adamo

R · O · B · O · T

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ADAMO ROBOT - V 1.0

User manual

Contents

GENERAL DESCRIPTION OF THE PRODUCT

Adamo Robot is a revolutionary automated device designed to provide highly personalized and effective physiotherapeutic treatment services, especially aimed at alleviating pain in the back area. This innovative robot combines cutting-edge technology with a collaborative human-robot approach to deliver optimal and safe treatments.

ADAMO Robot ensures seamless human-robot collaboration, providing security and flexibility in its use. Equipped with the collaborative robotic arm UR5e from Universal Robot, this device offers a unique combination of precision, ease of use, and adaptability.

The standard treatment offered by ADAMO Robot consists of personalized sessions during which continuous pressure is applied using compressed air on myofascial trigger points defined by qualified medical professionals. These sessions, which can be programmed and repeated autonomously, provide effective and comfortable therapy for the patient.

The thermographic technology integrated into ADAMO Robot provides healthcare professionals with a detailed image of the area to be treated, allowing optimal decision-making regarding the treatment to be performed. Additionally, the powerful software of the device facilitates the management of patients' medical history, the parameterization of personalized treatments, and the consultation of support images.

Illustration 1. ADAMO robot V1.0

Declaration and class IIA medical device

The Class IIA marking according to the MDR of the machine indicates compliance with the essential safety and health requirements established by the European directives listed in the CE Declaration of Conformity.

The label is laser-printed on a stainless-steel sheet and has the following dimensions:

Length = 104 mm - Height = 180 mm - Width = 1 mm

It is applied externally on one side of the machine and expresses the following data, legibly:

- ADAMO ROBOT LOGO, UDI-DI, WARNING SYMBOLS
- CE MARKING, NAME AND ADRESS OF THE MANUFACTURER
- MACHINE DESIGNATION (MODEL)
- SERIAL NUMBER (model-mmyy-unit)
- INPUT VOLTAGE / Frequency (V~/Hz)
- RATED CURRENT (A)
- RATED INPUT POWER (VA)
- WEIGHT (Kg)

adamo R·O·B·O·T	MD CE 0297 UDI	
Adamo Robot SL C/ Manuel Tovar 49 28034 Madrid, Spain Phone +34 91 417 04 57	**Duty Cycle:** **Max. Treatment mode: 25 min.** **Min. Standby mode: 10 min.**	
MODEL	**V1.0**	
SN	**01-XXXX-XXXX**	
INPUT VOLTAGE	**230V~ / 50Hz**	
RATED CURRENT	**15.2 A**	
RATED INPUT POWER	**3500 VA**	
WEIGHT	**180Kg**	

For any inquiries, assistance, or technical support, please feel free to reach out to us using this previous contact details.

Symbols

SYMBOL	TITLE	STANDARD
CE 0297	CE Mark – Notified Body	MDR 2017/745
MD	Medical device	N/A
UDI	Unique device identifier	N/A
SN	Serial number	ISO 7000-2498
	Manufacturer	ISO 7000-3082
	Refer to instruction manual/booklet	ISO 7010-M002
	Generic warning	ISO 7010:2003-W001
	WEEE label	Directive 2012/19/EU
	Fragile, handle with care	ISO 7000-0621
	Keep dry	ISO 7000-0626
	Temperature Limit	ISO 7000-0632
XXXX XXXX XXXX	UDI-DI GS1 DataMatrix	EAN-13

Importance of this manual

Before using the machine, the authorized operators are obliged to read and thoroughly understand this manual in all its parts.

This instruction manual has been prepared in accordance with the directions provided by the European Directives in order to ensure an easy and correct understanding of the topics covered by the authorized operators operating and maintaining the machine in question. If, despite the attention being paid by the manufacturer while drafting this document, such operators should not fully understand this text while reading, they are requested to ask the manufacturer for the correct explanations and information in order to avoid incorrect personal interpretations that may jeopardize safety. Before using the involved machine, the authorized operators are obliged to read and understand all parts of this manual and adhere strictly to the rules herein described in order to assure their own and others' safety, the best performance of the machine and ensure the maximum efficiency and durability of all its components. This manual shall be available at any time for the authorized operators and shall be well protected and preserved, always close to the machine.

Before using the machine, authorized operators are required to undergo clinical and technical training and pass usability tests.

It is necessary for users to receive appropriate clinical and technical training and to pass the corresponding usability tests before using the machine. This training is essential to ensure the safety of both operators and patients, as well as to ensure effective and proper use of the machine.

This manual should always be available for authorized operators and located in the vicinity of the machine well protected and preserved.

This manual must compulsorily be delivered together with the machine when it is transferred to another user.

The manufacturer disclaims all liability for injury to persons, animals and/or property caused by ignoring the rules and warnings described in this manual.

This manual reflects the state of the art of technique at the time of the machine marketing and cannot be considered improper just because, according to new experience, it may be updated later on.

In case of loss or damage of the manual request a copy to the manufacturer, specifying the identification data of the document: code, issuance and review.

In addition to this manual, there is an IFU (Instructions For Use) document that provides detailed usage instructions. Both documents are complementary and should be consulted together to ensure proper and safe operation of the machine.

State "Machine Off"

Before performing any type of maintenance and/or setting on the machine, disconnect the power supply ensuring that the power switch (18) is in position "OFF", the plug of the power cable is unplugged and placed near the machine and the tank has been drained from residual compressed air by opening the drain valve.

INDICATIONS, CONTRAINDICATIONS AND WARNINGS

Indications

The ADAMO ROBOT® indications are:

a) Regarding patient clinical conditions, the use of ADAMO ROBOT® is adequate in the following cases:
- Myofascial pain syndrome: Supports the reduction of muscle tension and alleviates discomfort linked to myofascial pain, a condition commonly associated with chronic pain syndromes.
- Trigger points: Assists in deactivating trigger points and alleviating localized muscle pain in areas of chronic muscle stiffness.
- Cervical, dorsal, and low back pain: Suitable for managing pain in the neck, upper back, and lower back that is related to muscular tension, stiffness, or myofascial restrictions.
- Tendinopathies: Applicable in cases of tendon inflammation and discomfort (such as rotator cuff or patellar tendinopathy), aiding in pain reduction and functional recovery.
- Chronic muscular tension: Effective in reducing persistent muscle tension and spasms, as seen in conditions like tension headaches or stress-related muscle pain.
- Soft tissue stiffness: Indicated for improving flexibility and movement in soft tissues with restricted range of motion due to scarring, fibrosis, or chronic stiffness.
- Postural dysfunctions: Beneficial for managing muscular discomfort associated with postural imbalances (e.g., forward head posture, rounded shoulders), where prolonged tension and muscular imbalances contribute to pain.
- General musculoskeletal discomfort and overuse syndromes: Suitable for alleviating discomfort in conditions arising from repetitive strain or overuse (e.g., office-related muscle pain, sports overuse injuries).
- Age and ability to cooperate: ADAMO ROBOT® is primarily indicated for adults between 18 and 60 years of age who can cooperate during treatment and remain in the appropriate position throughout the session.

b) Regarding the environmental conditions:
- ADAMO ROBOT® is exclusively designed for use indoor, in hospitals, physiotherapy clinics, rehabilitation centers, and other authorized medical facilities. It is not intended for home use, outdoor use, or non-clinical settings.
- ADAMO ROBOT® shall be placed on a flat surface that ensures stability in relation to the overall dimensions and weight respecting the minimum position referred in of the instructions for use.
- ADAMO ROBOT® is intended to be used in the following environmental conditions:

Temperature	Relative Humidity	Atmospheric Pressure	Electronic Disturbances
20-28ºC	70%	70-100 KPa	According EMC ISO standards

ADAMO ROBOT® indications regarding environment

c) Regarding type of movement

As described in section 2.3.16.1 Configurations, the robotic arm has five different type of movements, one for each mode. In the table below, it is described the indications for each type of movement.

Manual mode	Point by point mode	On arch mode	Lineal mode	Pendular mode
The user moves the arm by himself. When a free movement is required	When discontinuous application of air pressure at specific points is required. This may be combined with heat	When continuous air pressure is applied to specific points. Heat may be added or not.	Continuous air pressure with optional heat is applied along a pre-established points maintaining pressure in both directions for the set of number of cycles	Continuous air pressure, with optional heat is applied back and forth along pre-established points, maintaining pressure in both directions for the set number of cycles

ADAMO ROBOT® indications regarding robotic arm movement

Contraindications

The use of ADAMO ROBOT is contraindicated in the following situations

a. **General contraindications:**

- Its use is contraindicated in patients under 18 years or over 60 due to the lack of safety data in these populations.

- Open skin lesions or dermal involvement: Treatment should not be applied to areas with open wounds, burns, dermatitis, eczema, or any other active skin condition, as compressed air could penetrate tissues and lead to complications such as the formation of air bubbles in the body.

- Fever and systemic infections: Patients with fever or systemic infections should not undergo treatments with Adamo Robot, as the application of pressure or heat could exacerbate the underlying condition.

- Severe circulatory disorders: Treatment is contraindicated in patients with severe vascular diseases such as deep vein thrombosis or chronic venous insufficiency, where pressure could increase the risk of complications.

- Recent surgeries: Patients who have undergone recent surgeries in the treatment areas should avoid using the device until healing is complete and the physician approves it.

- Severe skin allergies: Patients with allergic skin conditions should avoid treatment on affected areas, as the pressure could aggravate the reaction.

- Bleeding disorders: Patients with bleeding disorders, such as haemophilia, or who are taking blood thinners, should avoid applying pressure, as it could increase the risk of bleeding or bruising.

- Pregnancy: Although massage therapy may be safe during pregnancy in certain circumstances, the application of pressure and heat to the abdominal or lumbar area during pregnancy should be avoided.

- Sensitive areas and body orifices: Compressed air should not be applied near the eyes, ears, nose, mouth, or other orifices of the body. Air pressure in these areas can cause serious injuries, such as eye damage,

perforation of the eardrum, or the introduction of air into cavities where it can lead to infections or embolisms.

b. **Specific contraindications related to the use of hot air**

- Acute inflammatory diseases: Although the air emitted does not reach dangerous temperatures, patients with acute inflammatory diseases (such as acute rheumatoid arthritis) may still experience an exacerbation of symptoms due to the application of moderate heat.

- Severe neurological alterations or altered sensitivity to heat: Patients with peripheral neuropathies, multiple sclerosis or diabetes with neuropathy should be closely monitored, as they may not correctly perceive temperature changes, even if they are minor.

- Cancer: Heat is not recommended near areas with tumours or where radiation therapy has been given, because of the risk of affecting the tissues involved.

- Metal implants or electronic devices: Although the maximum temperature does not exceed normal body temperature highly, heat applied near metal implants or electronic devices could affect the patient's perception or interfere with these devices.

- Heat sensitivity: Patients with conditions such as Raynaud's disease or other diseases that respond negatively to heat should avoid applying any type of heat, even moderate.

c. **Specific contraindications related to the use of air at room temperature**

- Cold sensitivity: Patients with conditions such as cryoglobulinemia or cold urticaria should not be treated with room temperature air, as the sensation of decompression cooling could exacerbate these disorders.

Warnings

Users of ADAMO ROBOT® shall observe the following warnings when using the device

- For a thorough understanding of device functionality, the user shall read the instructions for use in its entirety before starting to use the device.

- Before using the equipment, users are required to be trained. Do not use ADAMO ROBOT® if you are not trained for it.

- The user shall verify that the patient remains immobile during the treatment to ensure its correct application.

- The ADAMO ROBOT® User Manual should always be available for authorized operators and be located close to the device, well protected and preserved.

- ADAMO ROBOT® generate loud noise during use. The use of hearing protection is required for users when a continuous use is made.

- Some patients (around 5% of the population) may experience physical urticaria related to stimuli such as heat or changes due to a decrease in temperature caused by heat dissipation, potentially causing an itching sensation, which is generally temporary and minor. This itching sensation can create discomfort for sensitive patients. For first-time use, patients should be appropriately monitored.

- During treatment, some dispersed air outside the target area may cause a mild cooling sensation for the patient. To ensure comfort, it is recommended to inform the patient about this possibility and cover non-treated areas to minimize unintended cooling.

- ADAMO ROBOT® is intended to be used during a maximum of 25 minutes/session. If several sessions are performed, a rest time of 10 minutes among sessions shall be observed. Other conditions of use can lead to equipment overheating.

- ADAMO ROBOT® complies with requirements regarding EMC safety; however, even though the device is compliant at the levels of immunity specified in the standards, certain devices (as magnetic resonance imaging, MRI) emits interferences that can affect its performance if it is placed too close to these equipment or electrical power sources. Users shall be aware of this possibility and do not use the device close to this devices.

- Keep the device away from water and humidity to avoid electrical hazards.

- These devices shall be conserved and checked as outlined in the instructions for use.

- Do not use the device if defective and contact the manufacturer as soon as possible. Only authorized and qualified personnel can make maintenance or modifications in the device. The user shall have sole responsibility for any malfunction due to maintenance operations performed by anyone not trained by ADAMO ROBOT S.L.

- Each user has a user name and password to access to ADAMO ROBOT®. User name and password ensure privacy and confidentiality of patient data. Do not share with other persons.

TECHNICAL DESCRIPTION

All the specifications shown in this section corresponds to the **ADAMO ROBOT V1.0**:

Name of parts

The medical device ADAMO ROBOT® is composed of the key functional elements laid down.
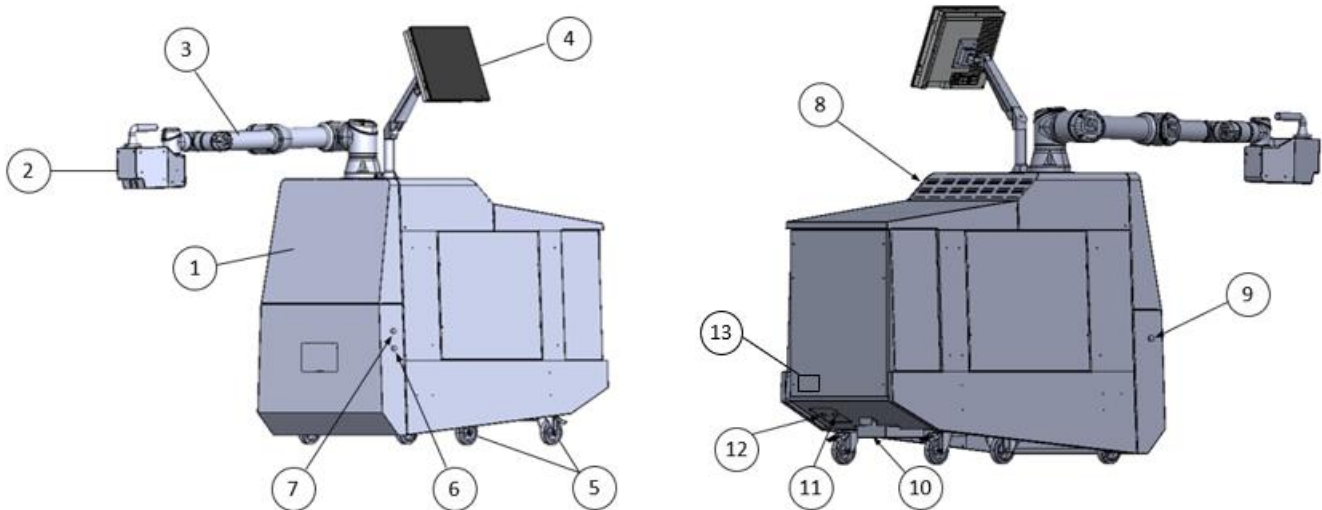
ADAMO ROBOT® key functional components

Code	Element	Description	Supplier
1	Metal enclosure	Painted galvanized sheet metal chassis	SAPEMI
2	End effector	Painted aluminium enclosure	SAPEMI
3	Robotic Arm	Collaborative Robot UR5e for programmable treatment positioning	Universal Robots
4	Panel PC Screen	User interface Touch Screen Panel PC	Advantech
5	Rear rotating wheels	Swivel castor with wheel brake	Tente
6	Temperature selector	Three position (low, med and high) manual temperature selector	Eaton
7	Temperature button	Temperature selection confirmation button	Eaton
8	Cooling Fan	Air extraction fans for internal enclosure cooling	Sunon
9	Detention button	Treatment detention button	Eaton

10	Condensation water container	Compressed air condensation humidity collector	SAPEMI
11	Electric power supply plug	Panel mounted power male connector	Schurter
12	Main power switch	Green illuminated green power switch	Arcoelectric
13	Label	Inox sheet CE Label	Graincas

ADAMO ROBOT® list of key functional components

On the other hand, inside the end-effector there are the following main components:
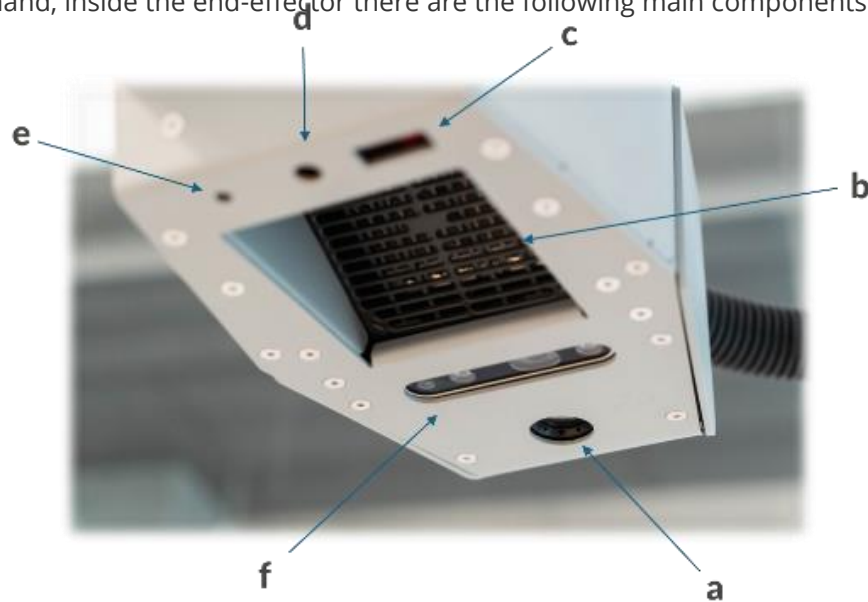
ADAMO ROBOT® end-effector

Code	Element	Description	Supplier
a	Thermal camera	High resolution thermographic camera	Teledyne Flir
b	Air Heater	Compresses air heater	Stego
c	Safety proximity sensor	Near patient detection sensor	Pepperl+Fuchs
d	Compressed air outlet nozzle	Treatment air precision output nozzle	Silvent
e	Laser cross indicator	Treatment point laser indicator	Laserfuchs
f	3D volumetric and colour camera	Patient body contour measurement	Intel RealSense

ADAMO ROBOT® end-effector list of components

Dimensions of the machine

The following figure shows the clearances of the machine and for the movements of the robotic arm. Al dimensions are given in mm.
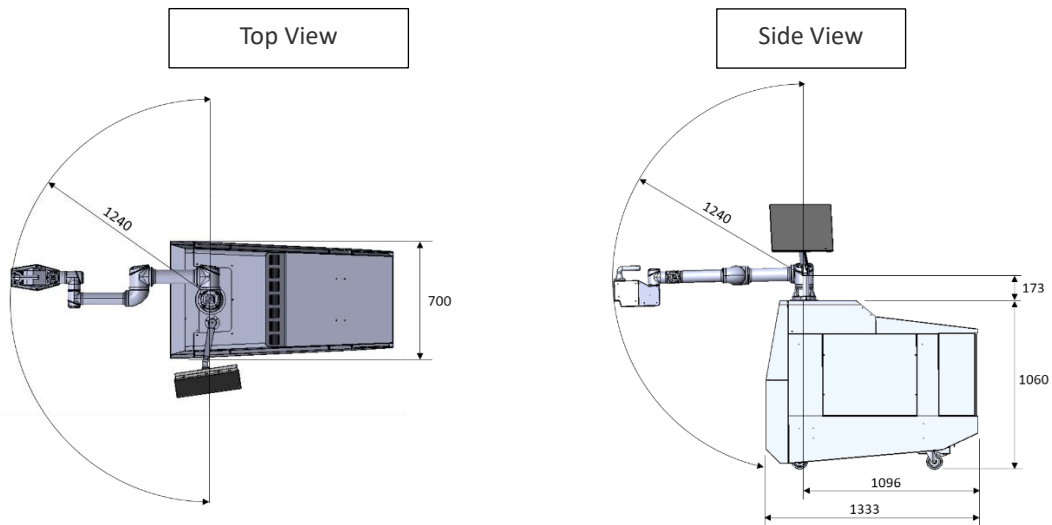

Illustration 2. Top view and side view of ADAMO robot

Technical data

ADAMO ROBOT V1.0	
Power Supply (VAC / Hz)	230 / 50
Electric Consumption (A)	15,2
Input Power (VA)	3500
Max. Air Pressure (Bar)	6
Air flow output (l/min)	230
Air flow intake (l/min)	415
Noise (db)	78
Weight (kg)	180

Intended use of the machine

The machine was designed and built for the use described in the next table.

FIELD OF USE	MEANING
PLACE OF USE	Indoor places with sufficient lighting, ventilation and controlled temperature conditions having the characteristics referred in "Technical Data" and "Products used for the operation" appropriate to the laws in force in the country of use for safety and health in the workplace. The machine must be placed on a surface that ensures stability in relation to the overall dimensions and weight, respecting the minimum position shown in "POSITIONING THE MACHINE of the IFU ADM-001." ⚠ **YOU MUST KEEP THE MACHINE OUT OF REACH OF UNAUTHORIZED PERSONS.**
INTENDED PURPOSE	ADAMO ROBOT® is intended to support users in alleviating musculoskeletal pain and enhancing movement and daily function in patients, through physiological effects on muscle tension and neural signalling.
INTENDED USERS	ADAMO ROBOT® intended users are rehabilitation healthcare professionals trained by the manufacturer in the device use.
NON- CONTINUOUS OPERATION	The active operation rate of the machine is 25 minutes of active treatment mode and 10 minutes in standby mode.

