body weight, and typically, values below 100 or above 450 are not realistic.



Figure 24 - Health Gateway: Counterweight.

### 3.3 Warm Up

To perform a Warm Up training, you must first indicate the *trainingweight recommendation* (starting weight women: 45-50lbs, starting weight men: 75-80lbs) and store all machine parameters in HealthMonitor to make this information available in Health Gateway (Figure 25).

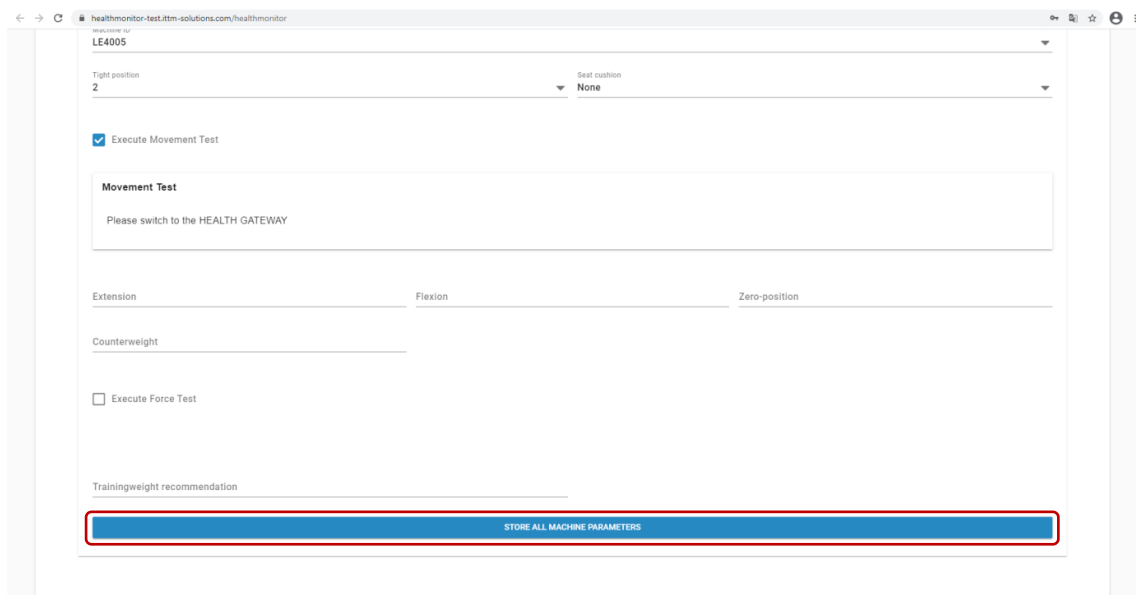


Figure 25 - HealthMonitor: Store machine parameters.

Then, you need to switch to Health Gateway software. Make sure that the connection to the B-Health IoT Box is established and the calibration performed. Go to the exercise tab and follow these steps:



1. Move the citizen back and forth a few times (from its maximum flexion to maximum extension) to prepare the muscles for the movement.
2. Move the citizen to the full flexion position and unlock the weight in order to begin the training and click *Start* button or use the machine switch (Figure 26).
3. Perform the Warm Up training (1 to 1:30 minutes, 6 to 9 reps.). For optimal training performance, the citizen should keep the blue needle close to the orange needle.
4. Upon completion of the training, click the *Stop* button or use the machine switch. Lock the weight.

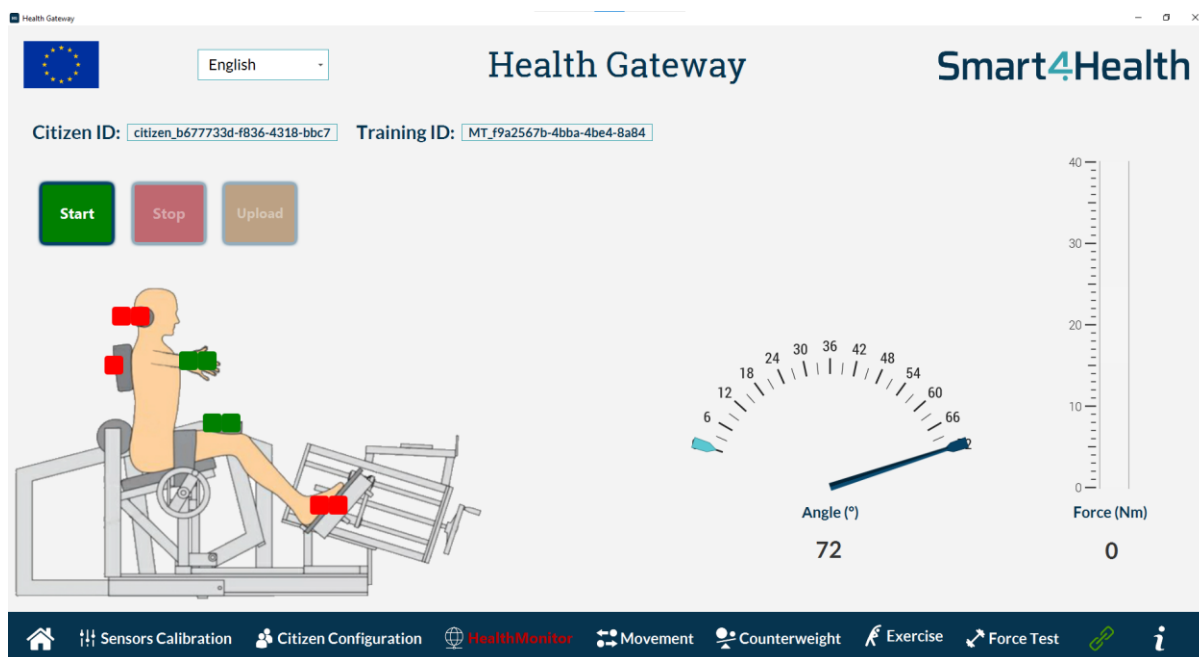


Figure 26 - Health Gateway: Start training.