Environmental Conditions

ENVIRONMENTAL CONDITIONS	
Min – Max ambient Temperature (ºC)	20 - 28
Max. Relative Humidity (%)	70
Atmospheric Pressure (kPa)	70-100

Energy supply

ENERGY SOURCE	POWER SOURCE
ELECTRICITY	Connection by plugging into electrical panel. (See ''Technical Data'').

Products used for the operation

PRODUCT USE FOR OPERATION
Ambient "clean" air, free of pollutants harmful to health.

DEVICE CONFIGURATION

To ensure optimal performance and proper integration with our system, it is essential to perform the correct configuration of the device. Below are the necessary steps to set up our equipment:

- Verification of Installed Power in the Room (3.5KW):
  Before configuration, it is important to verify that the installed power in the room is at least 3.5KW to ensure adequate electrical supply.
- Configuration of Current Levels for Operation:
  Adjust current levels according to the operational needs of the device for optimal and safe operation.
- Establishment of Internet Connection:
  Connect the device to the Internet via an Ethernet plug or Wi-Fi connection to enable communication and remote access.
- Pairing with Cloud Data (AWS):
  Configure the device to pair with AWS cloud data for secure and accessible information storage.
- Insertion of Software Access Credentials:
  Enter the necessary software access credentials for the device's operation.
- Technical Training for Client Engineers:
  Provide technical training to client engineers to ensure they are familiar with the operation and maintenance of the device.
- Clinical Training for Physiotherapists and Medical Staff:
  Conduct clinical training for physiotherapists and medical staff on the proper use of the device in clinical settings.

PRINCIPLES OF OPERATION OF THE DEVICE AND MODE OF ACTIONS

The use of pressure and temperature, as therapeutic modalities, has been researched and has been shown to be effective in various musculoskeletal pathologies and other health conditions.

These techniques are essential in physiotherapy to improve recovery processes and reduce pain in patients with musculoskeletal disorders. Below is a brief justification and review of the state of the art in order to support Adamo Robot's main therapeutic tools: pressure and temperature using compressed air.

Pressure and massage

Pressure and massage have been studied in multiple musculoskeletal pathologies, cancer and fibromyalgia, among others (1–3). These techniques can be defined as the "mechanical manipulation of the body's tissues with pressure and rhythmic movements with the aim of promoting health and well-being" (4). Within the treatment of these disorders, manual therapy and different types of pressure are often the first option in passive and conservative treatment (1), with the aim of improving the processes of contraction, relaxation and collagen production.

Techniques such as ischemic pressure, pressure release, and pressure accompanied by manual movements are commonly used. It is estimated that, in general, pressure and massage can represent up to 45% of the total treatment time in physiotherapy (5). Scientific evidence has investigated the effects of pressure on various pathologies, recognizing that these effects encompass biomechanical, psychological, neurological, and physiological aspects (6). In particular, the effectiveness of these techniques in the treatment of myofascial pain syndrome (7), a common musculoskeletal pathology, has been demonstrated.

Fascial tissue, which covers both superficial and deep areas of the body, has a direct relationship with the nervous system, vascular system, and lymphatic system, making it a key element in proprioception, motor coordination, and tissue thermoregulation (8).

Myofascial pain syndrome is especially prevalent in back problems, such as neck and low back pain, due to current risk factors, such as sustained postures or repetitive movements that are not prepared to support tissue systems (9). This type of pathology generates local and referred pain, stiffness, decreased joint range, and muscle weakness, among other symptoms (10).

According to the control gate theory, pain can be blocked by surface pressure and control of the underlying neurological mechanisms (11). In turn, the pressure generated, such as that exerted by compressed air, at the level of the skin can block the release of allogenic substances (substance P, bradykinin, histamine) (12) and prevent the activation of different ion channels in the nociceptive fibers that cause pain (13).

Thermotherapy

The use of temperature to generate physiological responses is one of the oldest tools in conservative treatment. In physiotherapy, temperature is a fundamental physical tool, which in many cases becomes the only treatment, or an essential adjuvant treatment.

Temperature directly influences cell metabolism, nerve conduction speed, and regulation of the circulatory system, all key elements for the homeostasis of the human body.

1. Application of heat

The use of heat as a treatment has been investigated in both acute and chronic pathologies (14). Heat has been shown to increase skin temperature (15), at the intra-articular and muscle level (16), and generate vasodilation, which ultimately promotes tissue proliferation through increased local metabolism and increased oxygen consumption through faster catalysed biochemical reactions (14).

This metabolic modification also affects the elasticity of connective tissue, which reduces joint tension and improves joint range (17,18). In addition, heat is useful for improving strength, reducing pain, and even improving quality of life.

2. Application of cold

Cold, on the other hand, is used to reduce local temperature and control pain, especially in the management of various pathologies of the human body. Cold induces vasoconstriction, which reduces blood flow by activating a vasoconstrictor reflex mediated by the sympathetic nervous system (19). This decreases edema and slows down the production of inflammatory mediators such as leukocytes (20).

Likewise, the reduction in blood flow decreases local metabolism and slows down nerve conduction velocity, which weakens the signals sent by nociceptors, thus reducing the perception of pain by the central nervous system (21).

Air compression and its effects

Compressed air allows pressure to be applied to human tissues, generating physiological reactions due to this pressure. According to Newton's law of cooling, the difference in body temperature with respect to the temperature of compressed air (whether hot or cold) will generate a change proportional to this difference. For example, applying cold air to an inflamed area will reduce the temperature in that area due to increased blood circulation in inflammation, while hot air can increase the temperature of stiff and hypovascularized areas.

Compressed air has been investigated with positive results in terms of its physiological effects on body temperature, improving healing in pathologies such as diabetic foot (22).

Mode of action

- **Robotic arm**

ADAMO ROBOT® is a device with a six-degree robotic arm able to place the air nozzle at its end-tool. The reach of the robot has been defined to treat at least half of a patient's body high. This means that if the mean high of a patient is 1.75m the minimum reach of the robot must be 0.85m which may also include the gap between the patient and the robot.

For therapeutical comfort and therapeutical purposes, the air must be heated up at different temperature levels (High, Medium and Low).

As security control, the system identifies when the robot is in near-contact or touches the patient or it is blocked by its surroundings. When that happen, the device stops its movement and inform the user to act accordingly.

On the other hand, users can select from five types of robotic arm movement:

- Manual use: The rehabilitation professional can freely move the robot without pre-established points and has the ability to select the temperature heating mode of the air being applied during the session.

- Programmable use:
  - o Point to point mode: The user can program specific points in three dimensions, defining how long the air pressure is applied at each point and at how it is heated. The robot moves between points without stopping the airflow.
  - o Arch mode: Similar to point-to-point, but the airflow stops when moving between points. For example, air can be applied to one point, and the robot moves to the next without air before resuming treatment.
  - o Lineal mode: The robot follows a continuous path through pre-established points, maintaining air pressure and temperature throughout the entire cycle. After completing the path, it returns to the first point to repeat the cycle as programmed.
  - o Pendular mode: The robot moves back and forth along the defined points, maintaining constant air pressure and temperature in both directions, repeating the cycles as programmed.

The information on the treatments is saved on cloud server services (AWS) and the device has internet access thought Wi-Fi and/or Ethernet connection.

- **Software**

The device has a human-machine interface (HMI) that guides the user through the treatment configuration and programming process. It also is accessible for the user during the treatment programming and setting process.

List of configurations

Regarding robotic arm movement ADAMO ROBOT® has the following configuration possibilities:

- Treatment parameters: the user can select
    - Temperature and time in free movement in manual mode
    - Temperature, time and points of treatment in programmable mode.
- Type of arm movement: the user can select manual mode or programmable mode. In the manual use the user controls the robotic arm and there is no limit regarding the number or points. In the programmable use, the points are limited to six and there are four possible types of movement

1. Discontinuous point-to-point (point by point mode)

This model involves applying air individually to each designated point. First, the temperature and application time are set, which are uniform for all defined points. Upon starting the treatment, the robot moves to the safety point with respect to the first designated point. Subsequently, it approaches the specific point and proceeds to apply the air. Once the pre-established time has elapsed, the air application ceases, and the robot returns to the safety point.

From this safety point, the robot moves to the next designated point and repeats the same process: it positions itself over the indicated point, applies air for the established time, ceases the application, and returns to the safety point. Once this procedure is completed for all defined points and after positioning itself at the safety point of the last point, the robot moves to the resting position.
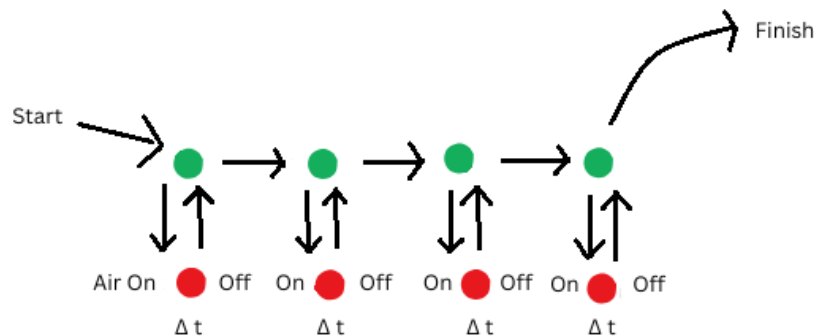
Fig. 16: Point by point mode

2. Continuous point-to-point (on arch mode)

This model operates by executing a single cycle along the preconfigured points, with adjustments available for the speed, temperature, and treatment application time at each point. Upon starting the treatment, the robot moves to the safety position with respect to the first treatment point, and the air

supply is activated. Then, it moves to the first designated point, where it remains for the established time, and then directly moves to the second point, bypassing intermediate safety points. This process is repeated for each point, with the robot staying at each one for the predefined time.

Upon concluding the necessary time at the last point, the robot stops the air expulsion, moves to a safe position with respect to this last point, and finally moves directly to the resting position, as it is a single-cycle treatment.
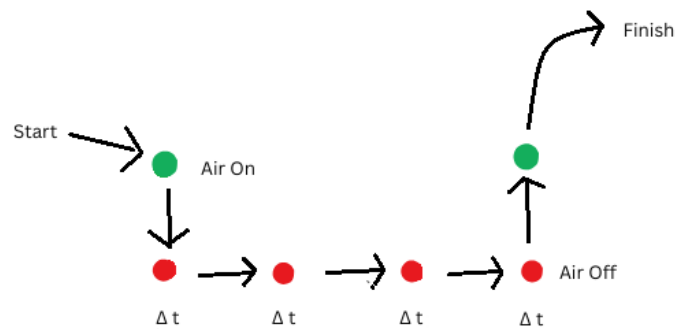
Fig. 17: On arch mode

3. Lineal mode

In the linear movement process, parameters are configured on the setup screen, defining the points to be treated, the number of cycles, and the temperature and speed conditions for all points.

Upon starting the treatment, the robot moves to the safe position with respect to the first treatment point. The air supply is activated, and the robot moves to the first designated point.

Once at that point, it remains for 6 seconds before moving directly to the next point, without passing through intermediate safety points. This process is repeated at each designated point, also remaining for 6 seconds at each one.

Upon reaching the last point and after supplying air for 6 seconds, the robot stops the air expulsion and moves to the safety position with respect to this last point.

If multiple cycles have been defined, the robot will return to the safe position with respect to the first point and repeat the entire process. Conversely, if only one cycle has been defined, the robot will move to the resting position, thus ending the treatment.
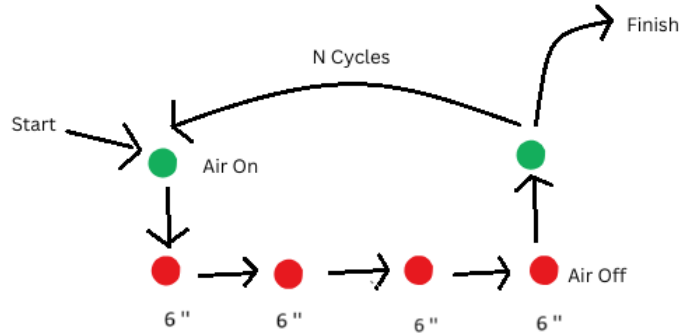
Fig. 18: Lineal mode

4. Pendular mode

Like the linear procedure, this method involves moving the robot through predefined points, but with the peculiarity of executing multiple cycles. On the setup screen, the temperature, speed for all points, and the number of cycles to be performed are established.

The main distinction from the linear mode is that, upon reaching the last defined point, if multiple cycles have been programmed, the robot does not move to a safety point but rather returns directly to the first point to start again. In this context, referred to as "pendulum," after applying the treatment at the last point, the robot returns directly to this point, then to the penultimate, and so on until reaching the first.

Once all established cycles are completed, the robot moves to the safety point of the last visited point and then returns to the resting position.

Therefore, if only one cycle is set, the linear and pendulum modes will be equivalent. It is essential to consider that one cycle represents a single pass through the points; therefore, for the robot to traverse the points in both directions, it is necessary to configure at least 2 cycles.
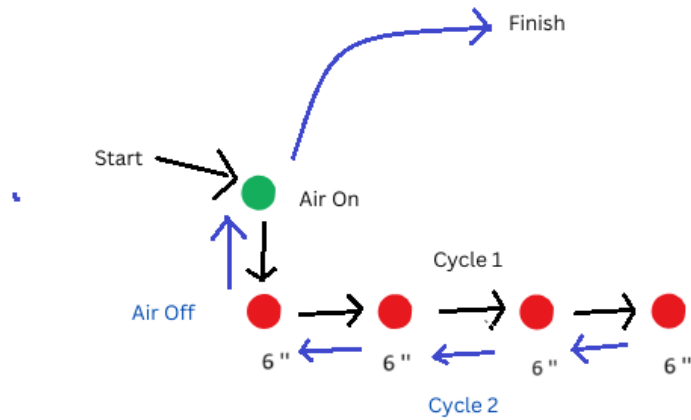
Fig. 19: Pendular mode

A summary of configurations is described in the table below:

Type of use	Treatment parameters	Type of arm movement
Manual	Temperature (20 - 28ºC) Treatment Time (0 to 25 min) Rest Time (10 min)	Not configurations. The arm is moved by the user
Programmable	Temperature (20 - 28ºC) Treatment Time (0 to 25 min) Rest Time (10 min) Number of points (1 to 6)	1. Point by point mode 2. On arch mode 3. Lineal 4. Pendular

Fig, 20: ADAMO ROBOT® configurations

USE INSTRUCTIONS

Informatic system

ADAMO's computer system has been designed following a cloud-based distributed architecture. The system is intended to distribute all the necessary information for the operation of the machines and for the exchange of treatment information between machines. This way, a patient could receive a session of a treatment on any ADAMO machine located anywhere.

Illustration 3. Adamo robot: architecture SW in the cloud.

This allows healthcare professionals to access information remotely from any device to track treatments. The Panel PC on the robot is supported by a support arm to move the PC panel screen so that the user can adjust the screen position while configuring treatments for patients.

Robot power-up

The ADAMO robot startup process consists of the following steps:

1. Confirm that the following cables are connected:
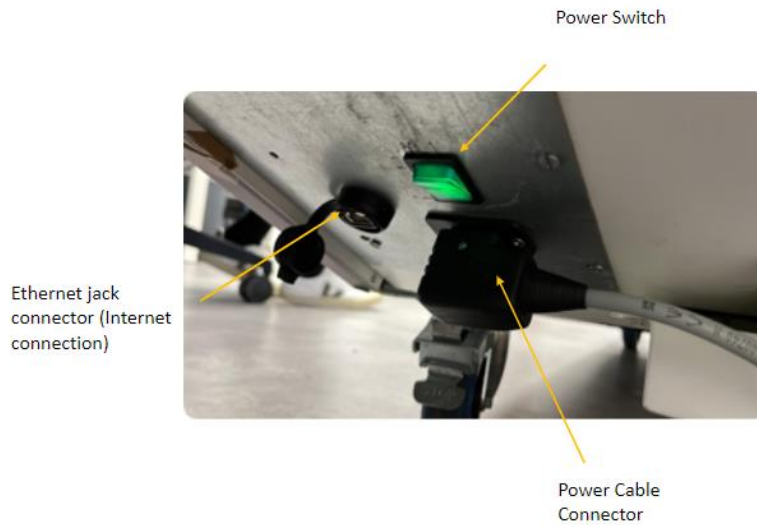
Illustration 4. Important connections for the functioning of ADAMO robot

2. **Press the power button** to activate the internal system of the device.

3. **Wait for initialization**: Once you've pressed the power button, the robot will begin its startup sequence. This process may take a few minutes to complete, during which various internal systems and components of the device will be activated.

4. **Confirmation of startup**: You'll know that the robot has powered on successfully when the pup up indicating the "releasing of the breaks" will disappear.

5. **Start of use**: Once the robot has powered on and you've confirmed that the brakes have been released, you can begin using the device as needed to carry out the planned therapeutic treatments, following the instructions in the user interface section.

Manual modification of the temperature

To choose the compressed air temperature, you can do so through the user interface when defining a treatment or manually. In case you want to adjust the compressed air temperature manually, we have two buttons:

- Temperature Selection Button: This button allows the user to choose the desired temperature for the treatment. By rotating the button clockwise or counterclockwise, the user can adjust the temperature according to the patient's needs or the type of treatment being performed. Cold, medium, or hot temperatures can be selected based on therapeutic indications.

- Temperature Confirmation Button: Once the desired temperature has been selected using the selection button, the confirmation button is used to set that temperature and start the treatment. This button, therefore,

confirms and executes the temperature setting chosen by the user. Once the button has been pressed, its color changes to white.

Ilustración 5. Temperature selection button and temperature confirmation knob of ADAMO robot

These two buttons work together to provide precise and effective control over the temperature used during the treatment.

User interface

The user interface is used to develop the following workflow:
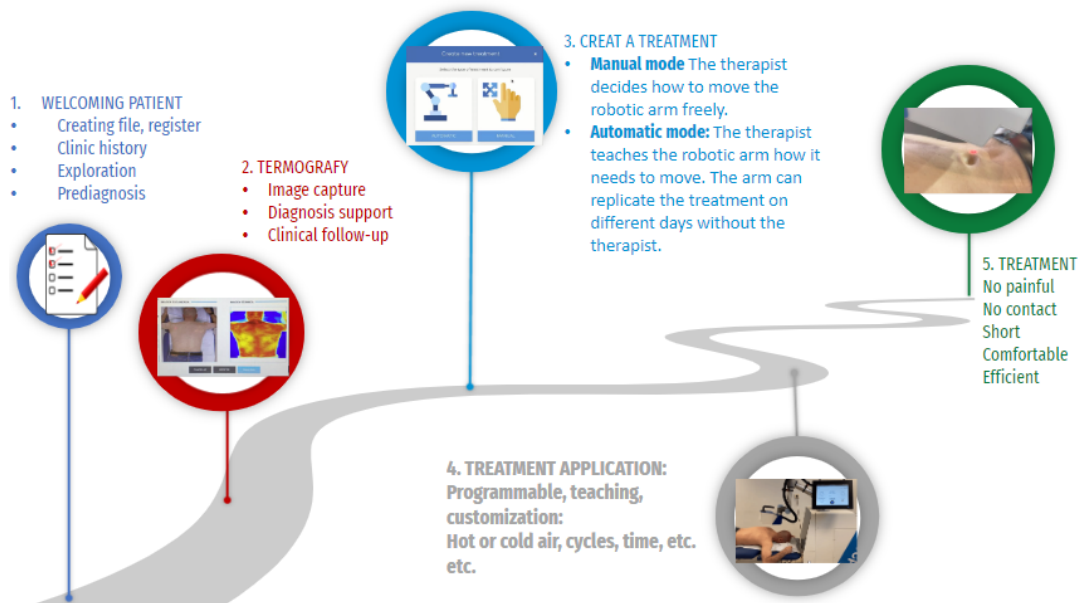
Illustration 6. Workflow of ADAMO robot

The user interface runs in the cloud, and users access it through the Firefox web browser. Below, we will detail this interface so that physiotherapists can operate the robot, attending to all its different needs throughout the process while maintaining a focus as simple as possible to facilitate the operation of the Adamo robot.
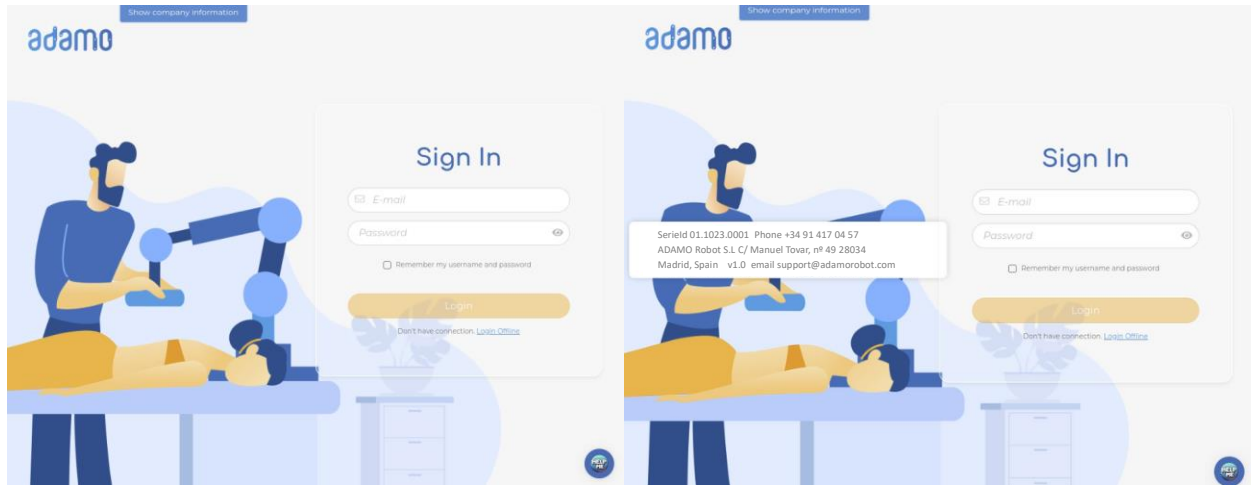
Illustration 7. ADAMO robot: user interface (I)

Company information

Within this screen, the **'Company Information'** button is displayed. By pressing this button, the following information regarding ADAMO appears for contacting in case it's necessary:

- Serial number
- A contact number
- The address of the device
- The version of the device
- An email address

Login

To enter in the interface, the following steps must be followed:

1. Enter the password. The icon 👁 disables the mask and allows the user to view the entered characters.

2. Activate the "Remember Me" box if the user wants to browser to remember the data for future sessions.

3. Click the "**Sign In**" button.
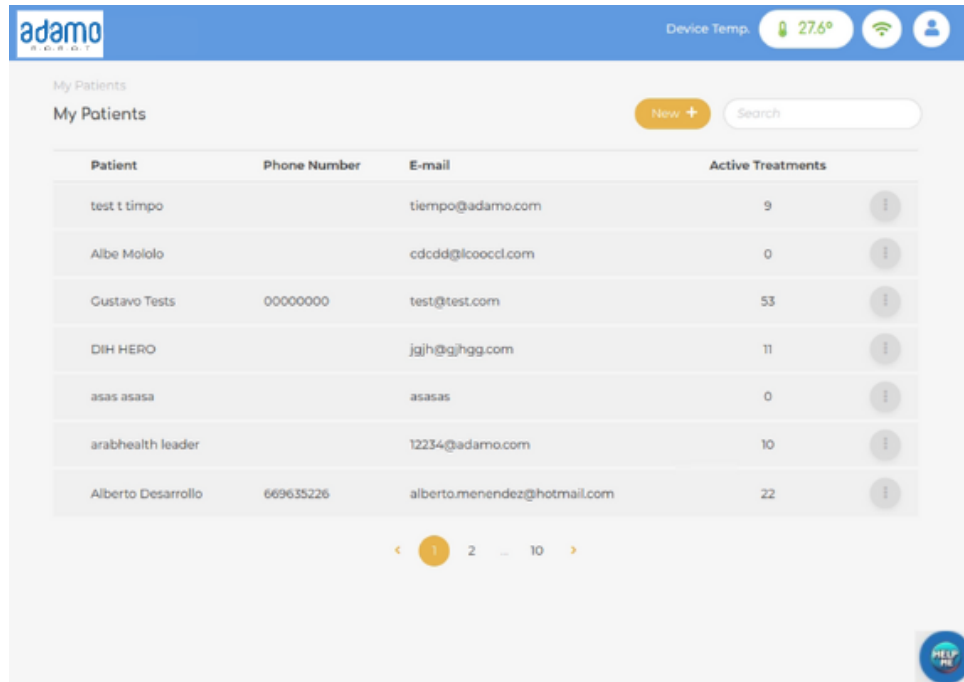
Illustration 8. ADAMO robot: user interface (II)

Help chat

Another relevant button on this main screen is the help button, which has been integrated to provide you with the best real-time support and assistance. With just one click on the chat icon, located in the bottom right corner of the screen, you can connect directly with our support team. It's important to note that this button will appear on all the different screens throughout the interface so that the user has the possibility to ask a question at any time.