**Note 1:** In this tab it is possible to observe the extension and flexion angles of the citizen through two markers in the respective angles.

**Note 2:** This tab also shows the status of the other sensors on the machine that allows the citizen to be positioned correctly during training. This information is shown by red symbols when the citizen is badly positioned and green symbols when it is correctly positioned. On machines that do not have extra sensors, this information is not displayed.

## 4 Perform a Force Test

### 4.1 Force Test in Registration Process

To perform a force test within the registration process, follow these steps (Figure 27):

1. Click the box *Execute Force Test*.
2. Click *Store Parameters Force Test*.
3. Perform force test in Health Gateway (see 4.3).
4. Click *Verify Upload* to see the results in HealthMonitor.
5. Check the training weight recommendation and adjust if necessary.
6. Click on *Store All Machine Parameters*.
7. Explain the force curve to the citizen.
8. Upload the force test to Smart4Health platform (see 4.4). As mentioned beforehand, this is only possible after successful connection to the Smart4Health platform, see section 2.3.1.4.

The screenshot shows the HealthMonitor web interface. At the top, there are three input fields: 'Extension' with the value '0', 'Flexion' with the value '72', and 'Zero position' with the value '21'. Below these is a 'Counterweight' field with the value '160'. A checkbox labeled 'Execute Force Test' is checked. Underneath is a 'Force Test' section with a teal button labeled 'STORE PARAMETERS FORCE TEST'. Below that, a 'Force Test ID' is shown as 'FT\_e4bd2ce0-146e-4d3e-86c2-1644c8f17af0'. A button labeled 'VERIFY UPLOAD' is present. At the bottom, there is a 'Trainingweight recommendation' section with a blue button labeled 'STORE ALL MACHINE PARAMETERS'.

Figure 27 - HealthMonitor: Force test in registration.

### 4.2 Force Test Outside the Registration Process

To perform a force test for a citizen outside the registration process, follow these steps:

1. On HealthMonitor, click on *citizen management*, synchronize the list, and select citizen (Figure 28).
2. Click *force test* tab (Figure 29).
3. If necessary, edit the machine parameters by clicking *Edit* button.
4. Click *Start force test* button.
5. Perform force test in Health Gateway (see 4.3).
6. Click *Verify Upload* and *Visualize Result* to see the results in HealthMonitor.
7. Check the training weight recommendation and adjust if necessary.

8. Click on *Store all machine parameters*.
9. Explain the force curve to the citizen.
10. Upload the force test to Smart4Health platform (see 4.4).

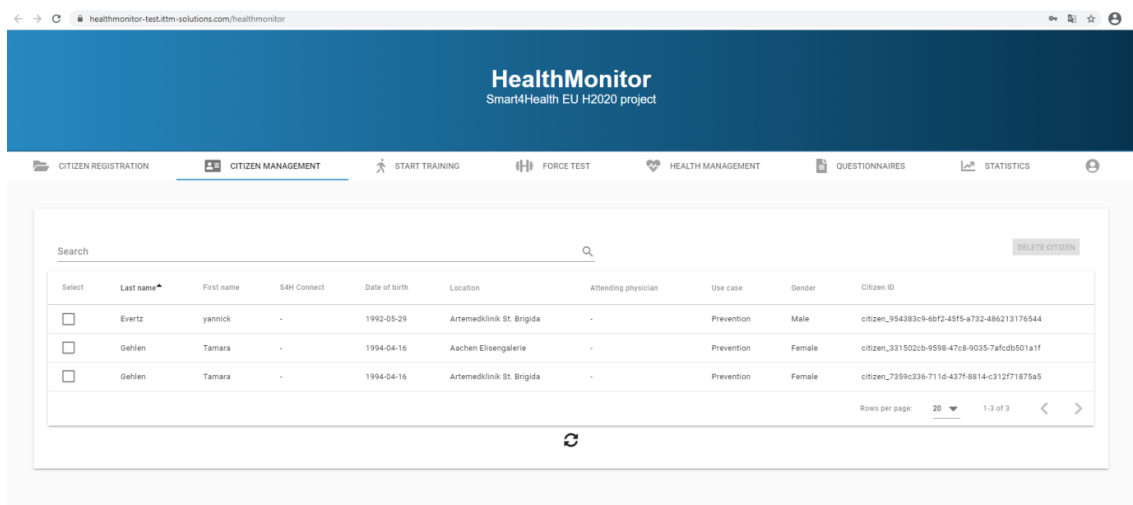


Figure 28 - HealthMonitor: Citizen management.

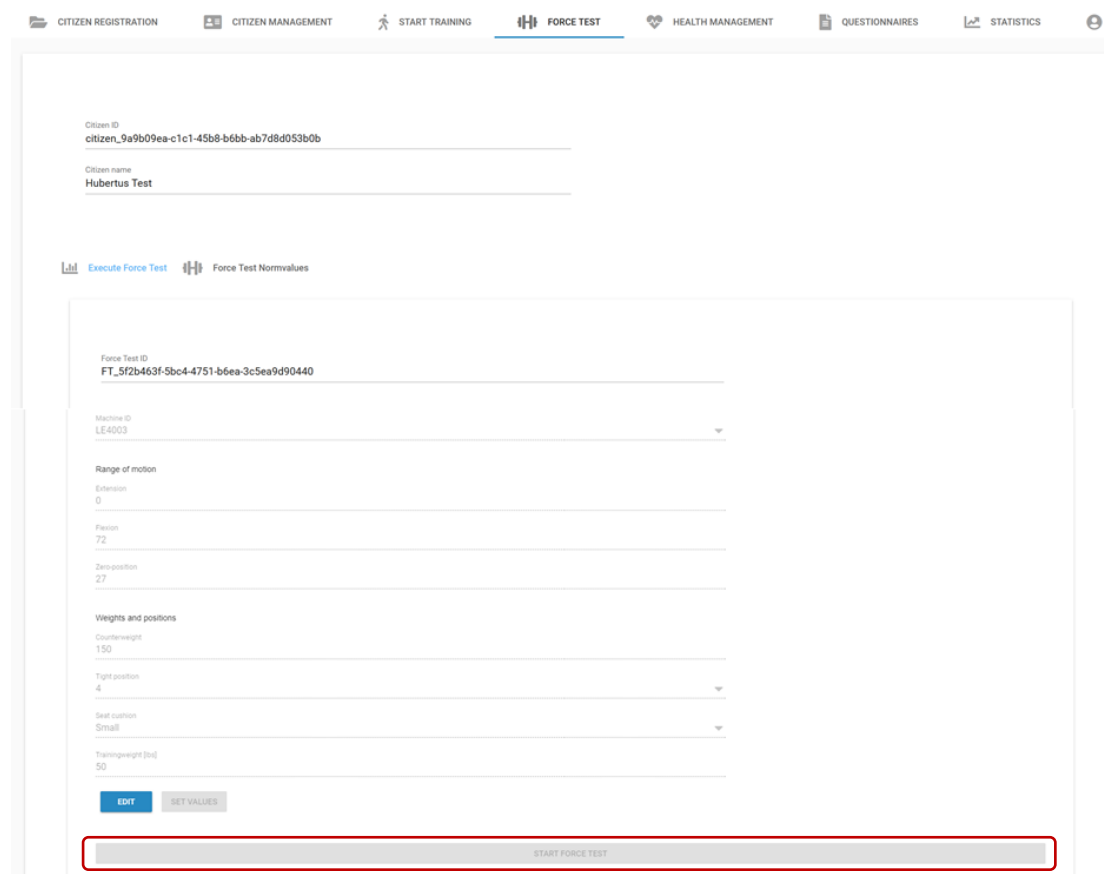


Figure 29 - HealthMonitor: Force test tab.



### 4.3 Health Gateway – Force Test

Make sure that the connection to the B-Health IoT Box is established and the calibration performed. Go to the force test tab and follow these steps (Figure 30):

1. Check if citizen ID and force test ID match those in HealthMonitor. If not, make sure that click in *store machine parameters* in HealthMonitor and go to *citizen configuration* tab and click *Load Citizen* button to update.
2. Click *Start* button to start the test.
3. Move the citizen to a valid position and click *Next* button or use the machine switch to initiate the test and again to complete the test in this angle. Start the test in maximum flexion and repeat it in all angle positions up to maximum extension.
4. Repeat step 2 for all test positions.
5. When force test is complete click *Finish*.
6. The Force test result will automatically be saved and available in HealthMonitor.

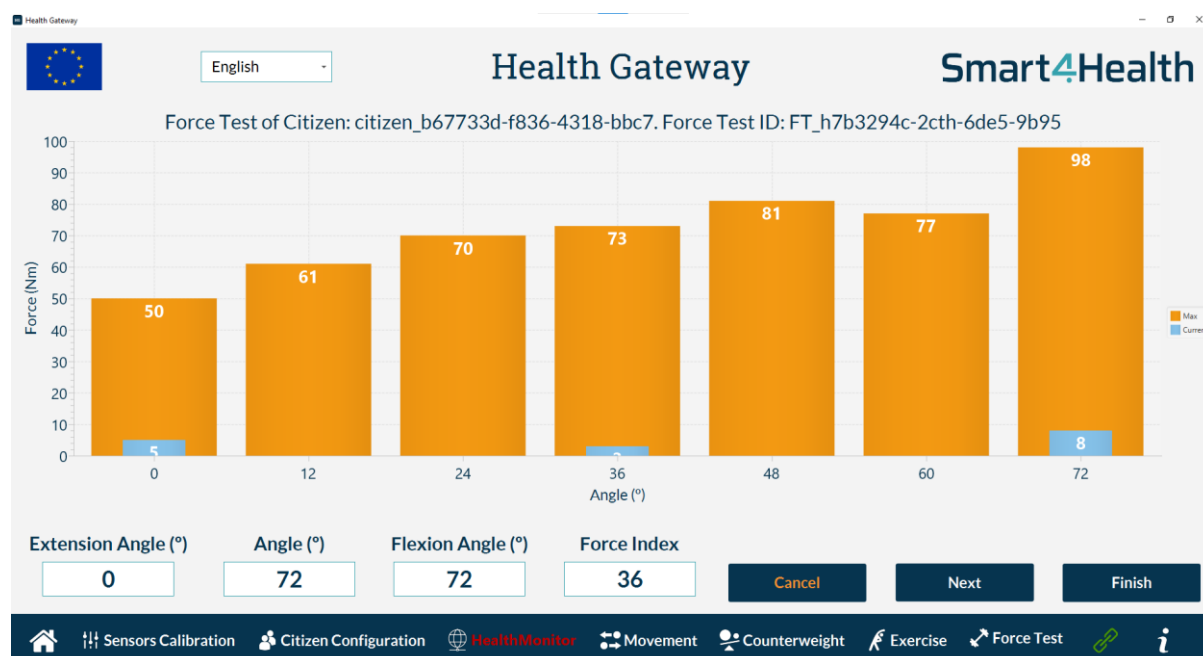


Figure 30 - Health Gateway: Force test.

**Note 1:** If some problem occurs during the test or if the citizen position is not correct, a popup window is shown informing the problem.

**Note 2:** You can redo the test at any angle by repeating step 2 in that angle.

**Note 3:** At any time, it is possible to cancel the process by clicking *Cancel* button.

### 4.4 Upload Force Test to Smart4Health Platform

In order for citizens to have access to their force test, it is necessary to send it from HealthMonitor to Smart4Health platform. To send it, follow these steps:

1. Click on *citizen management* tab, synchronize the list, and select citizen.

2. Click *health management* tab (Figure 31).
3. Select the force test in *force test history*.
4. Select *Smart4Health PDF upload*.
5. Click on *Upload* button.