Screen structure

The screen is divided in two parts:

- Header:
  o "Adamo robot" logo on the left
  o Temperature indicator on the right
  o Wi-Fi connection on the right
  o User button on the right
- Main area: information regarding the existing patients and the possibility to create new patients.

Temperature indicator

The internal temperature of the treatment station structure is monitored. When the sensors detect that the temperature has reached 35ºC, the built-in ventilation system is activated to expel the hot air. If the temperature continues to rise and reaches 50ºC, the treatment station stops and displays an alert message on the screen. The treatment station becomes operational again when the temperature drops to 40ºC.

User area
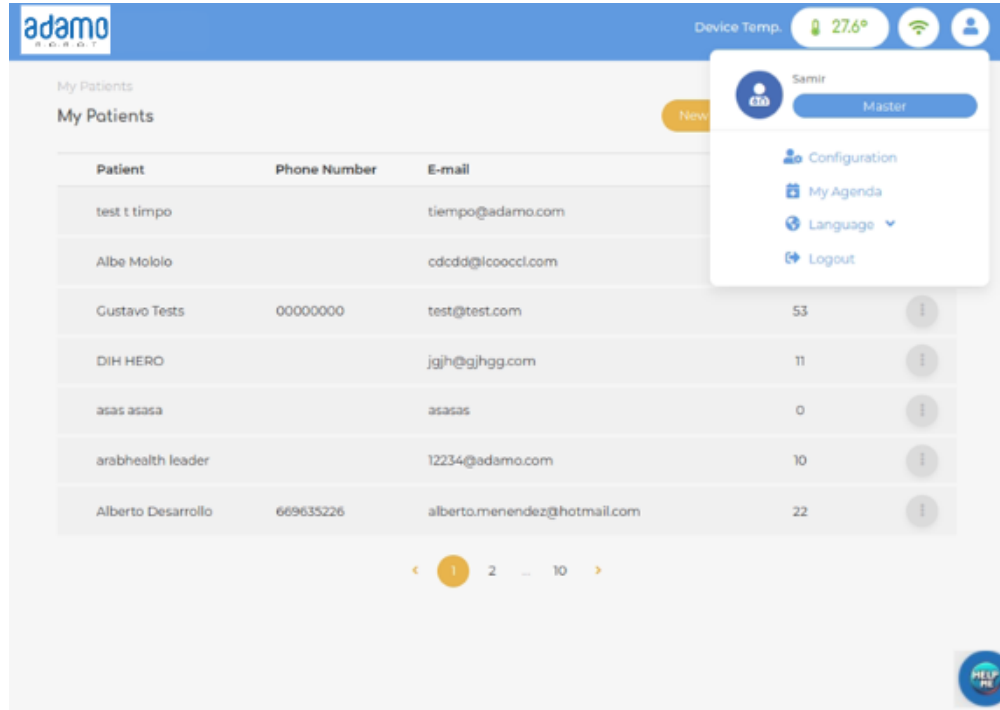
Illustration 9. ADAMO robot: user interface (III)

Dropdown button containing the following functionalities:

 a. Configuration: Selecting the configuration button opens the Configuration Screen where user information can be set up. This section will be explained in detail in the Configuration Screen section.

 b. Calendar: redirects to the annual calendar.

 c. Language: allows selection of the interface language between Spanish or English.
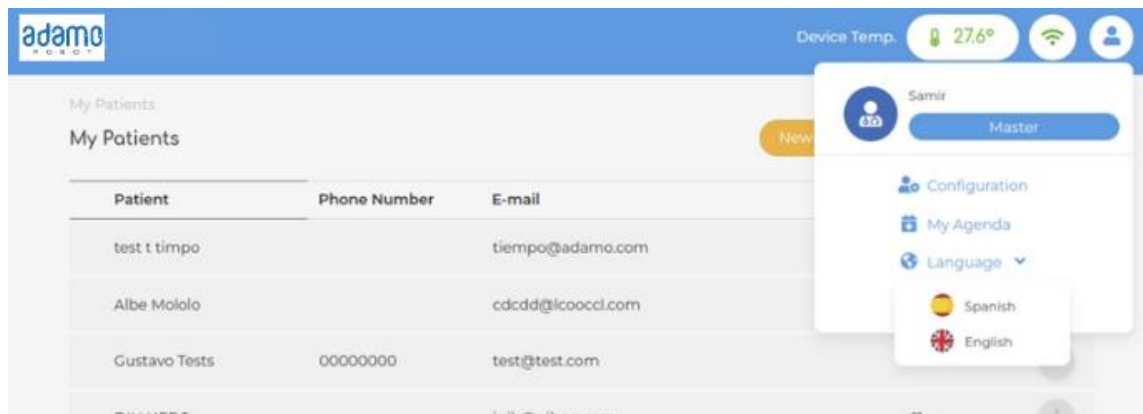
Illustration 10. ADAMO robot: user interface (IV)

 d. Log out

Main area / ''My Patients'' screen

In this section, we have information regarding the patients. It allows us to create, search, edit, and delete patients.

It presents a table listing the patients created in the system for the user group initiating the session. This table displays a total of 7 patients per screen. To view patients created previously, there is a button at the bottom of the screen to scroll through the table.

The rest of the information regarding this area will be explained in the Patients Screen section.

Touchscreen usage

The built-in screens on the 'Adamo Robot' stations are touchscreen-enabled to facilitate interface usage, freeing the user from the need for a keyboard and mouse.

Use instructions:

- A single tap on an icon or button is sufficient to select options and open or close dialog windows.
- The keyboard appears by tapping on the text fields of the forms.
- The keyboard closes by tapping outside of it anywhere on the screen.
- If the keyboard covers part of a data entry form, the form will automatically scroll when typing in the field where the cursor is located.
- If the keyboard covers part of the form and prevents you from switching to the next text field, close the keyboard and tap on the field to place the cursor and reopen the keyboard. If the screen or form appears displaced due to a browser loading issue, tap anywhere on the screen or outside the form to reset its position.

Configuration Screen

When pressing the **Configuration** button, the information regarding the user with whom the login has been made appears. By clicking on the pencil button, the user can edit this information.
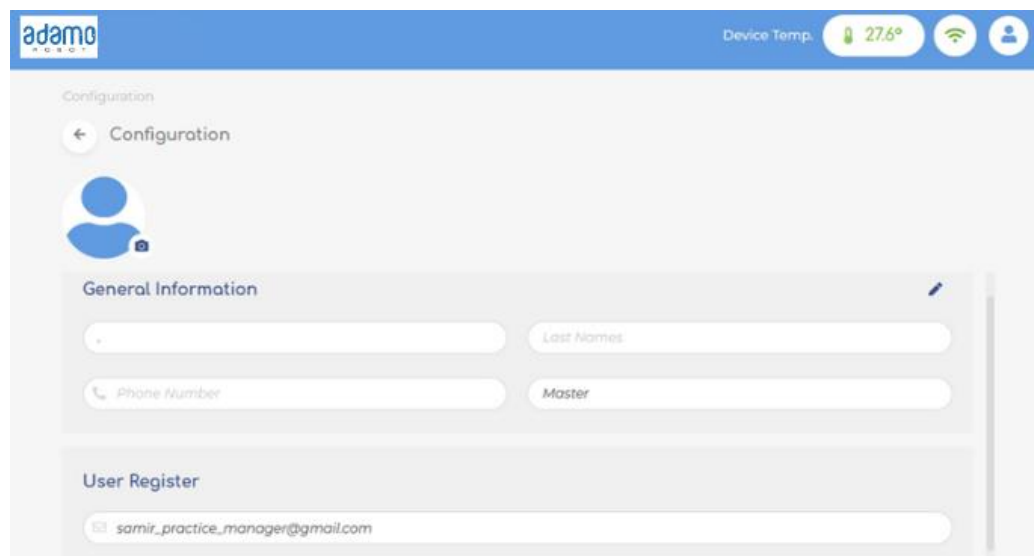
Illustration 11. ADAMO robot: user interface (V)

When clicking on the pencil icon, all the fields can be modified as shown below. It is important to note that these parameters must be filled in.
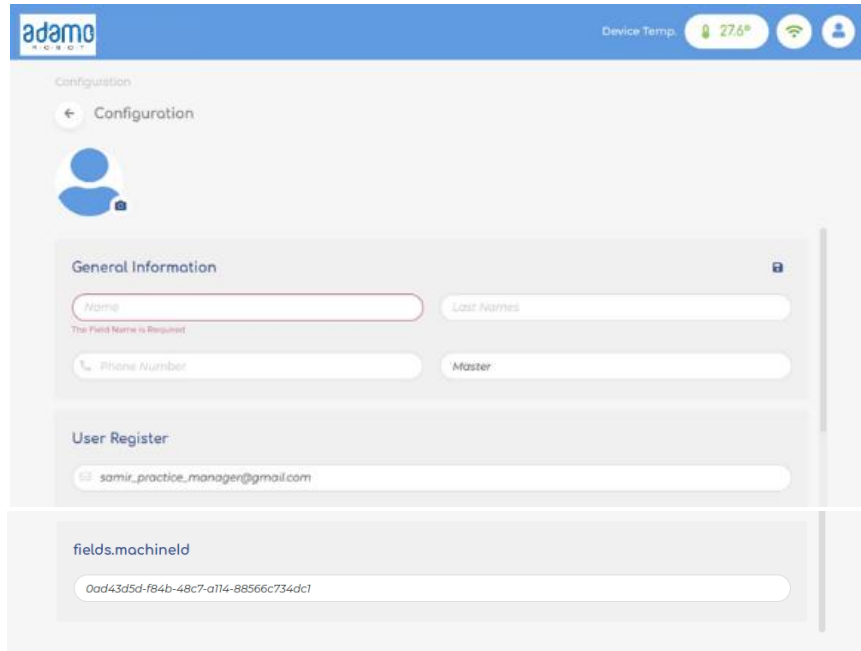
Illustration 12. ADAMO robot: user interface (VI)

Patients Screen

In this screen, the user can see, create, search, edit and delete patients.
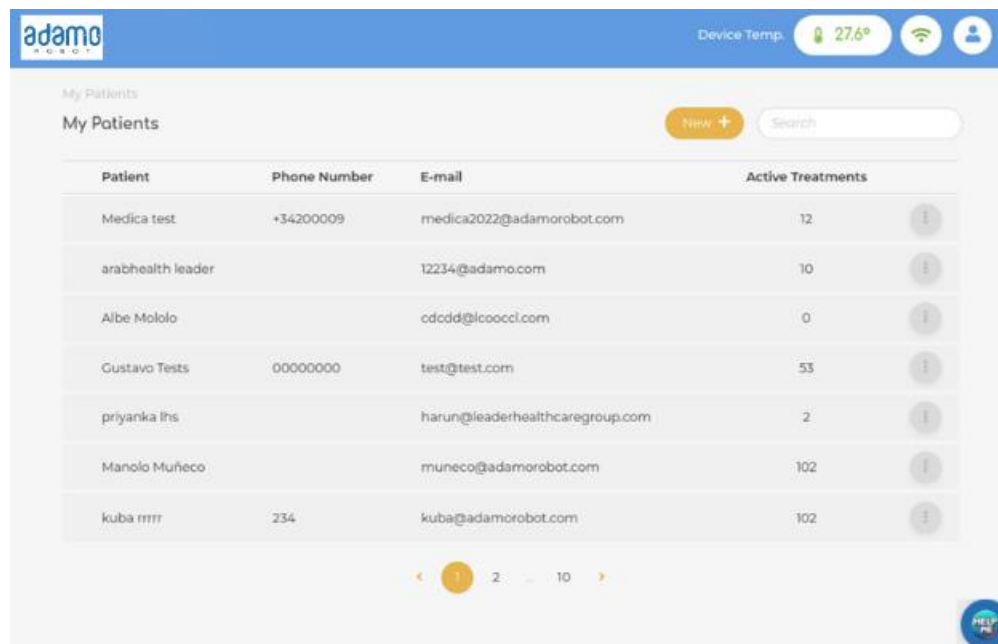
Illustration 13. ADAMO robot: user interface (VII)
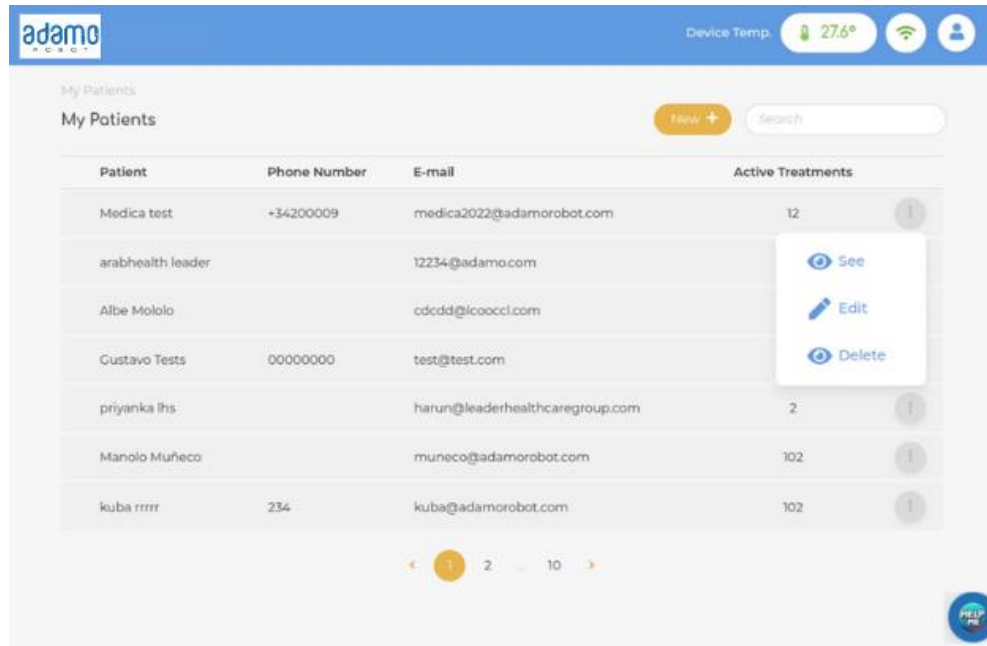
Illustration 14. ADAMO robot: user interface (VIII)

Create patients

1. Click on the button **New**

2. In the "Create new patient" dialog box, fill in the information. There is a total of three Windows, to navigate through them, click the **Continue** button. Once finished, click the **Create** button.

- Name
- Surname
- Identification (DNI o NIE)
- Date of birth (calendar selector)
- Occupation
- Email
- Phone No.
- Country
- City
- Address
- Gender
- Race
- Build
- Height
- Weight
- Allergies
- Medication
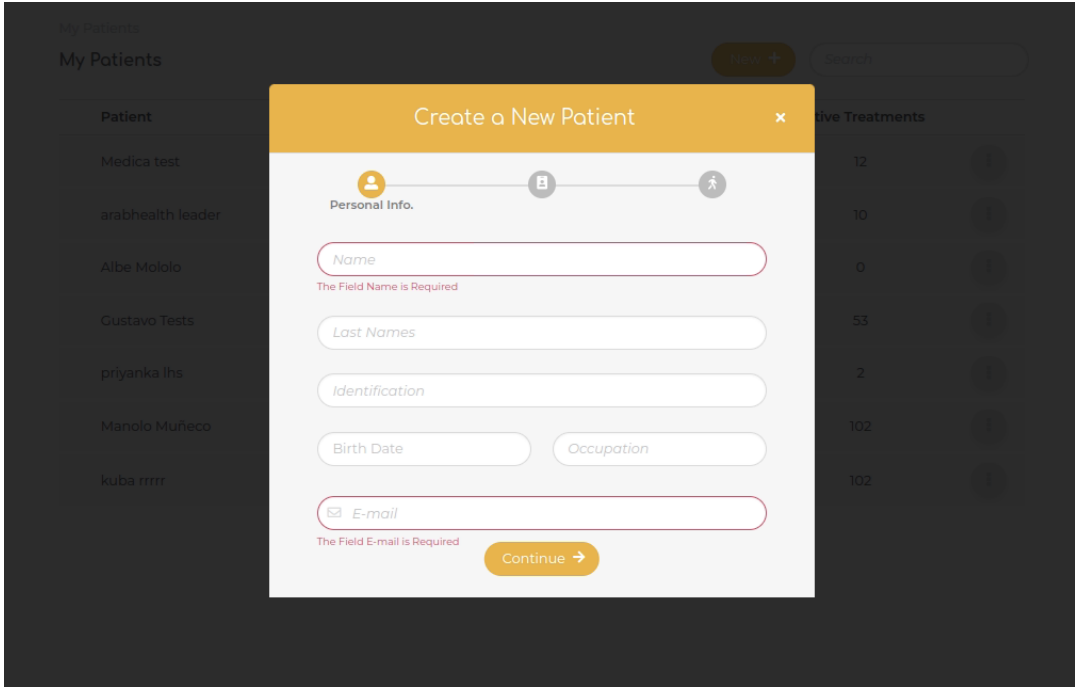
Illustration 15. ADAMO robot: user interface (IX)
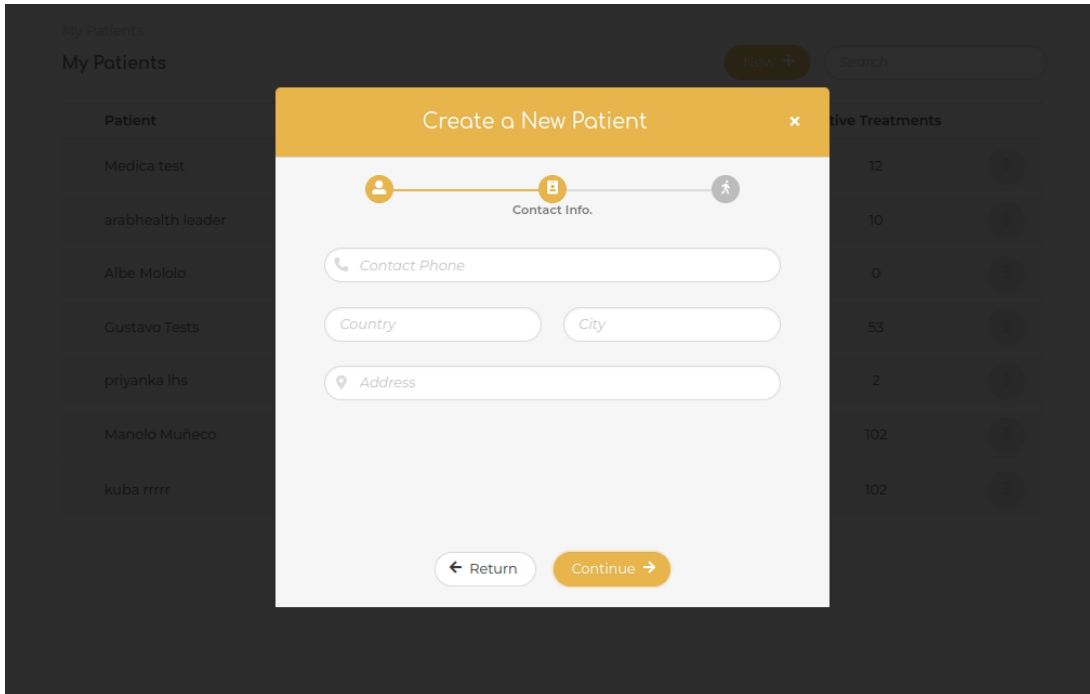
Illustration 16. ADAMO robot: user interface (X)
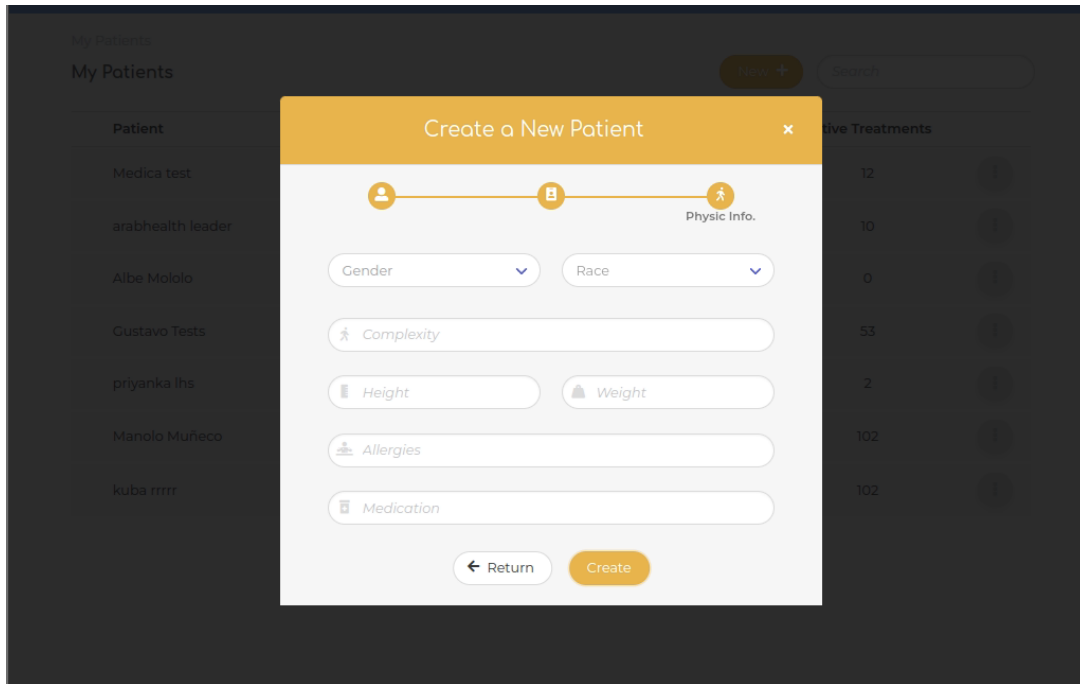
Illustration 17. ADAMO robot: user interface (XI)

Once the windows are filled out and the Create button is pressed, the screen automatically returns to the Patients Screen, and the following message appears on the screen:
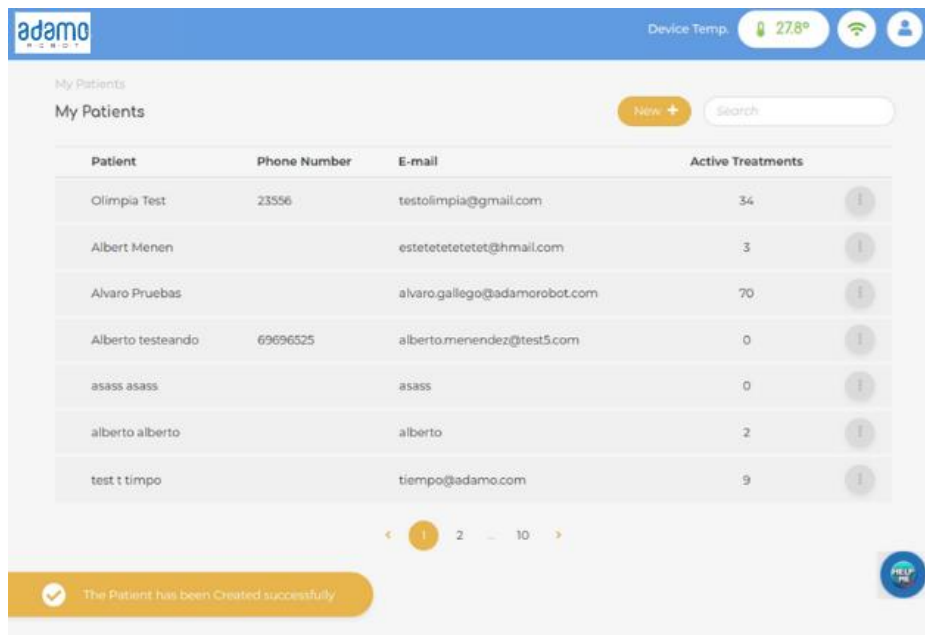
Illustration 18. ADAMO robot: user interface (XII)
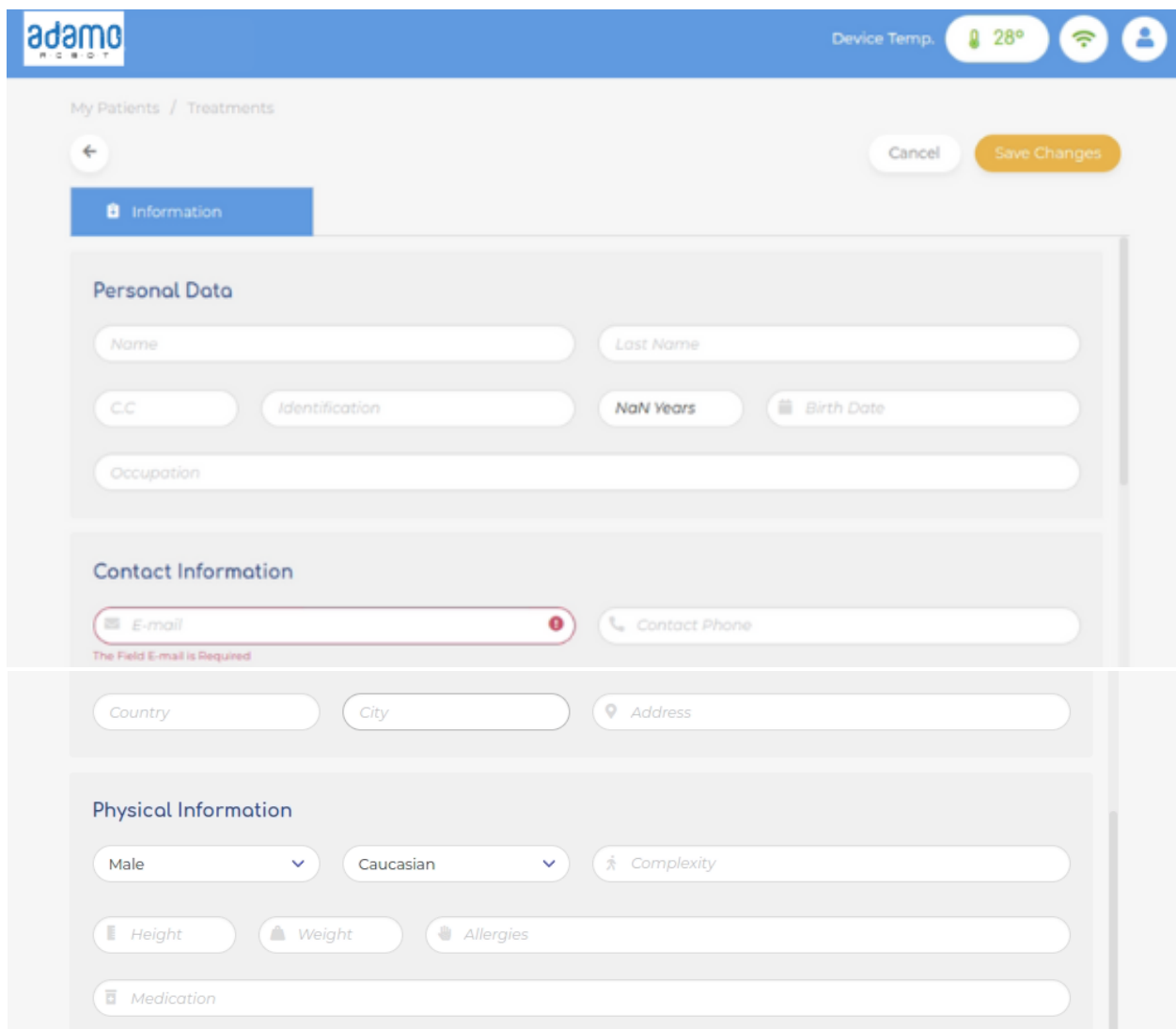
Search patients

To search patients, enter the specific name of the patient the user wants to find in the search bar.

See patients

When you click the **View** button or click on a specific patient, you are redirected to a new screen, the Treatments Screen. On this screen, you can view information related to a patient. This section will be explained in the following section.

Edit patients

When you click the **Edit** button, a screen opens to edit the patient's information. Once modified, click the **Save Changes** button.

Illustration 19. ADAMO robot: user interface (XIII)

Delete patients

To delete patients, you need to click on the **Delete** button. This opens the following window where you can choose to confirm deleting the patient or cancel the action.
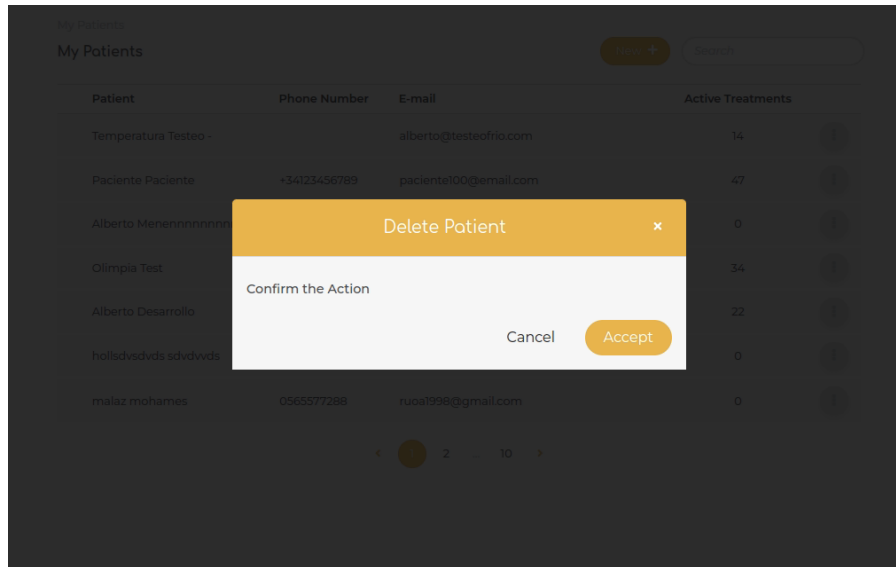
Illustration 20. ADAMO robot: user interface (XIV)

Treatments Screen

When clicking on a specific patient (or after creating a new one), you are redirected to the Treatments Screen. This screen features two sections: the Treatments section and the Information section.
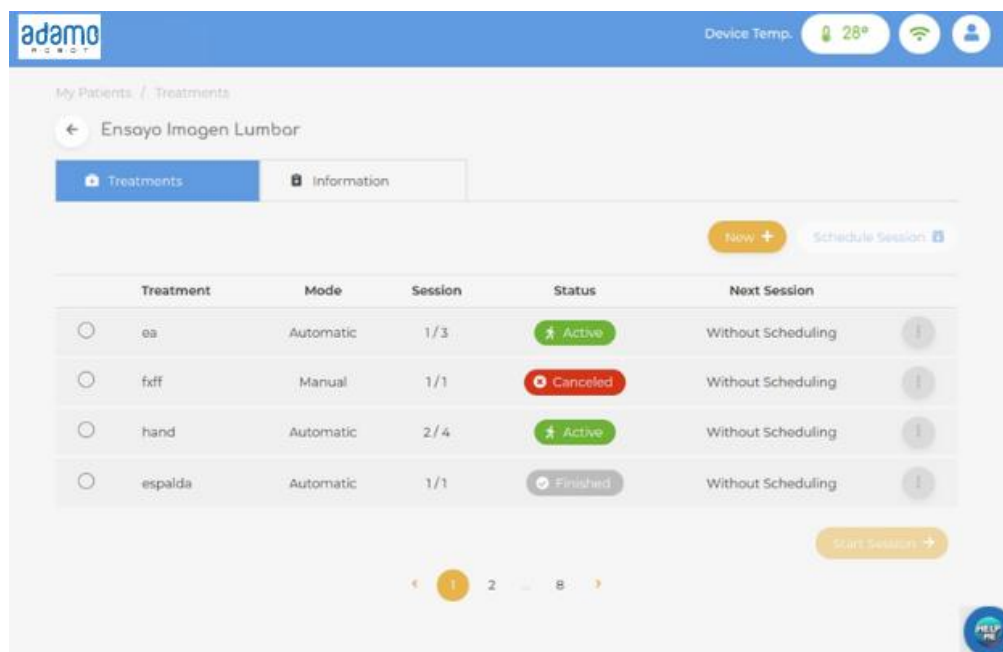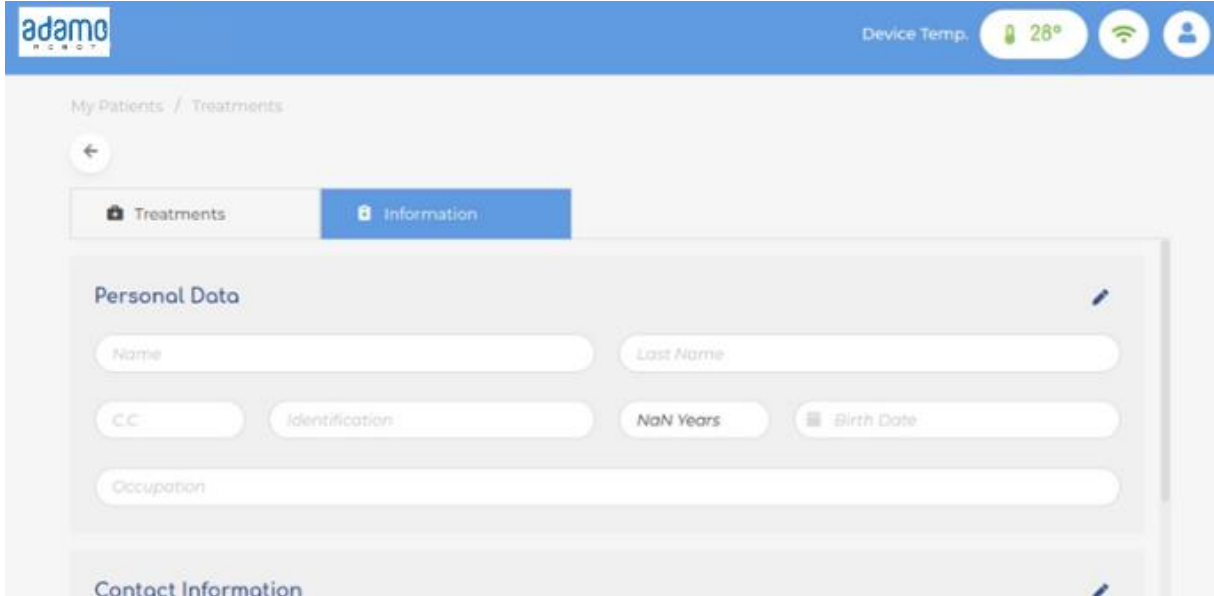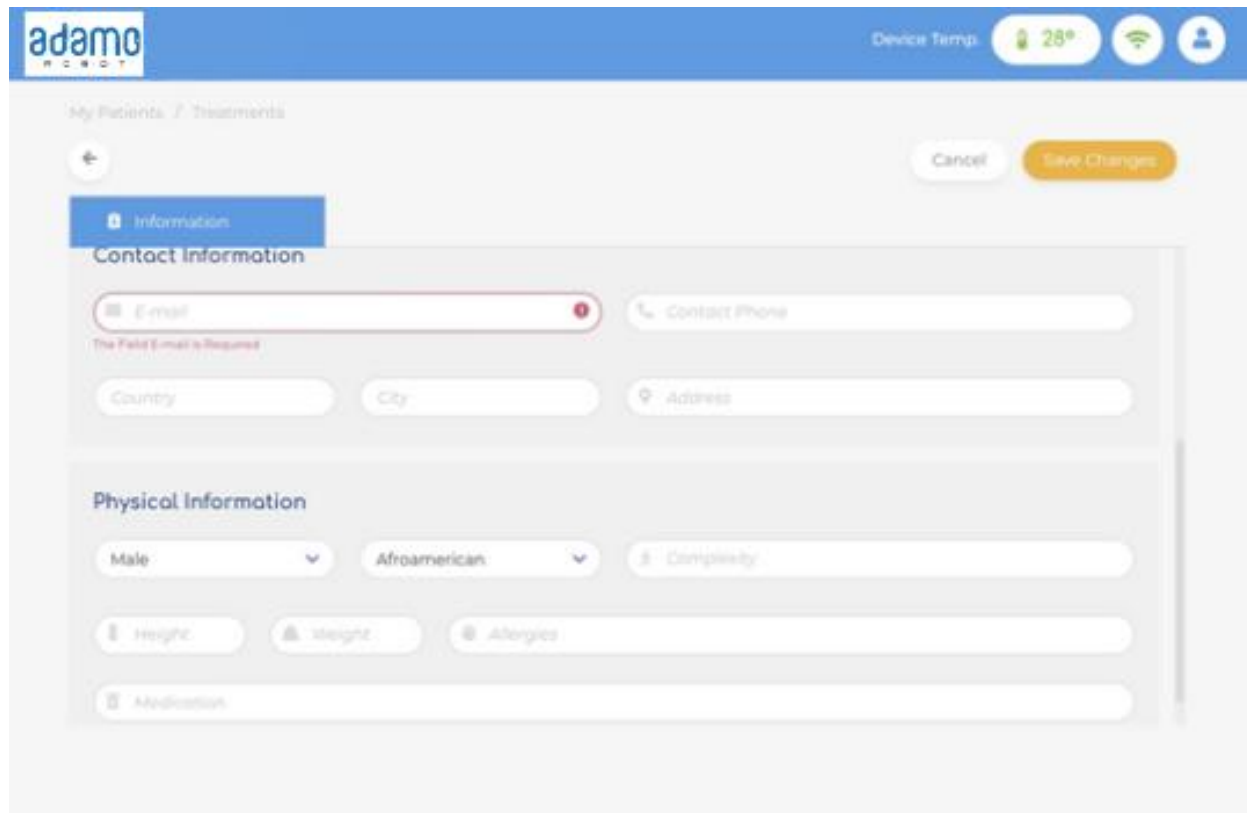

Illustration 21. ADAMO robot: user interface (XV)

Information

Where you can find the information entered during patient creation.

Illustration 22. ADAMO robot: user interface (XVI)

In this case, the user can click on the pencil icon to edit the patient information:
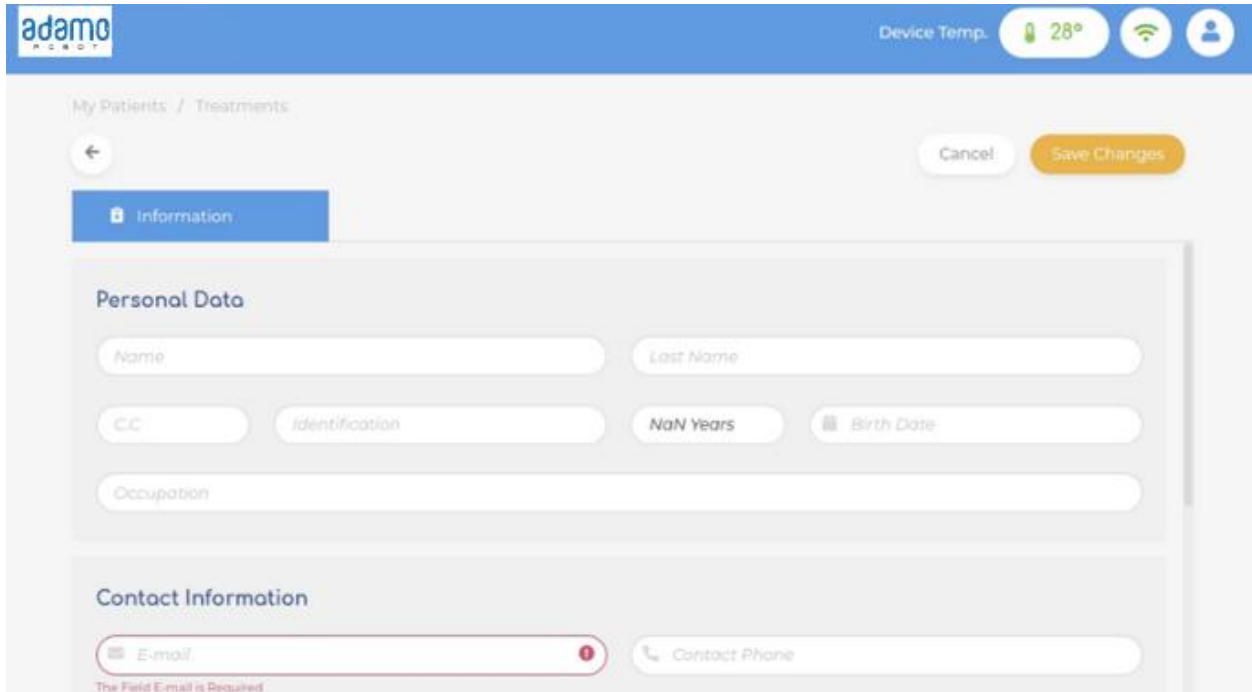
Illustration 23. ADAMO robot: user interface (XVII)

Once the data of the patient is modified, click on **Save Changes**.

Treatments

This is where you can see all the treatments that have been administered to the patient, create a new treatment, make changes to existing treatments, start sessions, or schedule a new session for a treatment. Similarly to the patient screen, here you can see a table of 4 treatments with the option to navigate through the table using the button below labeled "**Continue**".