Figure 31 - HealthMonitor: Upload force test to Smart4Health platform.



## 5 Perform a Training

To perform a training with a citizen, follow these steps:

1. Select participant in *citizen management* tab by placing a check mark next to the desired citizen (Figure 32).

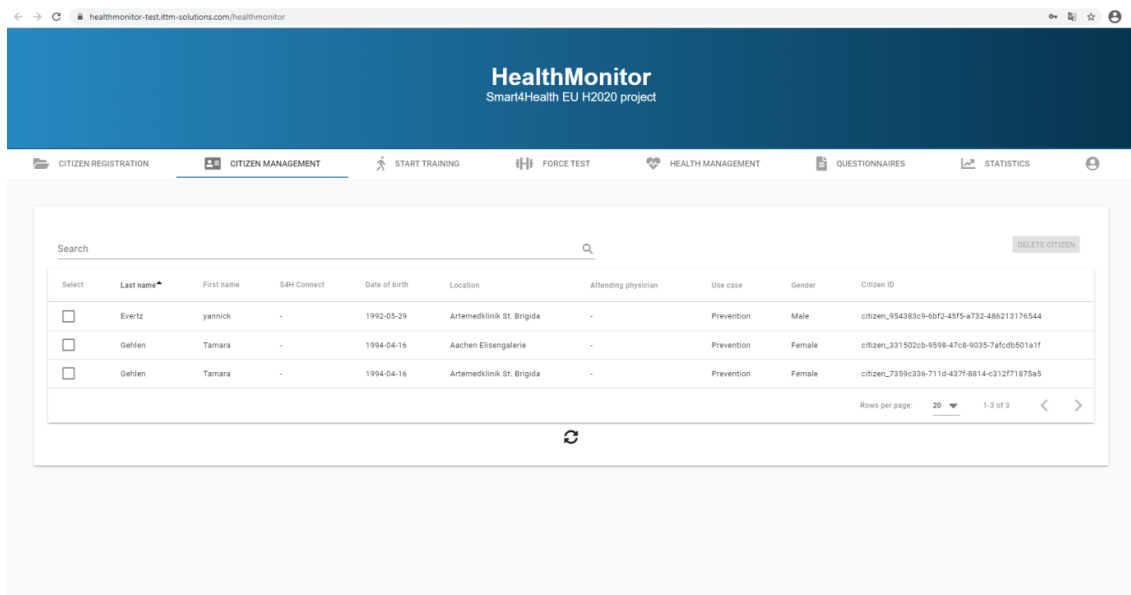


Figure 32 - HealthMonitor: Citizen management.

2. Select *Start training* tab (Figure 33).
3. A training overview and the adjustable machine parameters (range of motion, counterweight, etc.) appear. If necessary, adjust the machine parameters by clicking *Edit* button on *last machine parameters*.
4. Fill in the *trainingweight* for the training.
5. Fill in the *VAS pain* and *wellbeing* of the citizen.
6. Confirm the training parameters in checkbox.
7. Click *start training* button.
8. Confirm the training weight in popup window clicking on *start training* button (Figure 34).
9. Verify the citizen ID and training ID and perform the training in Health Gateway (see 5.1 and 7.1).
10. After click *upload* button in Health Gateway click on *verify upload* button in HealthMonitor (Figure 35).
11. Click on *training evaluation* (Figure 36).
12. Choose between increase, decrease, or retain training weight (see 7.3).



[CITIZEN REGISTRATION](#)
[CITIZEN MANAGEMENT](#)
[START TRAINING](#)
[FORCE TEST](#)
[HEALTH MANAGEMENT](#)
[QUESTIONNAIRES](#)
[STATISTICS](#)

Citizen ID  
 citizen\_331502cb-9998-47c8-9035-7afcd8501a1f

Citizen name  
 Tamara Gehlen

[Start Training](#)
[Training Game](#)
[Training Evaluation](#)

### MedX Training

Last training  
 -

Machine parameters  
 Determined

#### Data overview

Search

Session*	Training	Date	Trainingweight	Extension	Flexion	Repetitions	Duration [min:sec]	Score	Training ID
No data available									

Rows per page: 20

#### Persona

[Back program](#)

#### Last machine parameters

Machine ID  
 LE4005

#### Range of motion

Extension  
 0

Flexion  
 72

Zero-position  
 21

#### Weights and positions

Counterweight  
 -1

Tight position  
 2

Seat position  
 None

**Trainingweight [kg]**  
 -1  
Entry is not valid

Repetitions	Duration [min]	Trainingweight recommendation
No data available	No data available	No data available

[EDIT](#)
[SET VALUES](#)

#### Last training evaluation

### Training preparations

Please fill the following fields:

VAS pain  
 0 - No pain, 10 - Worst pain imaginable

Wellbeing  
 0 - All well, 10 - All bad

Summary of your health, general wellbeing and activities in the last days/weeks

I hereby confirm that the training parameters set above should be used for the MedX training.

[START TRAINING](#)

Figure 33 - HealthMonitor: Start training.