Illustration 24. ADAMO robot: user interface (XVIII)

Based on the status of the defined treatments, they are indicated differently in the Status column.

- Active: When the treatment consists of more than one session, and they have not all yet been carried out.
- Completed: When the treatment has been fully administered. All scheduled sessions have been completed.
- Interrupted: When the user stops a session midway through the pre-established movement.

When creating a treatment and configuring it, it's important to consider the types of treatments that can be used and the effects of temperature on the treatment. After explaining the possible modes in which the robot can administer the treatment and under what circumstances it's better to use heat therapy and when to use cold therapy,

we proceed to explain the possible options mentioned above: New treatment, View history, Edit, Delete, Start session, or Apply a session from an already created treatment.
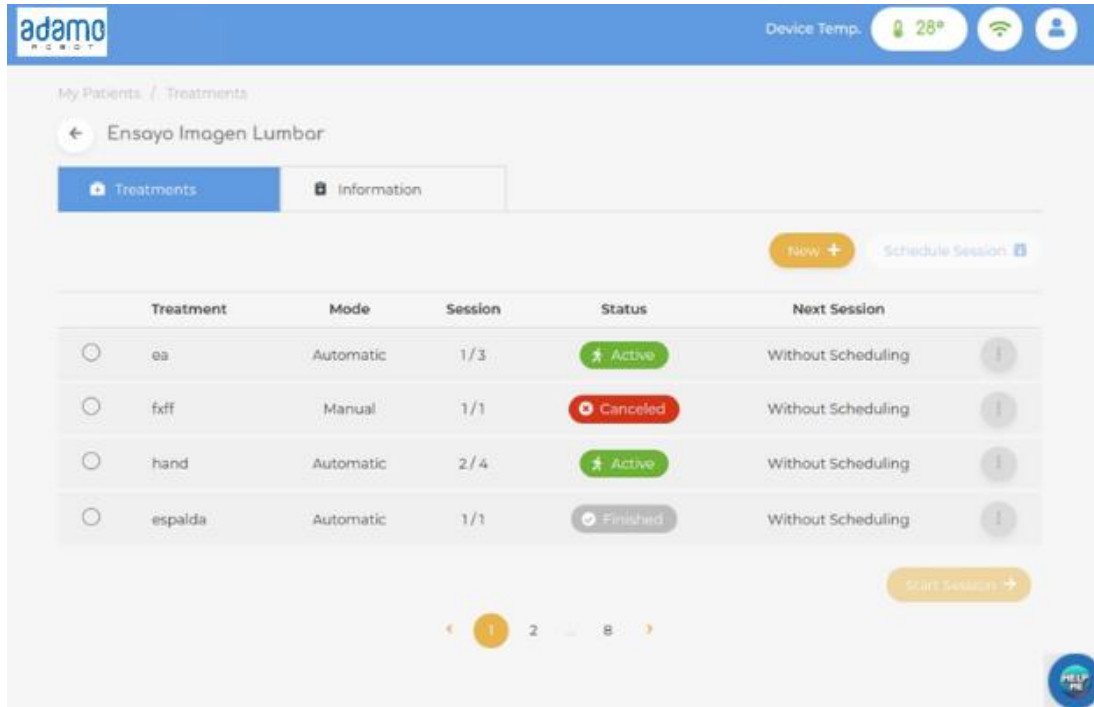

Illustration 25. ADAMO robot: user interface (XIX)

New treatment

To create a new treatment, the following steps must be followed:

1. Click on the button **New**.
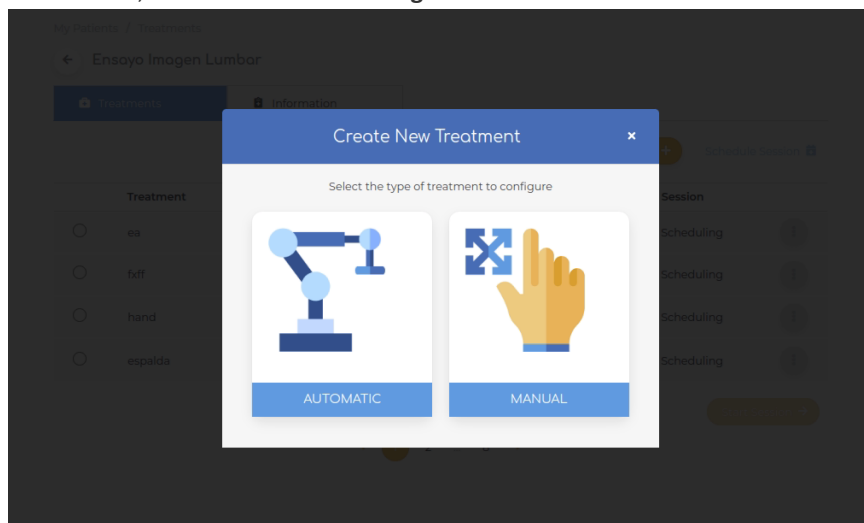2. Choose the type of treatment, between **Manual** or **Programmable**

Illustration 26. ADAMO robot: user interface (XX)

2.1. Manual:

2.1.1. A screen will appear to configure information related to the patient and the treatment to be applied. This includes whether they have had previous injuries like the current condition (selectable through the Yes/No button), indicating if they have had an injury and its cause, and any possible observations.
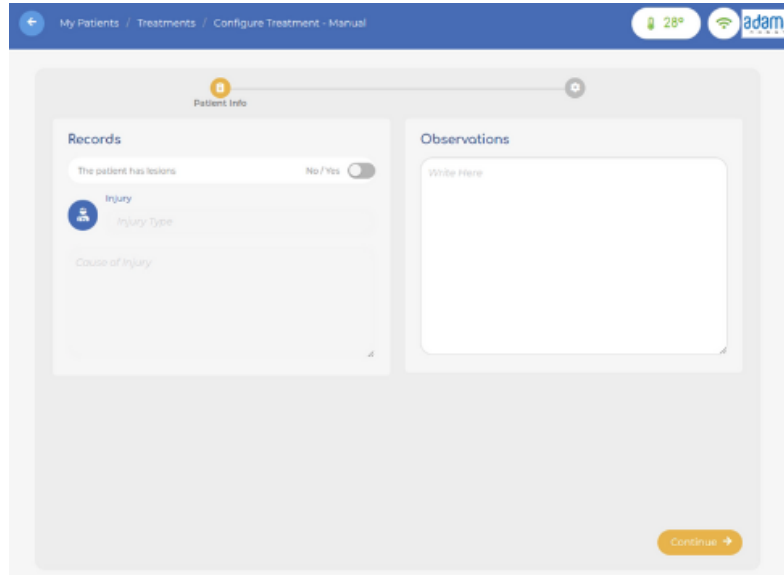

Illustration 27. ADAMO robot: user interface (XXI)

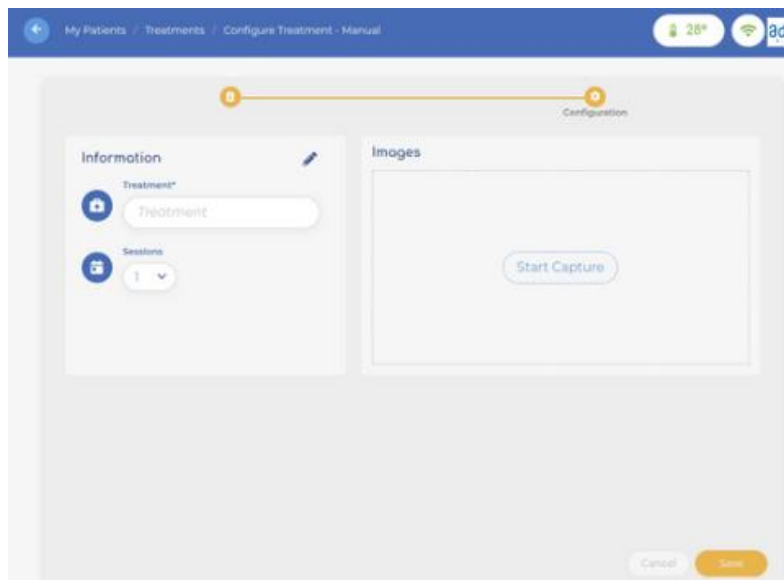2.1.2. Click in **Continue** and the following screen will appear:
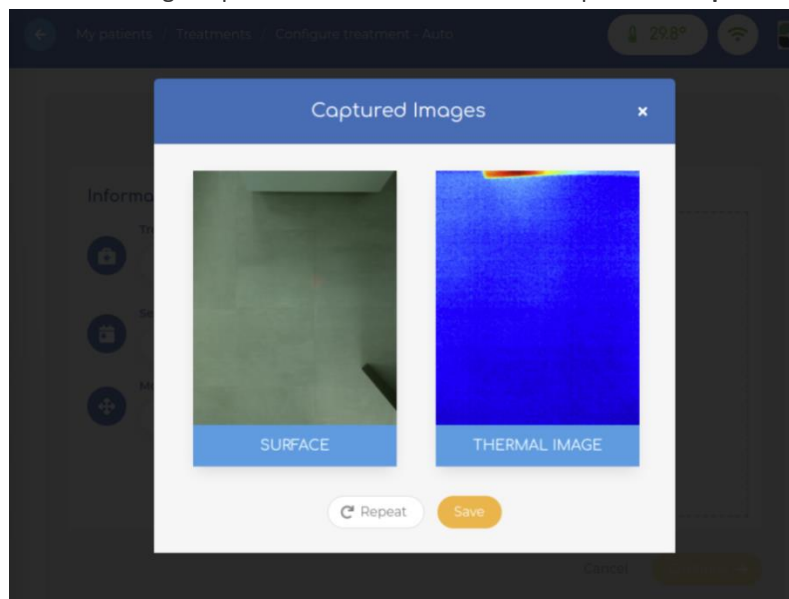

Illustration 28. ADAMO robot: user interface (XXII)

On this screen, you will need to enter the treatment area in the "Treatment" field (as indicated by the * next to "**Treatment**," it is mandatory information to save the treatment). You also need to specify the number of sessions for this treatment and click the "**Start Capture**" button for the robot to capture temperature and 3D images.

2.1.3. When pressing the "**Start Capture**" button, the robot arm automatically moves to the appropriate position to take the image.
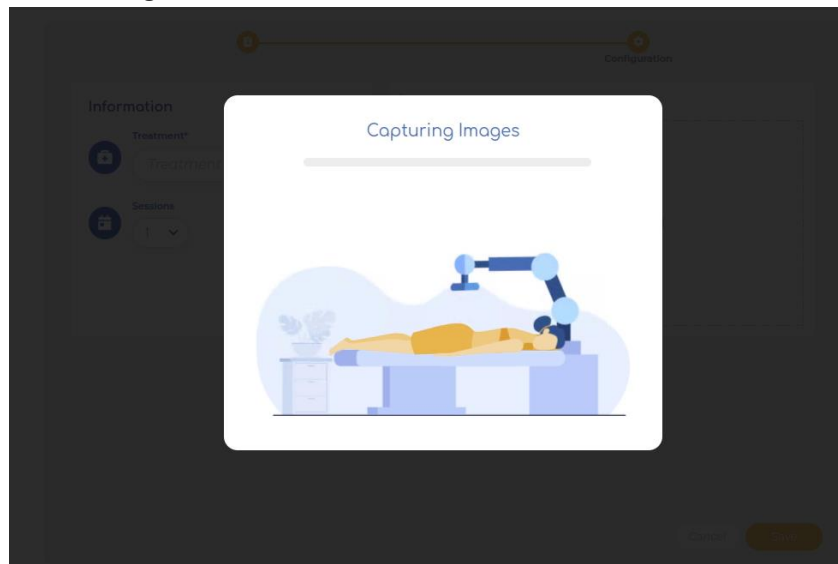
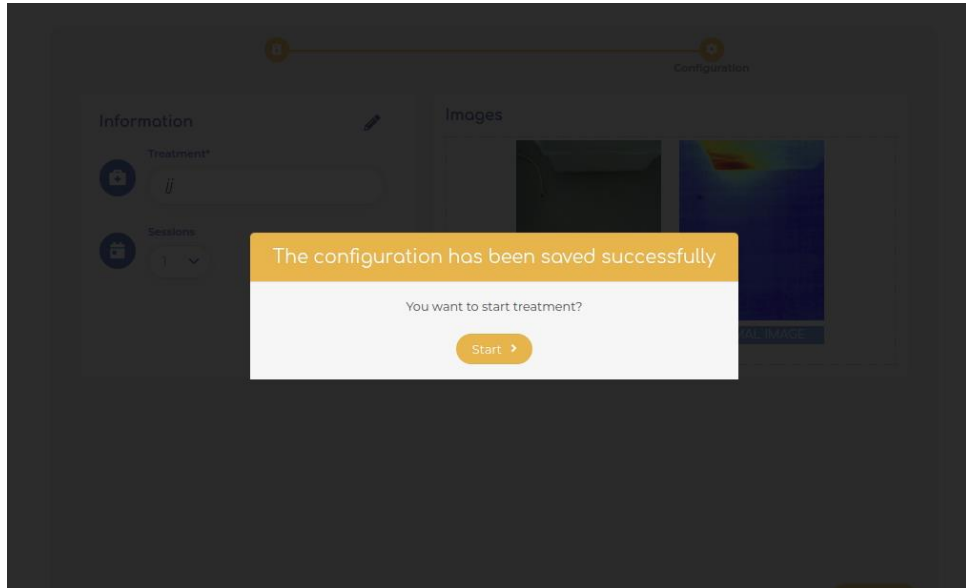*Illustration 29. ADAMO robot: user interface (XXIII)*

The "Image Capturing" window is displayed during the process. Once the process is completed, the image is shown on the "Image Capture Finished" screen with the options to **Repeat** or **Finish**.

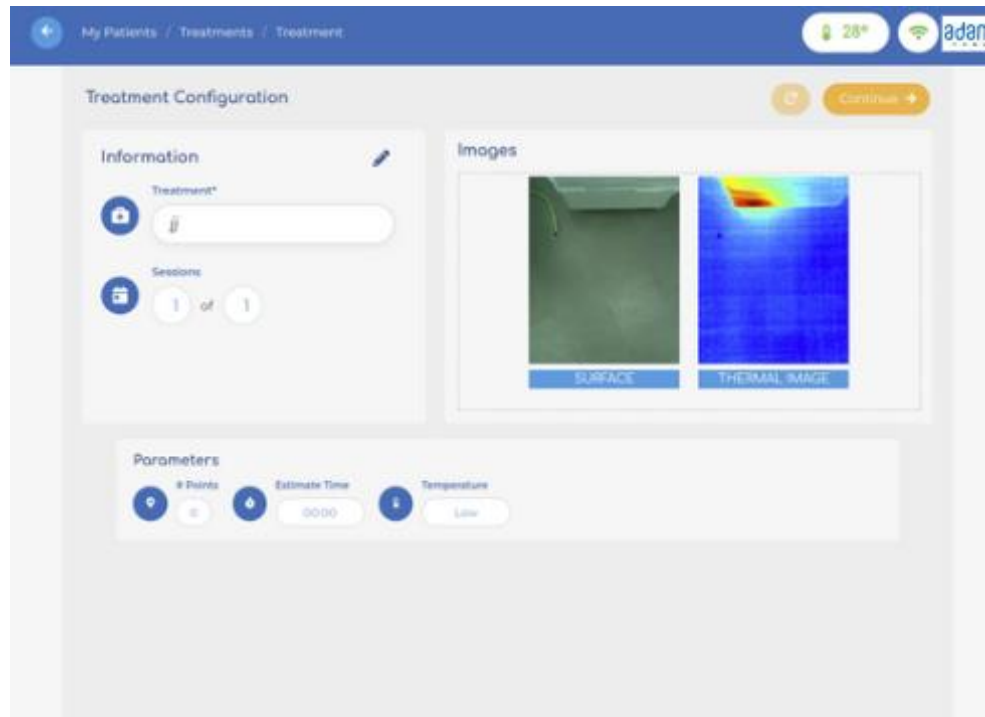*Illustration 30. ADAMO robot: user interface (XXIV)*

2.1.4. Click the "**Save**" button to save both images and return to the previous window.

2.1.5. Once on this screen, after taking the photos, click the "**Save**" button.

Illustration 31. ADAMO robot: user interface (XXV)

2.1.6. The user is redirected to another screen where you can see the information about the treatment to be applied, the temperature at which the treatment will be applied. Click the **Continue** button.

Illustration 32. ADAMO robot: user interface (XXVI)

2.1.7. The user is redirected to another tab where the **Start Treatment** button appears to begin air expulsion and a timer to control the application time.

Before pressing the **Start Treatment** button, it's important for the user to move the robot to the desired position for air application. To unlock the robotic arm, the user must press and hold the handle button for a few seconds, then, without releasing it, move it to the desired point, and finally release it.
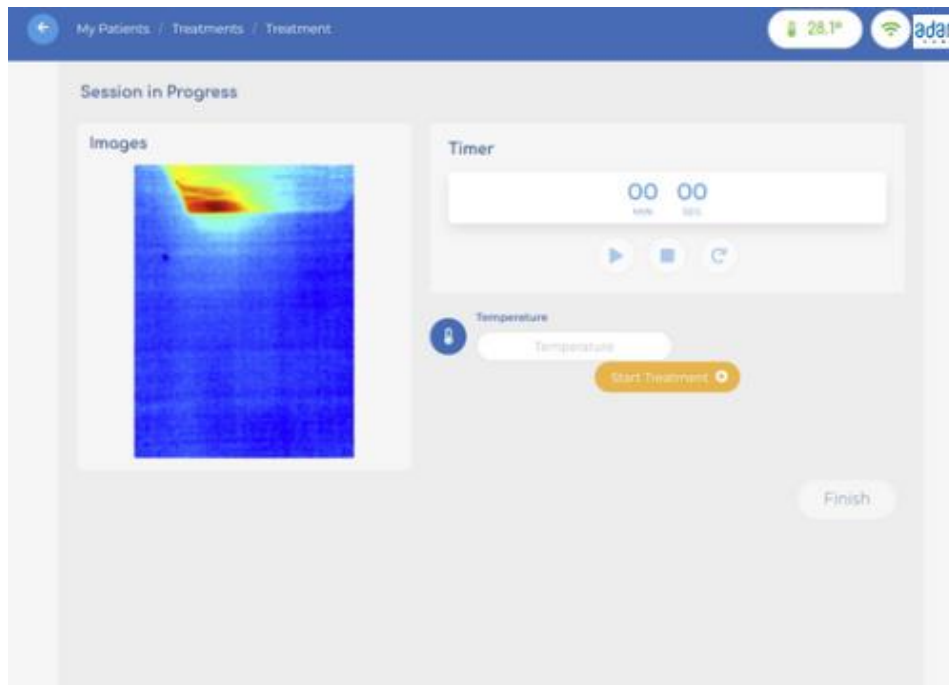

Illustration 33. ADAMO robot: user interface (XXVII)

2.1.8. Once the robotic arm is in the desired position, press the **Start Treatment** button. When the treatment begins, the timer on the screen will start counting so that the user has information about the duration of the air application.

2.2. Programmable:

2.2.1. A screen will appear to configure information regarding the patient and the treatment to be applied. This includes whether the patient has had a history of similar injuries (selectable through the Yes/No button), indicating if they have had an injury and its cause, as well as possible observations.
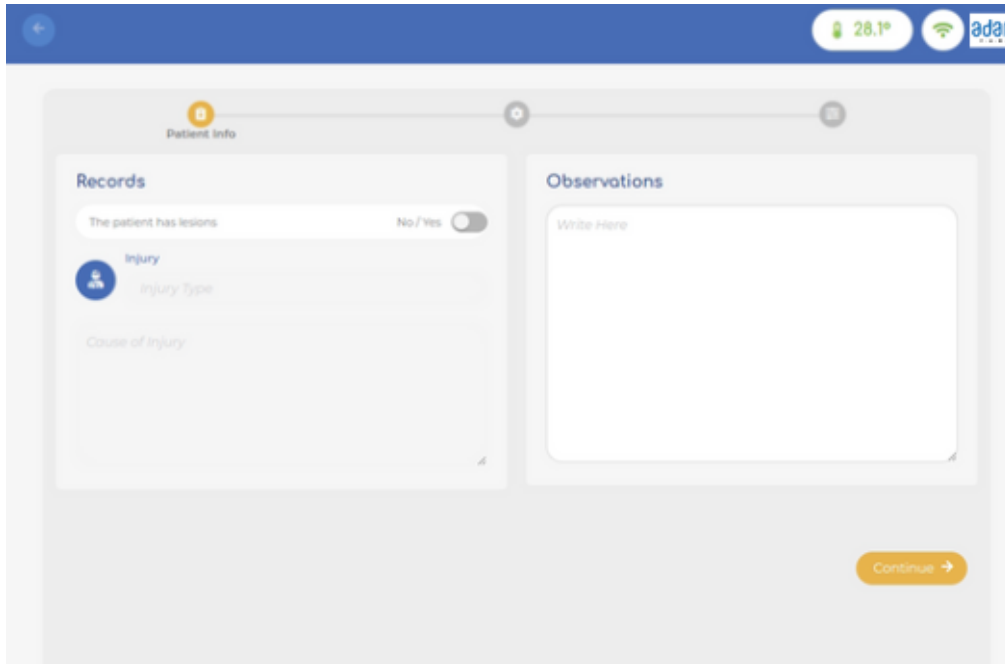
Illustration 34. ADAMO robot: user interface (XXVIII)

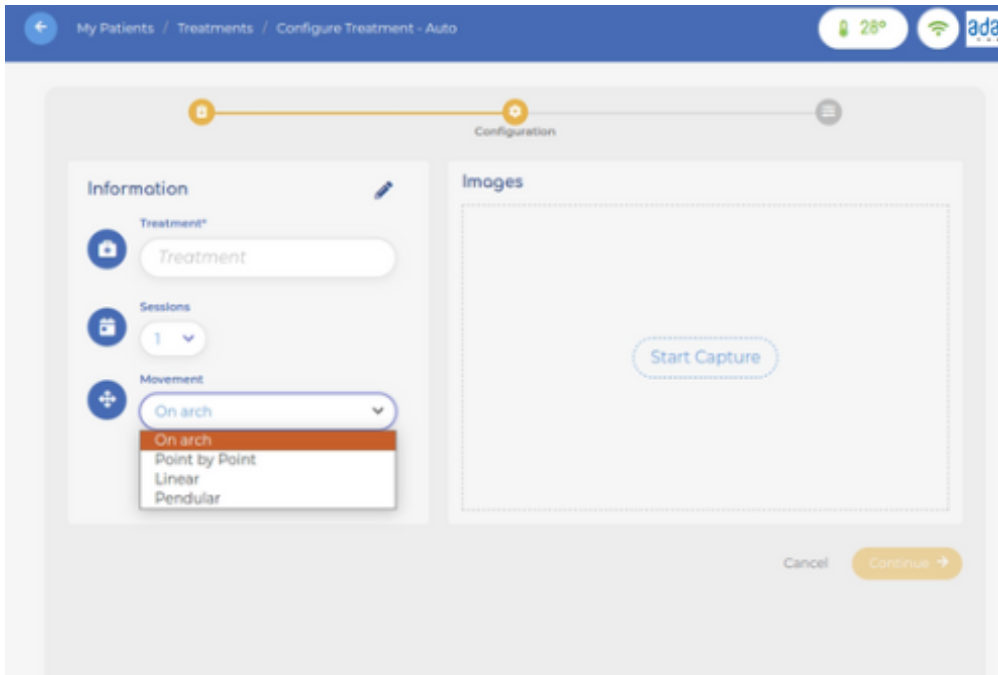2.2.2. After clicking **Continue**, the next screen Will appear:

Illustration 35. ADAMO robot: user interface (XXIX)

In this screen, the user needs to enter the Treatment, which refers to the area to be treated (since Treatment* has an asterisk, it indicates that it is mandatory information to save the treatment). You also need to indicate the number of sessions for this treatment and the type of movement to be applied. After making these configurations, click the Start Capture button for the robot to take temperature and 3D images.