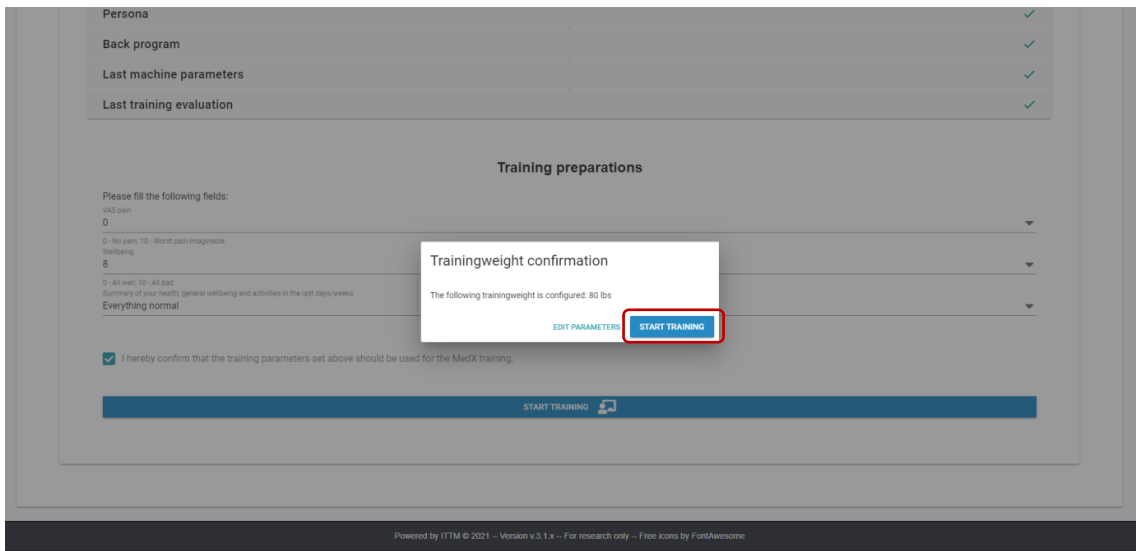


Figure 34 - HealthMonitor: Training weight confirmation.

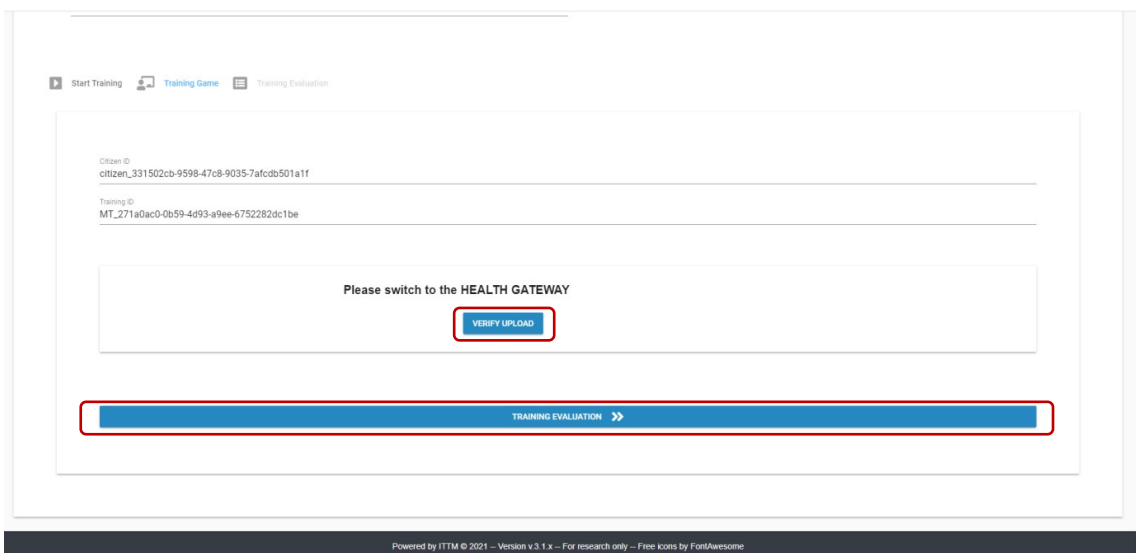


Figure 35 - HealthMonitor: Verify training upload.

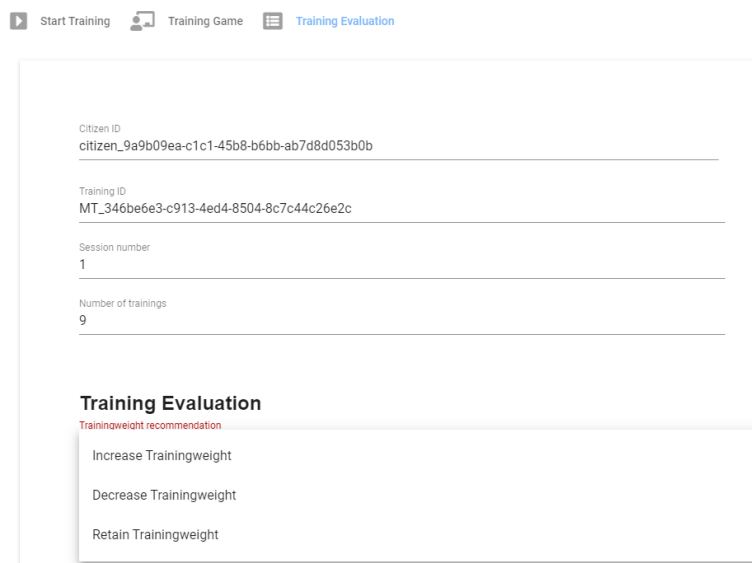


Figure 36 - HealthMonitor: Training evaluation.



## 5.1 Health Gateway - Training

Make sure that the connection to the B-Health IoT Box is established and the calibration performed. Go to the *exercise* tab and follow these steps (Figure 37):

1. Check if citizen ID and training ID match those in HealthMonitor. If not, make sure that click in *store machine parameters* in HealthMonitor and go to *citizen configuration* tab and click *load citizen* button to update.
2. Move the citizen back and forth a few times (from its maximum flexion to maximum extension) to prepare the muscles for the movement.
3. Move the citizen to the full flexion position and unlock the weight in order to begin the training and click *Start* button or use the machine switch (Figure 37).
4. Perform the training. For optimal training performance, the citizen should keep the blue needle close to the orange needle.
5. Upon completion of the training, click the *Stop* button or use the machine switch. Lock the weight.
6. The results can be saved and made available on HealthMonitor by clicking the *Upload* button.