2.2.3. When clicking the **Start Capture** button, the robot arm automatically moves to the appropriate position to take the image.
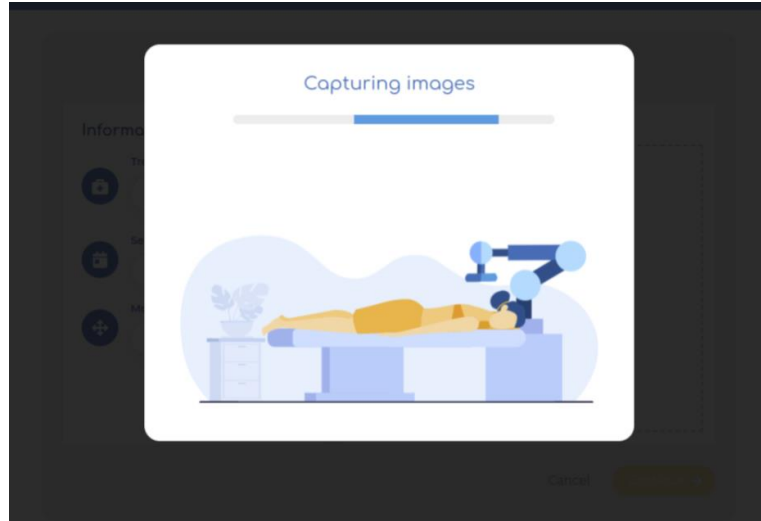

Illustration 36. ADAMO robot: user interface (XXX)

The screen displays the **Capturing images** window while the process is ongoing. Once the process is complete, the image appears on the "Image capture finished" screen with the options to **Repeat** or **Finish**.
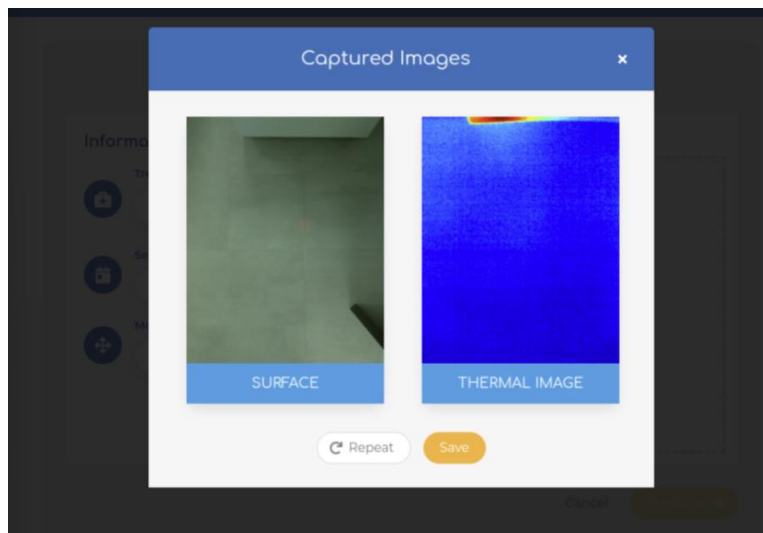.

Illustration 37. ADAMO robot: user interface (XXXI)

If you press the **Finish** button, you will see the thermal and color images in the Images area.

2.2.4. Click on the **Save** button to save both images and return to the previous window.

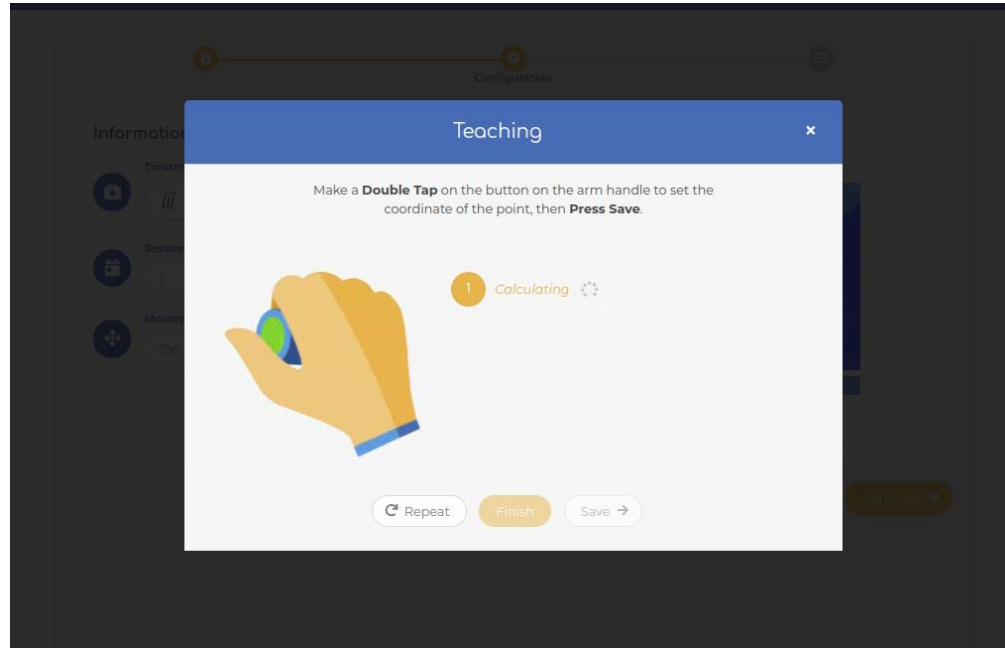2.2.5. Once on this screen, after taking the photos, click on the **Save** button.

Illustration 38. ADAMO robot: user interface (XXXII)

An instructional window opens for the **Teaching** part, to establish the number of points to define for the treatment. In this process, the robotic arm will be unlocked by pressing the handle button for a few seconds, and without releasing it, move it to the desired point. Press the robot's handle button twice to fix the point. For each point taken, you can choose to repeat or save it. Click on the **Save** button on the screen to add the point to the treatment. The point indicator turns green, and the next one (in red colour) is activated.

Illustration 39. The change in colour of the handle button of the robot in order to fix the necessary points.
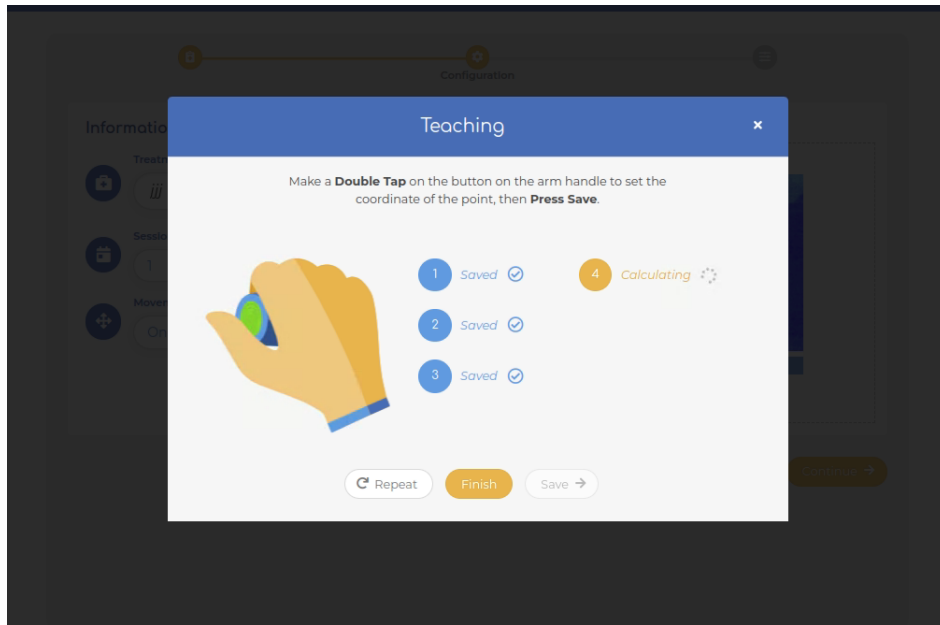
Illustration 40. ADAMO robot: user interface (XXXIII)

2.2.6. Once all the required points have been saved, click the **Finish** button.

In accordance with the type of movement established, different variables will appear in the treatment configuration window for modification. The options include temperature, time, and speed for each point individually or for all points simultaneously.

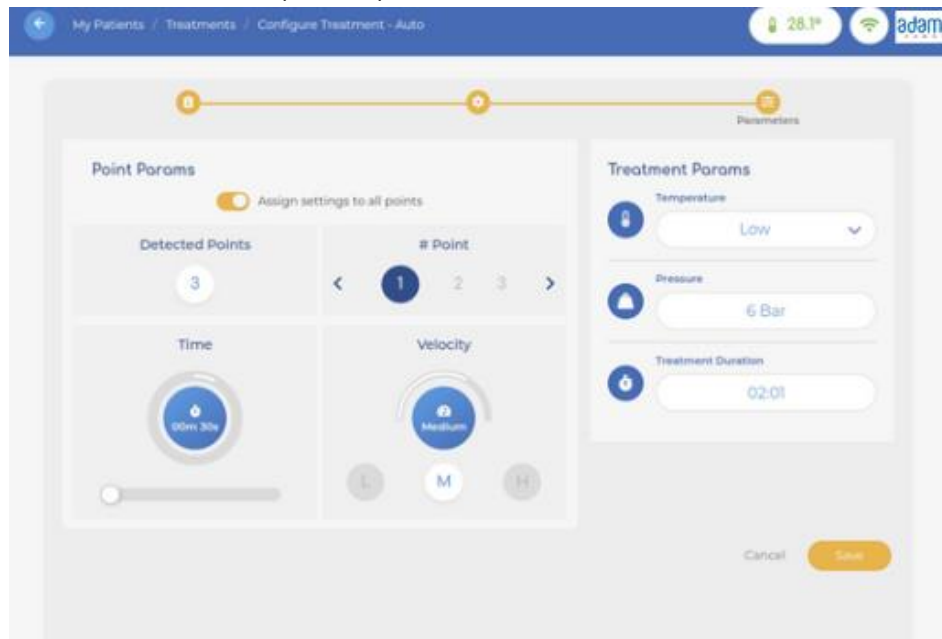2.2.6.1. For the case of continuous point-to-point movement:

Illustration 41. ADAMO robot: user interface (XXXIV)

In this mode, we can change the air application time at each point, the speed at which the robot moves to reach the point, and the temperature at which the air is applied at that point. Depending on whether the **Apply settings to all points** button is active or not, the configuration will be applied to each point separately or to all points simultaneously. The treatment time that the movement will take based on the points and the movement mode also appears.

2.2.6.2. For the case of discontinuous point-to-point movement:
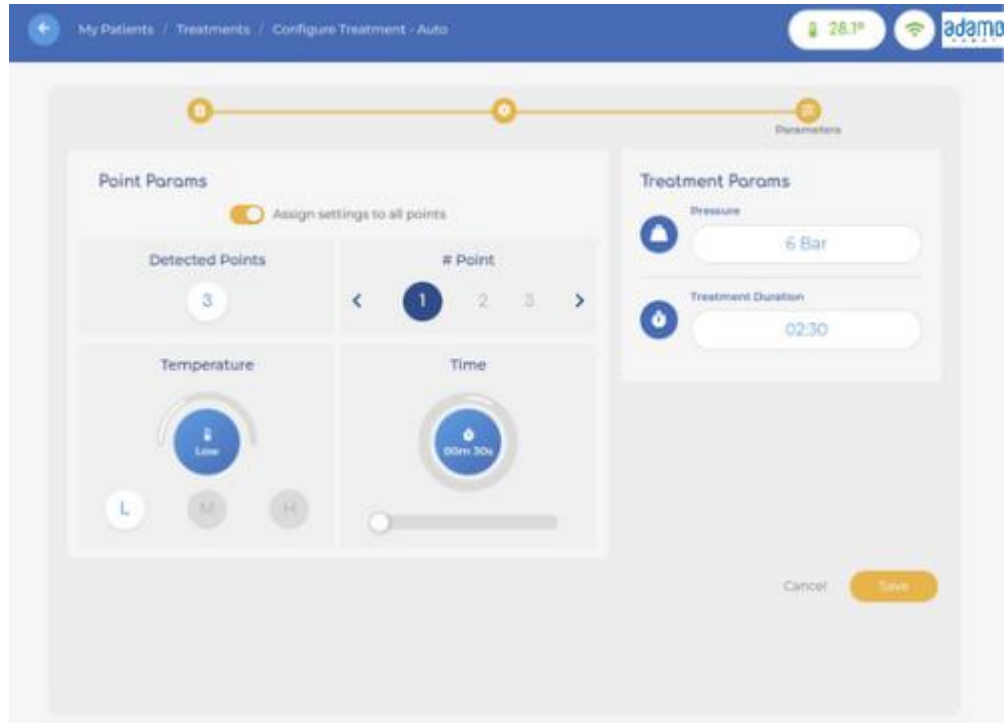
Illustration 42. ADAMO robot: user interface (XXXV)

In this case, since the movement is discontinuous, the duration for which the robot expels air at each point cannot be defined. It is a fixed parameter.
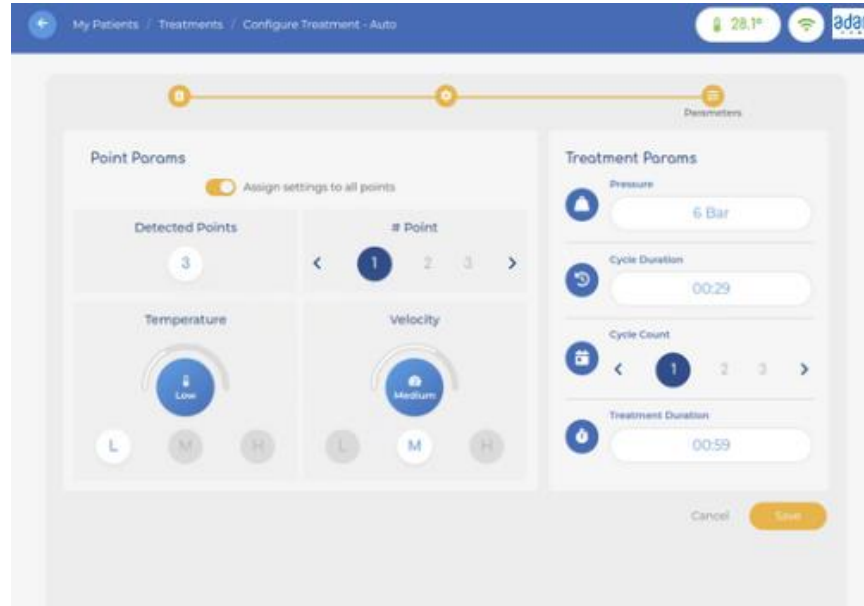
2.2.6.3. For the case of on arch:

Illustration 43. ADAMO robot: user interface (XXXVI)

In this case, besides modifying the temperature and the speed at which the robot moves, we also define the number of loops we want the movement to repeat.

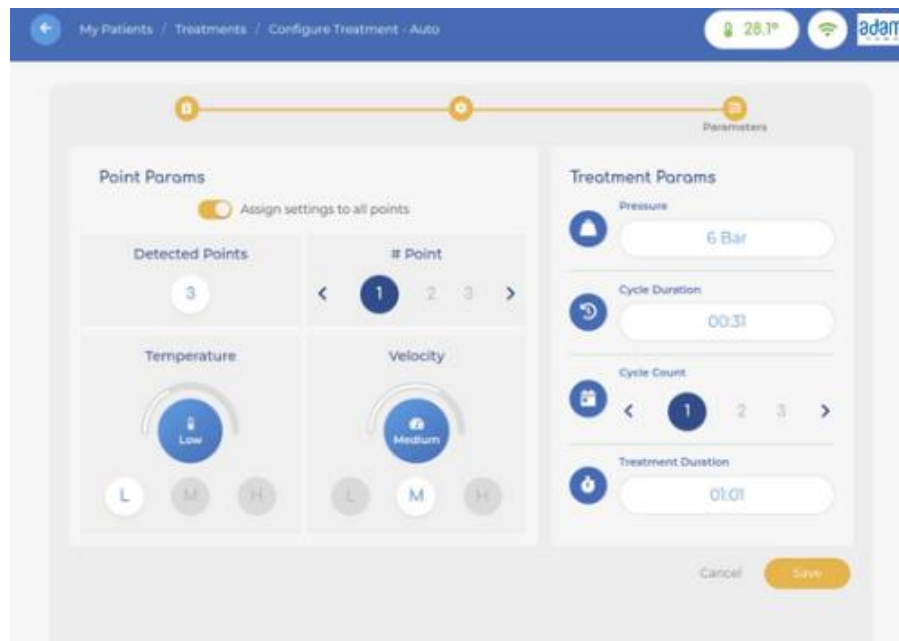2.2.6.4. Fort he case of point by point:

Illustration 44. ADAMO robot: user interface (XXXVII)

In the same way as the previous movement type, we define the temperature, speed, and the number of cycles that the movement through the points will repeat.

2.2.7. Once these parameters of the Treatment Configuration are defined, a window opens to start the treatment:
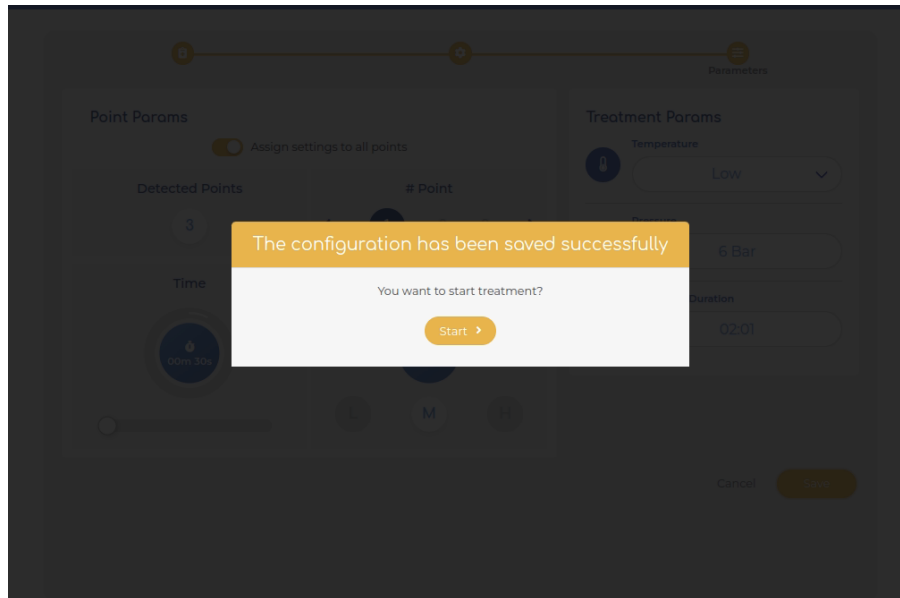
Illustration 45. ADAMO robot: user interface (XXXVIII)

2.2.8. The user will be redirected to another screen where you can view the information about the treatment that will be applied, including the treatment temperature, type, the images that have been captured, and the current session. Click the **Continue** button.