Figure 37 - Health Gateway: Training.

**Note 1:** In this tab it is possible to observe the extension and flexion angles of the citizen through two markers in the respective angles.

**Note 2:** This tab also shows the status of the other sensors on the machine that allows the citizen to be positioned correctly during training. This information is shown by red symbols when the citizen is badly positioned and green symbols when it is correctly positioned. On machines that do not have extra sensors, this information is not displayed.

## 5.2 Visualize Training

All data regarding training of a citizen can be displayed and evaluated following these steps:

1. Select citizen in *citizen management* tab.
2. Select *health management* tab.
3. Select *training* menu (Figure 38).
4. Click *visualize training* to visualize a selected training (Figure 39).
5. Click *visualize session* to visualize an entire session (Figure 40).

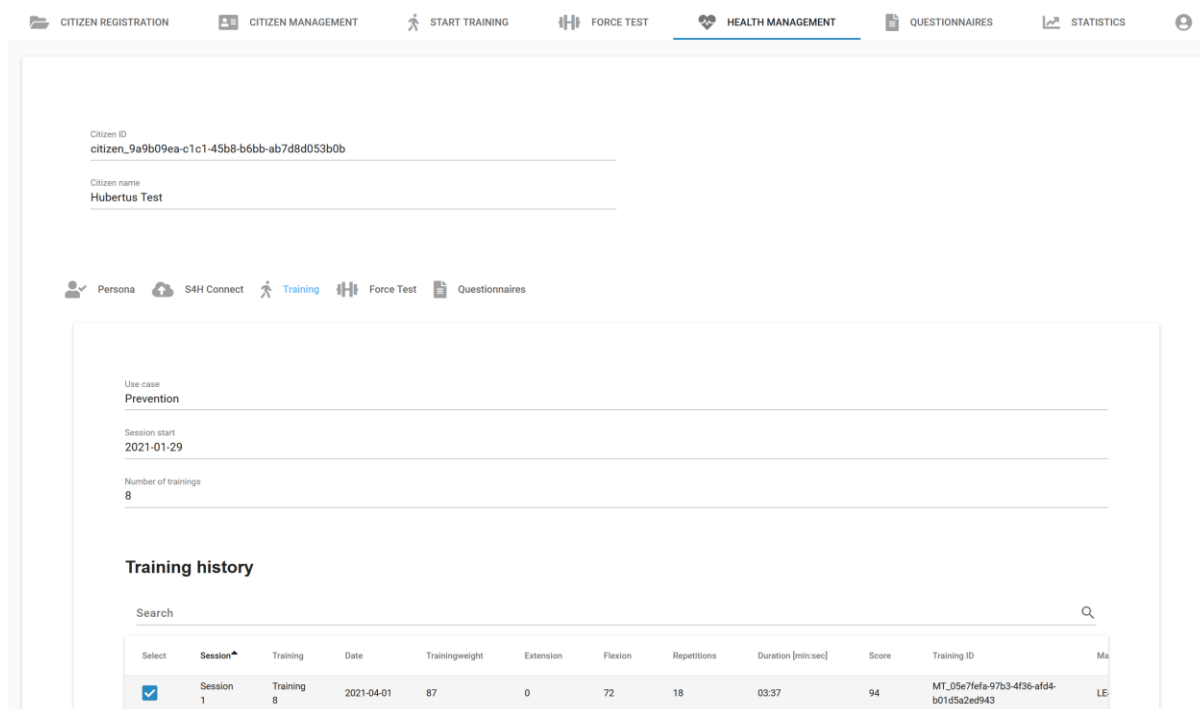


Figure 38 - HealthMonitor: Health management training.



VISUALIZE TRAINING  VISUALIZE SESSION 

Progress analysis



Figure 39 - HealthMonitor: Visualize training.