Illustration 46. ADAMO robot: user interface (XXXIX)

2.2.9. The user will be redirected to another tab where you will see the **Start Treatment** button to begin air expulsion, a timer to control the application time, a temperature indicator for the air application, and a progress section to track how the robot is moving through the points during the treatment.
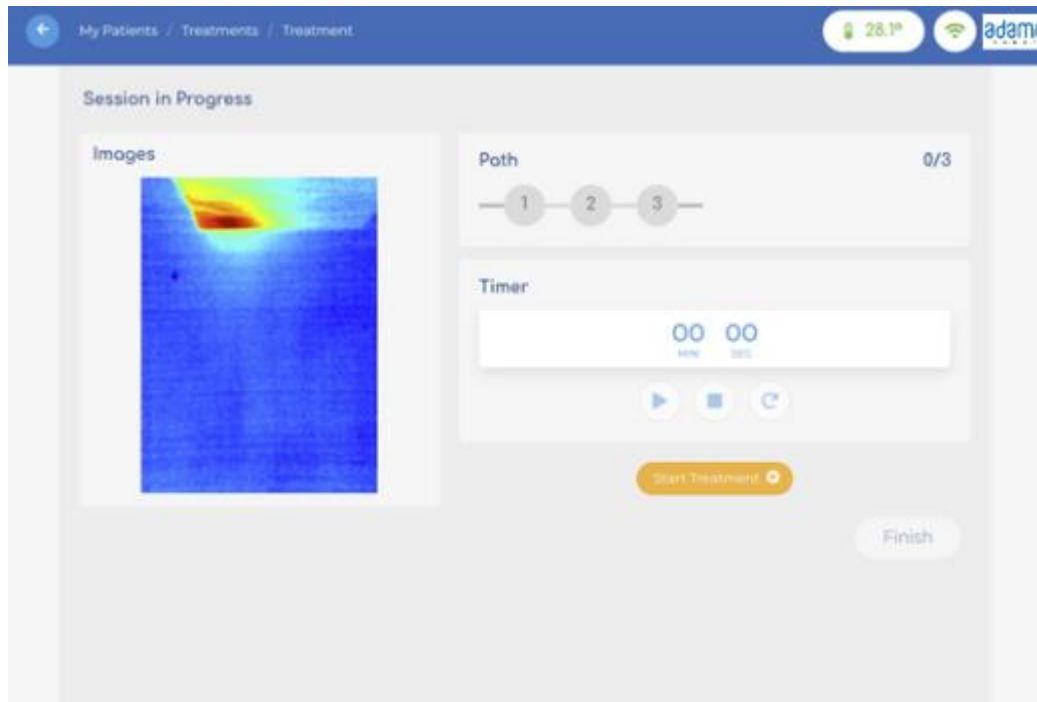
Illustration 47. ADAMO robot: user interface (XXXX)

2.2.10. Once the session is finished, the panel redirects to the Treatments Screen, updating the information up to that moment.
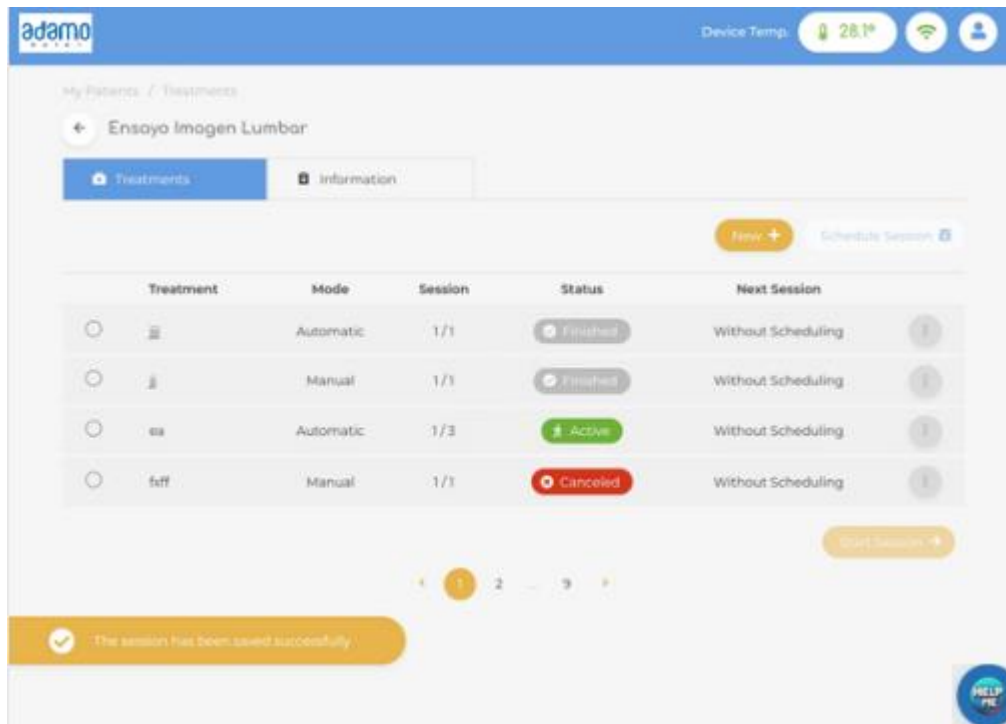
View history

When clicking on **View History**, it redirects us to a tab, the **History Tab**, where all the information related to that specific treatment can be seen. In case there are more than one session for the same treatment, the photos taken and the information regarding the duration, temperature, and specific pressure for each of the sessions conducted can be seen.
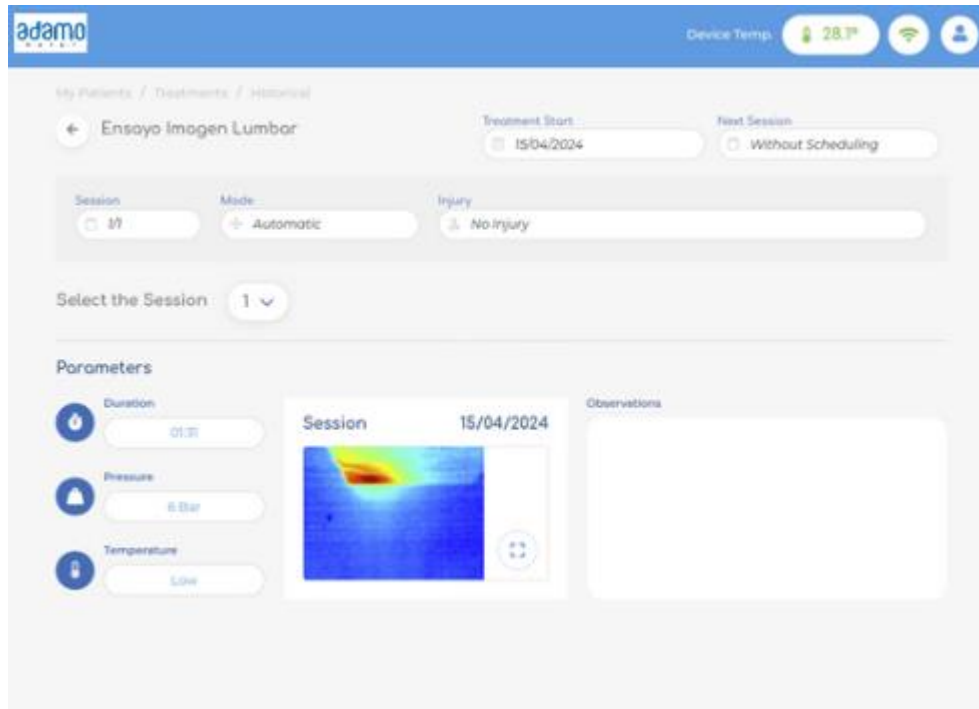
Illustration 48. ADAMO robot: user interface (XXXXI)

Edit

If the user clicks on the **Edit** button, it will redirect you to the Patient Information window, where you can modify any data on that screen. When you click **Continue**, it moves to the Treatment Configuration screen, where only the name of the treatment can be modified.
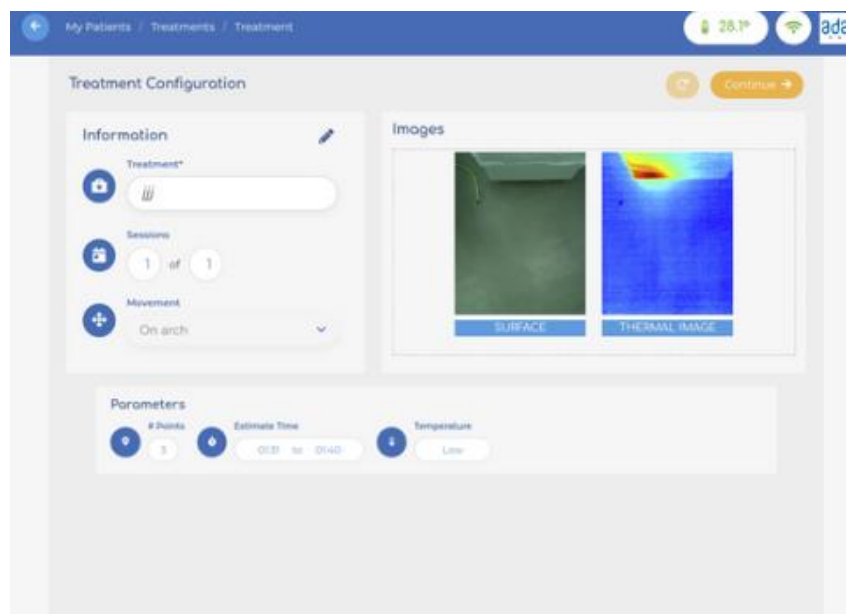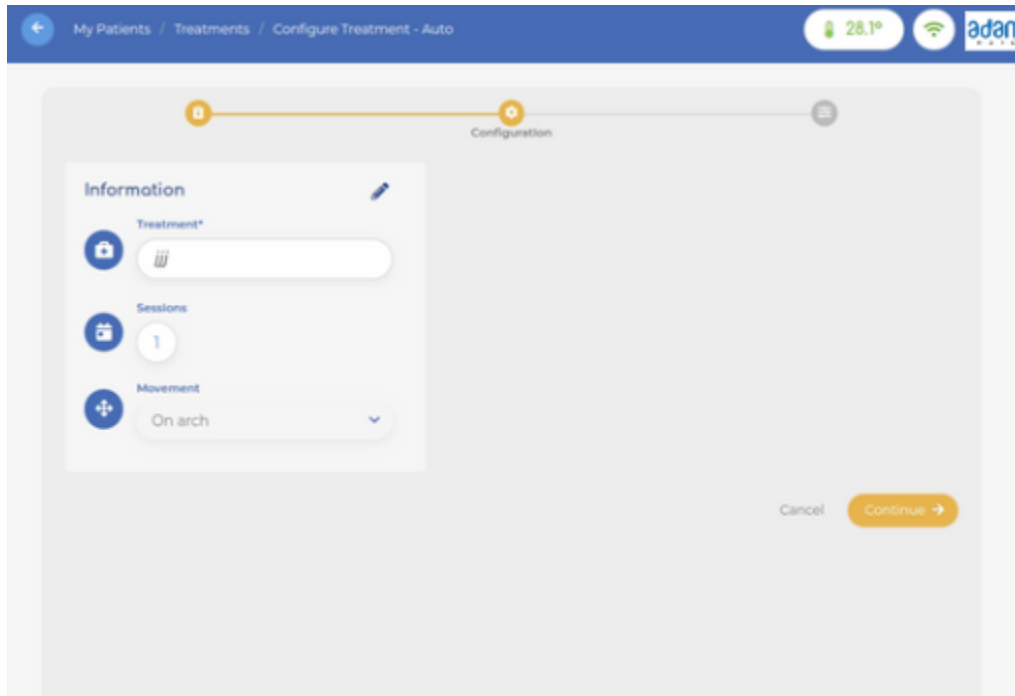
Illustration 49. ADAMO robot: user interface (XXXXII)

In the following treatment configuration screen, you can modify the temperature, time, and speed. We can see that we have gone directly from configuring the name to configuring the characteristics of the points. The coordinates of the points cannot be modified.
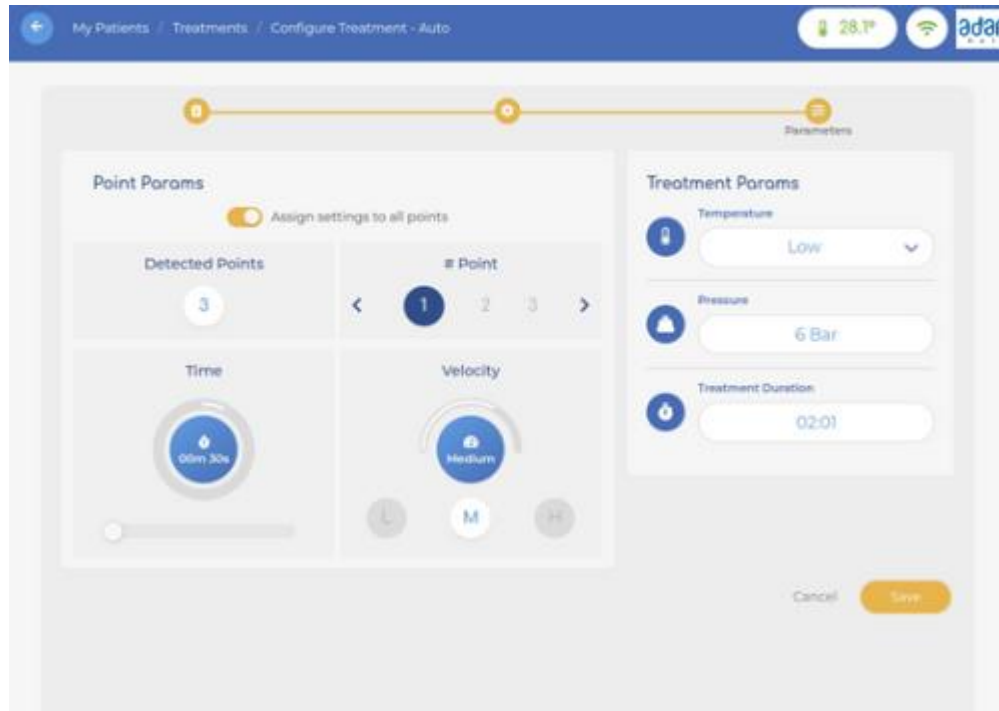
Illustration 50. ADAMO robot: user interface (XXXXIII)

Once this process is completed, click on **Save**, and the panel will redirect back to the Treatment Screen

Delete

When clicking on the **Delete** button, the following window opens to confirm or cancel the action of deleting a treatment.

Illustration 51. ADAMO robot: user interface (XXXXIV)

Start Session

If a treatment has been created with the option to perform multiple sessions, there is the option to start a predefined session. In this case, you need to click on the treatment you want to repeat, and the **Start Session** button will become active to be clicked.

When you click the **Start Session** button, the Treatment Configuration screen appears, where you can take photos of the patient again.

Illustration 52. ADAMO robot: user interface (XXXXV)

Then, click on **Continue** to be redirected to the treatment start screen.

Illustration 53. ADAMO robot: user interface (XXXXVI)

SAFETY FEATURES

Types of security

ADAMO robot is designed with multiple safety measures to ensure the protection of both patients and medical staff during treatments. These measures are divided into two main categories: passive safety and active safety

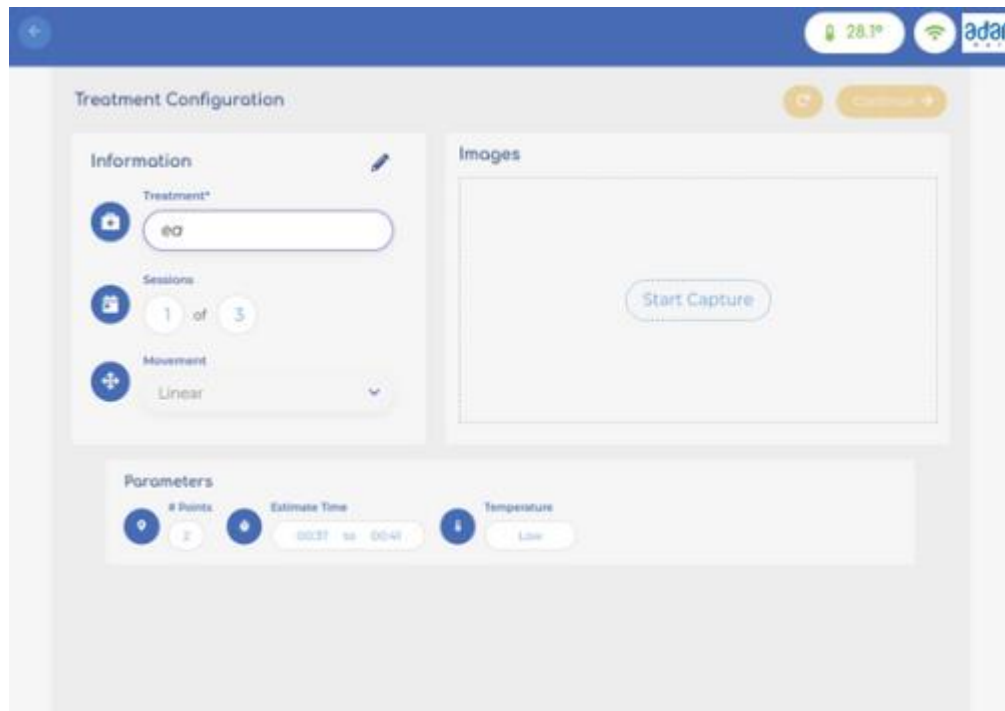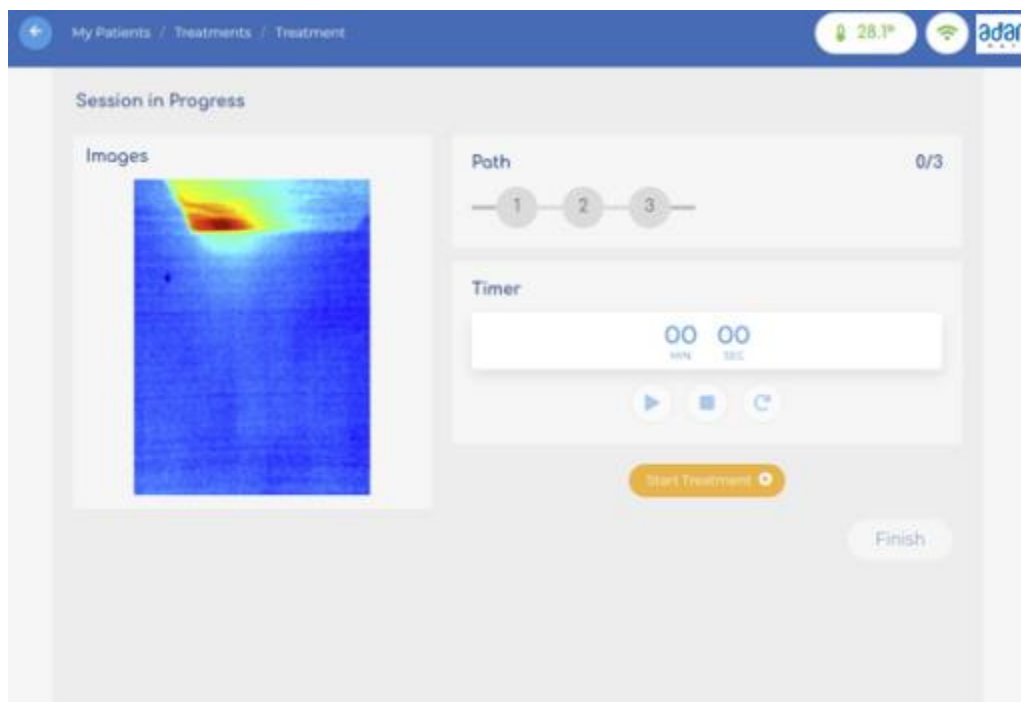### *Passive Safety*

The passive safety features of the ADAMO robot focus on systems and characteristics designed to prevent accidents without requiring active intervention. These include:

- **Sensors**: The robot is equipped with a variety of sensors that monitor the environment and detect any obstacles or unexpected movements.
- **Automatic Withdrawal**: If the system detects the presence of an object or if the patient moves during the treatment, the robot will automatically stop or withdraw to avoid any potential collision or injury.
- **Automatic Locking**: In case of detecting sudden movement by the patient or therapist, the robot can automatically lock to prevent dangerous movements.
- **Inverse Kinematics**: To ensure safety and efficiency in the robot's operation, an inverse kinematics calculation function has been implemented. When the user attempts to record any point in automatic mode, the robot automatically performs the necessary calculations to ensure the feasibility and safety of that position.
  If the treatment application point is not valid, the system does not allow the recording of that position, ensuring future operation and preventing blockages during operation. Subsequently, the user must modify the application point to a closer and reachable range for the robotic arm, configuring another point that fits within the system's capabilities and the treatment needs.

Active security

Active safety involves measures that are activated in response to a risk situation to prevent harm. In the case of the ADAMO robot, this includes:

- **Path of the robot during image capture**: Once the patient lies down, ensure that neither the patient nor the therapist is in the path of the arm movement.
- **Path of the robot during treatment**: Think of its programming like a human arm. It won't work well if it's too extended or too close to the body.
- **Path of the robot point-to-point**: It is advisable to save points without too much distance between them. Consider areas of greater height to avoid possible collisions with the patient.
- **Retraction**: Consider the path that the robot traces to retract, to avoid collisions with itself.
- **Treatment detention button**: This button allows the user to stop the robot without needing to access the monitor, providing easy access from any position around the patient. It enables the quick and efficient interruption of any movement or action being performed by both the robot and the air system at any moment.

Illustration 54. Treatment detention button of ADAMO ROBOT

On screen messages

Here are the different scenarios in which the Adamo Robot screen displays warnings:

- Collision
- Activating motors
- Robot in Fail (rearm needed)
- Internal Temperature Level
- Repeat the point
- Communication error
- Violation error
- Security error

Collision

When the robot detects that the end-effector (2) of the robot is closer to patient that the appropriate treatment distance the robot will stop and show the following message in the screen.
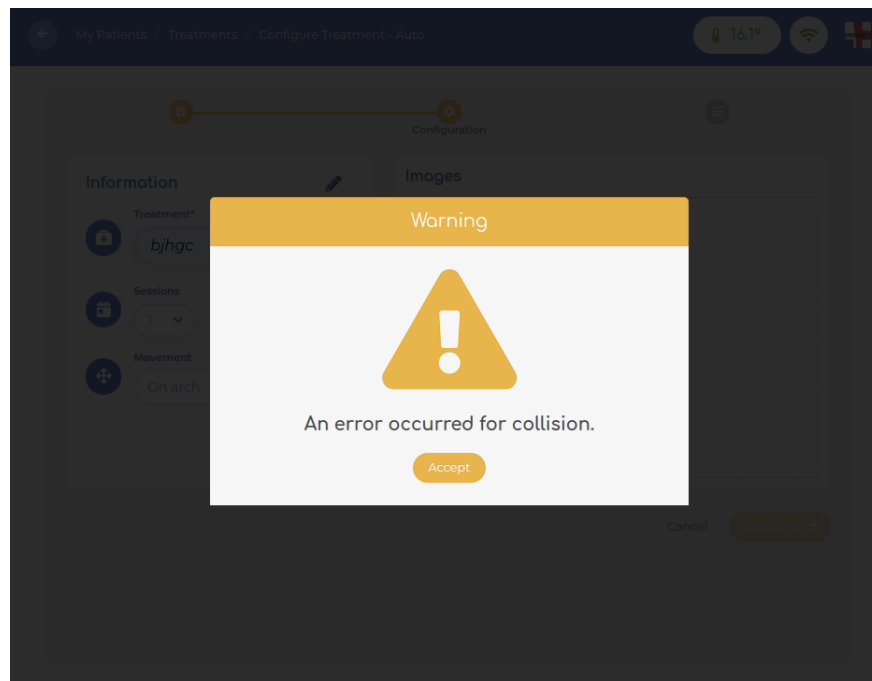
Ilustración 55. Screen messages (I)

Click accept to continue.