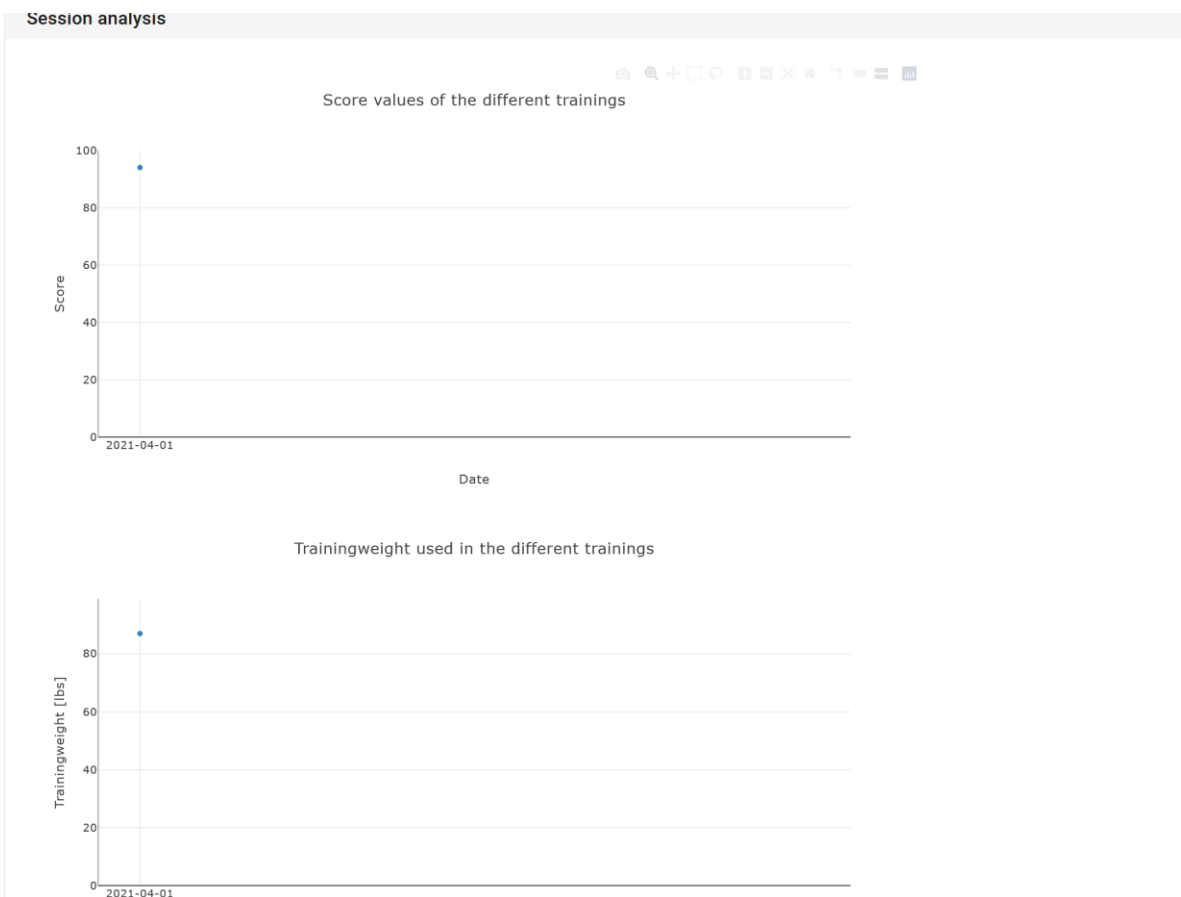


Figure 40 - HealthMonitor: Visualize session.



## 6 Questionnaires

To conduct pre-session and post-session questionnaires follow these steps:

1. Select citizen in *citizen management* tab.
2. Select *questionnaires* tab (Figure 41).
3. Select *timepoint* between *Pre-Session* or *Post-Session*. "Pre" means before the 18 trainings, "Post" after them.
4. Fill in the questionnaire.
5. Click *Store* button.

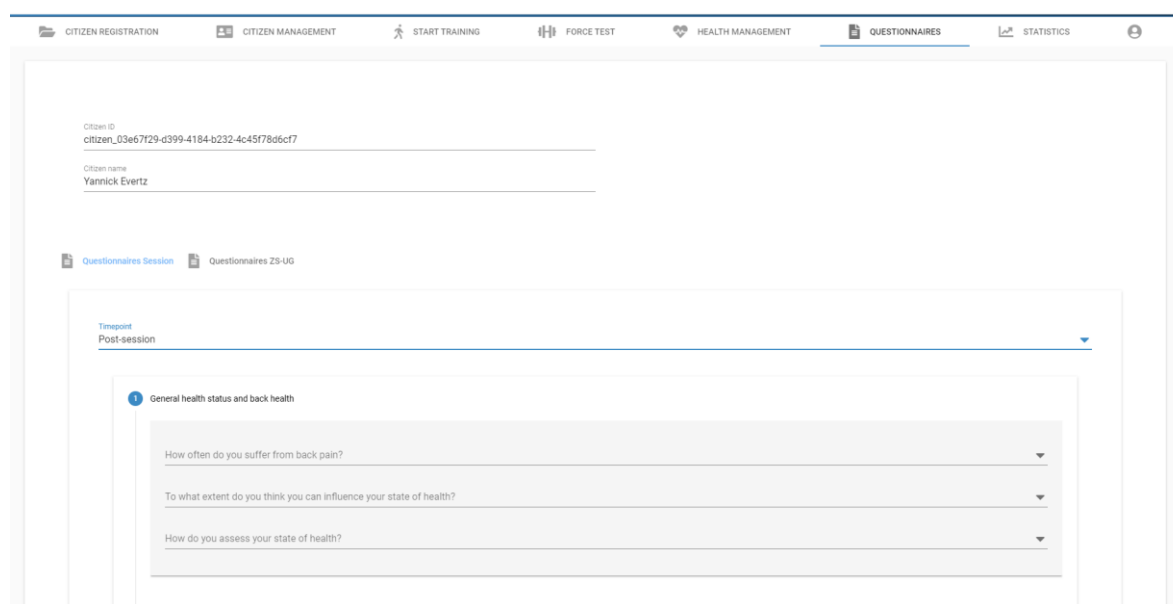


Figure 41 - HealthMonitor: Questionnaires.

### 6.1 Upload Questionnaires to Smart4Health Platform

All data regarding questionnaires of a citizen are available following these steps:

1. Select citizen in *citizen management* tab.
2. Select *health management* tab.
3. Select *questionnaires* menu (Figure 42).
4. Select the questionnaire that will be uploaded to Smart4Health platform.
5. Click *Smart4Health questionnaire upload* button.

Completed questionnaires

Search Q

Select	Date	Timepoint	Training number	Training ID	Questionnaire ID	Encounter ID
<input checked="" type="checkbox"/>	2021-01-29	Pre-session	-1	-	QT_990e5f36-d468-4b39-908b-d73bdc2c6b52	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-01-29
<input type="checkbox"/>	2021-02-11	Pre-training	1	MT_ea55ed4b-9e86-4fa4-8212-3f2ef90cbdde	QT_3ef0c30c-1bd2-42cd-9c59-aa862ca02705	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-02-11
<input type="checkbox"/>	2021-02-18	Pre-training	2	MT_1be97f8c-d649-44cf-af6c-1bf552a49622	QT_33fccc9b-27f6-4ac7-bae4-77c5e9800763	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-02-18
<input type="checkbox"/>	2021-02-25	Post-training	3	MT_62379133-8116-4b60-bd14-8f1b112ed999	QT_683c93e4-63c3-4318-b399-61deaadf77bc	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-02-25
<input type="checkbox"/>	2021-02-25	Pre-training	3	MT_62379133-8116-4b60-bd14-8f1b112ed999	QT_fbfa0986-d040-4d53-ae18-88e8c10793c4	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-02-25
<input type="checkbox"/>	2021-03-04	Post-training	4	MT_e42d9232-9440-4399-92df-ed97b533526e	QT_3f2734eb-8d69-47b1-988e-382a6815ce03	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-03-04
<input type="checkbox"/>	2021-03-04	Pre-training	4	MT_e42d9232-9440-4399-92df-ed97b533526e	QT_18ba8951-e855-48fe-bf6c-354fd52c30f1	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-03-04
<input type="checkbox"/>	2021-03-11	Pre-training	5	MT_413d5f7f-40f5-4426-a0da-d0c08284e776	QT_fad3ad9b-700b-4544-b272-2639a5871004	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-03-11
<input type="checkbox"/>	2021-03-16	Post-training	6	MT_b114dc0c-7661-4d53-be10-f4a94756d966	QT_5dda368c-faee-4bc3-acea-382bc0228c07	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-03-16
<input type="checkbox"/>	2021-03-16	Pre-training	6	MT_b114dc0c-7661-4d53-be10-f4a94756d966	QT_a7946bca-a0f1-40cc-9620-162366ecbe2c	SE_a5582376-3565-4443-8014-a63b3bb1a42f_2021-03-16

Rows per page: 10 1-10 of 13 < >

Selected row:

2021-01-29, -1, Pre-session, -, QT\_990e5f36-d468-4b39-908b-d73bdc2c6b52, SE\_a5582376-3565-4443-8014-a63b3bb1a42f\_2021-01-29

SMART4HEALTH QUESTIONNAIRE UPLOAD

Figure 42 - HealthMonitor: Upload questionnaire to Smart4Health platform.



## 7 ZS – MedX Standards

### 7.1 Smart4Health Treatment and Prevention Training

Target training time	Termination criteria	Training Intensity	Quantity Training units
180 seconds	Muscular exhaustion/failure	High	16 units, 1x/week

\* generally applies: abort at +30 seconds

### 7.2 General Treatment Training

Training period	Target training time (in sec.)	Termination criteria	Training Intensity	Quantity Training units
Familiarization period	180	Muscular fatigue	Low	2 to 4 units, 2x/week
Transition period	180	Muscular exhaustion	Medium	2 to 4 units, 2x/week
Development period	150	Muscular failure	High	Up to 12 units, 2x/week
Development period	120	Muscular failure	High	Up to 18 units, 2x/week
Maintenance period	120	Muscular failure	High	1x/week

\* generally applies: abort at +30 seconds

### 7.3 Increase in Load

- For every 5 seconds that the achieved training time exceeds the target training time, the training weight is increased by 1-2 ft-lb (remaining time expires).
- If the participant has only just exceeded the target time: increase by 1 instead.
- For strongly symptomatic participants, increase rather carefully by 1.
- Values in between can also be set as an increase.





## 8 The Most Common Types of Damage in MST

This information is important for understanding the range of motion limits that should be considered in case of common types of damage in Medical Strengthening Therapy (MST).

Extension	Both directions	Flexion
Spondylolisthesis max. 12°	Scoliosis	Intervertebral disc surgery
Spinal canal stenosis max. 12°	Hyperkyphosis	Kyphososis (hunchback)
Basstrap syndrome	Fusion (stiffening of the spine)	Hip arthrosis
Facet Joint Arthrosis - Always limit extension in a pain-adapted manner - Rather increase weight, reduce training time	Herniated disc/ spinal disc prosthesis - max. 60° - Restrict extension in a pain-adapted manner - if herniated disc is older than 6 weeks, offer full range of motion	Cervical and lumbar spine syndrome - normally no limitation of movement - possibly pain-adapted range of motion
Hemi-, laminectomy	Whiplash	Thoracal spine Syndrome
	Osteoporosis	Bechterew's disease
	Steep position	
	spinal warping / posture error - do not increase the curvature too much	

- With cortisone intake over 5mg per day: Exclusion from training (e.g., in osteoporosis, chronic heart disease, polyarthritis, lung diseases, neurological or inflammatory diseases)
- In case of thrombosis: if fresh, then no test, after 6 months ok
- Participant with neurostimulator: exclusion from MedX training
- No restrictions in the case of treated cardiovascular diseases (e.g., cardiac rhythm disturbances, hypertension, arteriosclerosis, stroke)



## 9 Contacts

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Any question or recommendation for improvement, contact the Smart4Health helpdesk at the link:

- <https://helpdesk.smart4health.eu/>

Specific questions about the AppID or Credentials, please contact:

- [healthmonitor-s4h@ittm-solutions.com](mailto:healthmonitor-s4h@ittm-solutions.com).



## Handbook Version History

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Version	Description
1.0	First version of Smart4Health Therapists Handbook. HealthMonitor version v.3.5.0. Health Gateway version v.2.0.6.



## List of Acronyms/Abbreviations

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Acronym/ Abbreviation	Description
<b>BMI</b>	Body Mass Index
<b>CUC</b>	Citizen Use Case
<b>EHR</b>	Electronic Health Record
<b>EU</b>	European Union
<b>IC</b>	Informed Consent
<b>ICcuc</b>	CUC Informed Consent
<b>ICp</b>	Smart4Health platform Informed Consent
<b>IoT</b>	Internet of Things
<b>ITTM</b>	Information Technology for Translational Medicine
<b>LE</b>	Lumbar Extension
<b>MST</b>	Medical Strengthening Therapy
<b>S4H</b>	Smart4Health
<b>Smart4Health</b>	Citizen-centred EU-EHR exchange for personalised health
<b>SMS</b>	Short Message Service
<b>UNINOVA</b>	Instituto de Desenvolvimento de Novas Tecnologias
<b>VAS</b>	Visual Analogue Scale
<b>ZS-UG</b>	ZS Unternehmen Gesundheit GmbH & CoKG



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