Activating motors

The robot's motors are currently being activated. It is essential to wait until the activation process is complete before proceeding with any tasks or operations involving the robot.
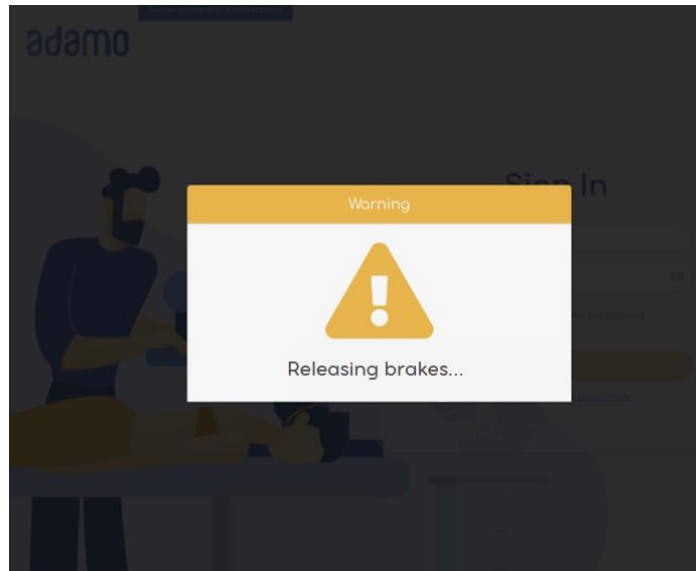
Ilustración 56. Screen message (II)

Robot in fail (rearm needed)
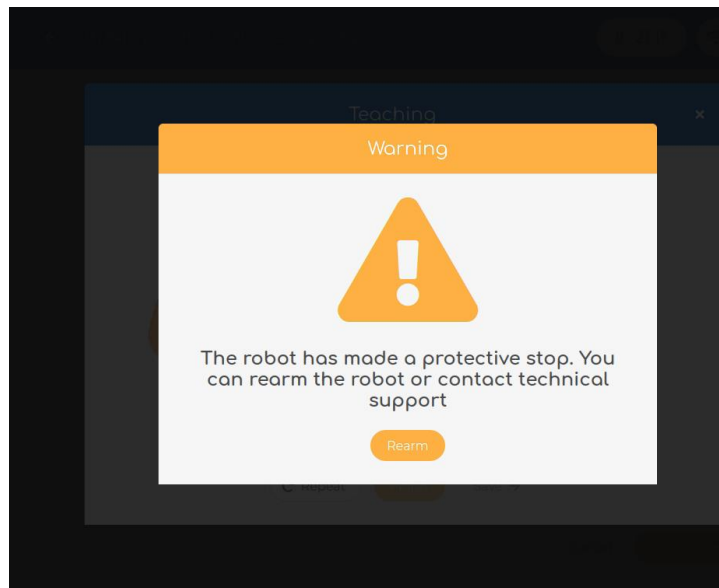
Ilustración 57. Screen message (III)

The different assumptions in which the robot will adopt the security position (home position) are explained below:

- If during a treatment session the patient or the staff touch the robot
- If during the "Teaching" stage (definition of the myofascial points when creating a new treatment) the robot detects a sudden and abrupt movement
- If the robot tries to reach a position out of its rage

In these cases, the following steps are followed:

1. The robot stops in its current position.

2. A warning message appears on the screen.

3. Press the **Rearm** button in the screen.

4. The robot returns to the home position.

Internal Temperature Level

If the internal temperature of the machine reaches up to 50ºC, the machine will stop, and the following warning message will show on screen. When the temperature lowers down to 40ºC the treatment machine will go back to operation.
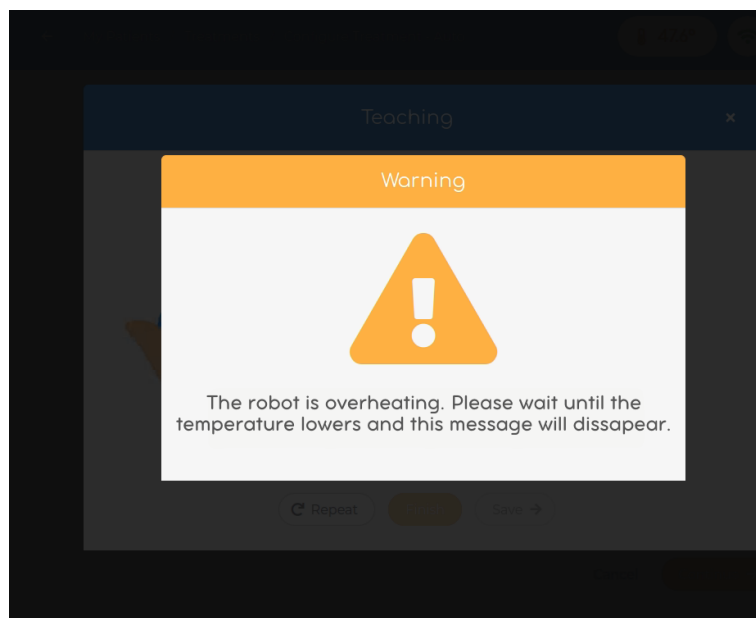
Ilustración 58. Screen message (IV)

If the error temperature doesn't decrease the following conditions should be checked:

- The ambient temperature of the room should comply with technical specifications.
- The cooling fans protection grids are not covered.

If these conditions are met and the machine continues to overheat contact technical support.

Repeat the point

It has been implemented a screen that triggers an error message in the event of attempting to save the same points as the previous ones during the Teaching step. This error prompts an automatic restart to prevent any potential issues.
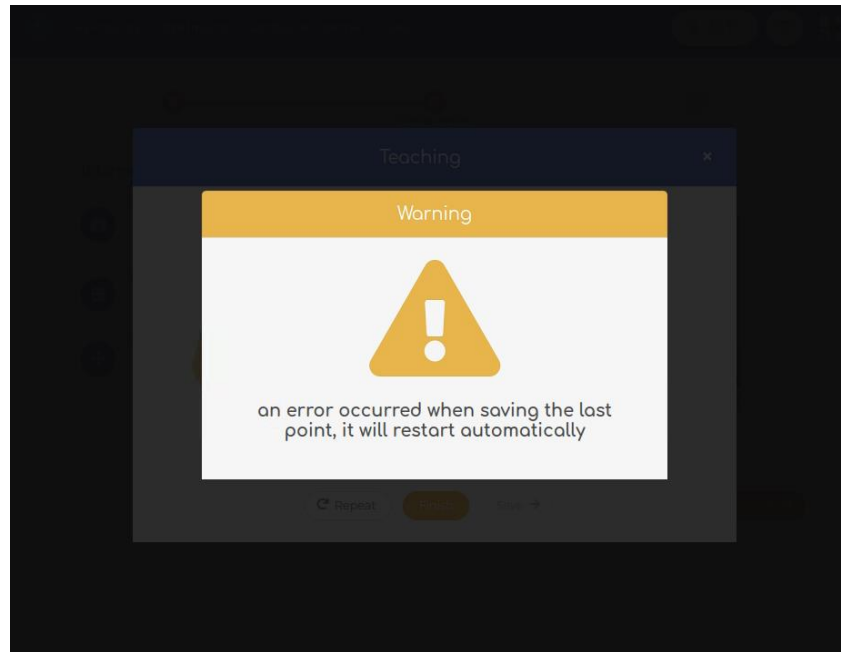
Ilustración 59. Screen message (V)

Communication error

There is an error message indicating a communication failure between the PC panel and the PLC. This issue may arise due to a malfunction or disruption in the communication link between the control panel and the programmable logic controller (PLC) responsible for coordinating the robot's operations.
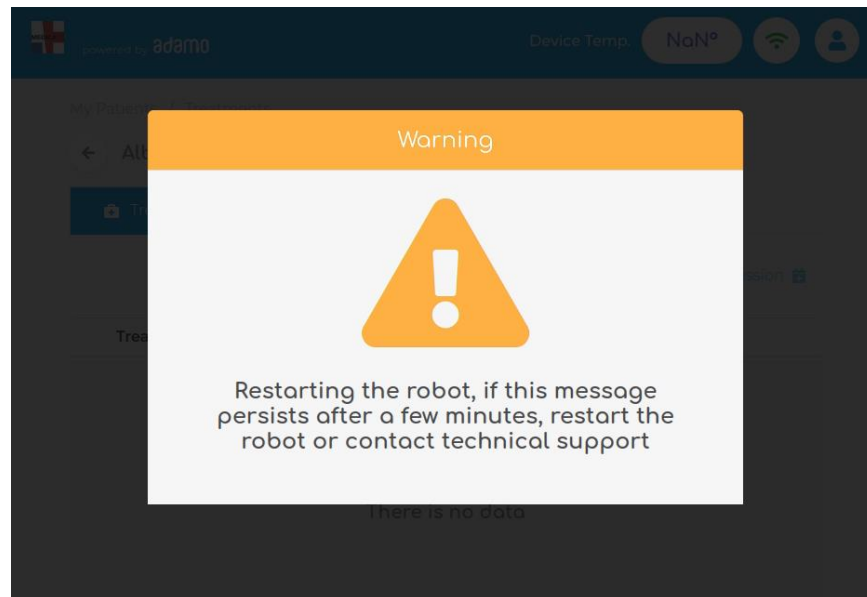
Ilustración 60. Screen message (VI)

Violation error

There is also a critical error message indicating a violation in the robot's controller due to a misalignment or improper positioning of the robot. This error arises when the robot's movements deviate from the designated path or when it encounters an obstacle, causing a breach in its operational parameters. Such violations pose a significant risk to the safety and integrity of the robot system, potentially leading to equipment damage or hazardous situations in the treatment environment.
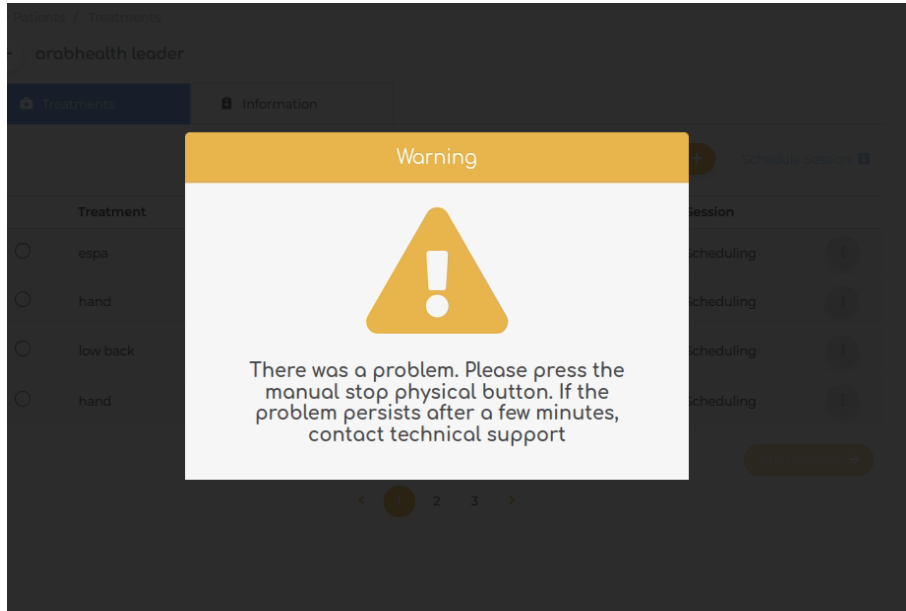
Ilustración 61. Screen message (VII)

Security error

A security error has been detected within the robot controller system. To ensure the safety and integrity of the system, it is recommended to restart the robot controller after a minute of waiting.
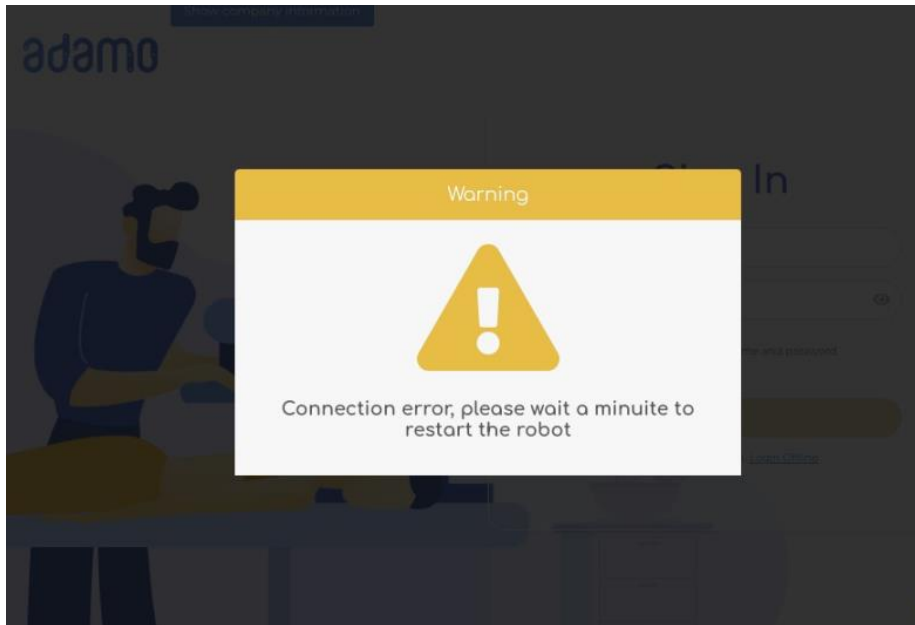
Ilustración 62. Screen message (VIII)

List of known errors

Now, it will be detailed a list of the most common errors and how to solve them:

Powering On and system startup

- Issue: When starting the operating system, a black screen with the Ubuntu logo appears at the bottom
  Solution: Wait a couple of minutes until the main ADAMO startup screen appears.
- Issue: When booting the device, a purple screen appears prompting for a startup password
  Solution: Enter the password "adamo" to initiate the user in the operating system.
- Issue Tab indicating authentication is required ("Authentication required" message).
  Solution: Enter the password "adamo" to authenticate device usage.
- Issue: Keyboard input error. When typing information or access passwords, characters are not displayed in the enabled space.
  Solution: Before typing any characters, press the delete key represented by a rounded cross. Then, type as usual.

Treatment recording

- Issue: The previously saved patient does not appear in the patient list.
  The patient list does not appear in an ordered manner, or the patient was not saved correctly.
  Solution: Search for the patient in the various tabs or use the search function provided in the top right corner.
- Issue: robotic arm lock during end-effector movement.

Illustration 63. Screen message (IX)

When the physiotherapist makes a sudden or rapid movement with the manipulator during the point recording phase, the robotic arm will be locked for safety, and a message to rearm the robot will appear.

Solution: Rearm the robotic arm from the PC screen. After the tab disappears, a second window will appear with a security message informing us of a problem. After waiting a few seconds, the second tab will disappear, and you can continue with the process of recording the points, making smoother and more controlled movements.
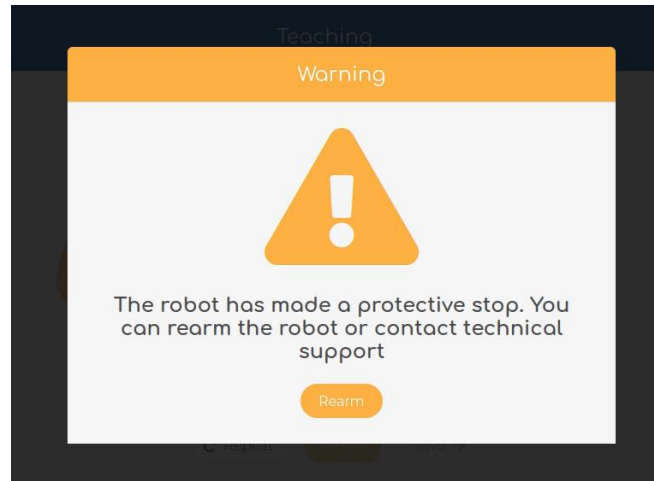
- Issue: when positioning the head at the desired treatment point, the option to "continue" does not appear on the screen, so the point cannot be saved.

  Solution: Position the robotic arm's head in another position that is more accessible for the robotic arm.

During the treatment

- Problem: the treatment stops immediately when the patient approaches or passes their hand under the head. Inverse kinematics error. During the treatment, the robotic arm will be unable to reach the indicated position, so the system does not allow saving the current point.

  Solution: Program the treatment points with a greater separation between the head and the patient's surface (4 cm of separation is recommended) and maintaining a parallel position between the patient's surface and the underside of the head.

- Problem: the motor stops, and the air output pressure begins to decrease.

  Solution: If the device's temperature is high, allow it to cool down, and rearm the internal protection described in Annex 1.

Ending of the treatment

- Problem: At the end of the treatment, after treating all the programmed points, the robotic arm remains fixed expelling air in the last position.

  Solution: Finish the treatment by pressing the blue stop button, the robot will end the complete treatment and return to its initial position.

WARNINGS

Risks related to the installation of the equipment

- Only authorized and qualified personnel should handle the installation, maintenance, or modifications of the ADAMO ROBOT®. Installation must be performed by an authorized technician, with verification of each installation in the presence of the Safety Manager and operator. Initial training on the correct and safe use of the equipment includes both the operator and Safety Manager.
- Do not use the device if defective; contact the manufacturer as soon as possible. The user is solely responsible for any malfunction due to maintenance by unauthorized individuals not trained by ADAMO ROBOT S.L.
- Ensure that the rear wheel brakes are locked before turning on the robot. This is a required safety check.
- Protective gloves are mandatory to guard against burn risks.
- Do not handle the equipment for maintenance or repair until at least two hours after its last use.
- The ADAMO ROBOT® must be placed on a flat, stable surface, according to the guidelines in "Positioning the Machine" of the Instructions For Use, considering the dimensions and weight for optimal stability.

Risks related to use and information provided by the manufacturer

- Take necessary precautions when operating the compressor. Initial training is required for equipment operators on its correct and safe use. The IFU must be delivered to authorized operators.
- Take precautions to avoid possible contact with the heater. Initial training is required for equipment operators on its correct and safe use. The IFU must be delivered to authorized operators.
- Operate the device only within the specified temperature, humidity, and atmospheric pressure ranges indicated in the instructions for use. Keep the device away from water and humidity to avoid electrical hazards.
- Ensure proper connection of the device with an electrical cut-off device of adequate sensitivity. Initial training is required for equipment operators on its correct and safe use.

PREVENTIVE MAINTENANCE

This is the set of activities designed to maintain the conditions of use and operation of the machine, through various types of intervention (adjustments, visual inspection, recovery levels, etc.) performed by the maintenance technician or by the manufacturer's technician at the frequency forecast.

⊘ THE AUTHORIZED OPERATORS SHOULD PERFORM ONLY THE MAINTENANCE WORKS REQUIRED IN ACCORDANCE WITH THEIR SPECIFIC PROFESSIONAL COMPETENCE AND UPON CONSENT OF THE SUPERVISOR IN CHARGE.

⊖ IT IS FORBIDDEN TO AUTHORIZED OPERATORS TO LEAVE THE MACHINE WITHOUT SUPERVISION DURING THE MAINTENANCE WORKS. THEY SHOULD ALSO PROTECT THE PLACE OF WORK WITH ADEQUATE NOTICE OF DANGER AND PROHIBITION FOR WORKS IN PROGRESS.

All maintenance operations must be performed when the machine is turned off according to the steps described in "Turning off the Machine"

Cleaning

All the surfaces of the machine can be cleaned with water, isopropyl alcohol or alcohol with 10% of ethanol.

To clean any trace of dirt of the surface of all components of the machine use a soft cloth avoiding getting moisture through the openings.

⊘ **Do not use harsh chemicals, strong detergents nor bleach.**

⊘ **Do not rub or hit the surface with anything hard or sharp as this may permanently damage the surface of its components.**

Every week

At the end of the workday, dispose the condensation liquid from the collection container (10).

1) Turn off the machine following the steps described in "Turning off the machine".
2) Remove the water collection container (10) pulling it from the back side of the machine.
3) Dispose the liquid.
4) From the back side of the machine, push the container again to its position ensuring that the draining hose stays inside the container.

⊘ **You must dispose of the condensation liquid in compliance with the regulations of the country of use.**

Every year

Only made by the Manufacturer's Technician the machine must be subjected to annual maintenance process keep the optimum working conditions.

To maintain the compressor in optimum conditions it must have the following maintenance using only manufacture's spare parts:

- Replacement of air sterilization filter
- Replacement of humidity filter

Extraordinary maintenance

This is the set of activities designed to maintain the conditions of use and operation of the machine, through various types of intervention (adjustments, changes, etc.) performed by qualified technicians in the event of failure or wear.

FOR ANY INTERVENTION OF EXTRAORDINARY MAINTENANCE IT IS COMPULSORY TO REQUIRE THE TECHNICAL ASSISTANCE TO THE MANUFACTURER OR AUTHORIZED DEALER.

HISTORY OF MODIFICATIONS

MODIFICATION HISTORY		
Edition No.	**Date**	**Change made**
1	March 2024	Initial edition
2	19/09/2024	Header, sign and sterilization aclaration
3	03/10/2024	Name of the document Importance of this manual – IFU reference Indications, contraindications and warnings Safety features – Passive Safety – Inverse Kinematics Warnings